

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

Final Report

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

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## ABSTRACT

1

2 The U.S. Nuclear Regulatory Commission (NRC) staff has defined subsequent license renewal to  
3 be the period of extended operation from 60 years to 80 years following initial licensing. The  
4 Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear  
5 Power Plants (SRP-SLR) provides guidance to NRC staff reviewers in the Office of Nuclear  
6 Reactor Regulation. These reviewers perform safety reviews of applications to renew nuclear  
7 power plant licenses in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR)  
8 Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." The NRC  
9 regulations in 10 CFR 54.29 establish the standards for issuance of a renewed license. For  
10 nuclear power plants that have received a renewed license, the regulations in 10 CFR 54.31(d)  
11 state that "a renewed license may be subsequently renewed in accordance with all applicable  
12 requirements." In the Statements of Consideration for the final rule, "Nuclear Power Plant License  
13 Renewal," 56 FR 64943, 64964-65 (December 13, 1991), the NRC stated that the requirements  
14 for subsequent renewal "include the provisions of [P]art 54 (unless the Commission subsequently  
15 adopts special provisions applicable only to subsequent renewals)." To date, the NRC has not  
16 adopted special provisions that apply only to subsequent renewal, so that the requirements in  
17 10 CFR Part 54 continue to govern subsequent license renewal.

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

28 This document is a companion document to NUREG-2191, "Generic Aging Lessons Learned for  
29 Subsequent License Renewal (GALL-SLR) Report," that provides guidance for SLR applicants.  
30 The GALL-SLR Report contains the NRC staff's generic evaluation of plant aging management  
31 programs and establishes the technical basis for their adequacy.

32 Both the SRP-SLR and GALL-SLR were published for public comment in December 2015, with  
33 the comment period ending February 29, 2016. Numerous public comments were received by the  
34 staff. The public comments received were reviewed and dispositioned by the staff. The  
35 disposition of these comments and the technical bases for the staffs' agreement or disagreement  
36 with these comments will be published shortly in a NUREG. The staff will also publish a second  
37 NUREG that will document all the technical changes made to the license renewal guidance  
38 documents published for first license renewal (i.e., for operation from 40 years to 60 years), along  
39 with the technical bases for these changes.



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## ABBREVIATIONS

ACI	American Concrete Institute
ADAMS	Agencywide Documents Access and Management System
AFW	auxiliary feedwater
ALE	adverse localized environment
AMPs	aging management programs
AMR	aging management review
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASME Code	American Society of Mechanical Engineers Boiler and Pressure Vessel Code
ASTM	American Society for Testing and Materials
ATWS	anticipated transients without scram
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	<i>Code of Federal Regulations</i>
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
FR	<i>Federal Register</i>
FRN	<i>Federal Register Notice</i>
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
IP	inspection plan
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISG	interim staff guidance
ISI	inservice inspection
LBB	leak-before-break
LCOs	limiting conditions for operation
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	pipng 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 analyses
TR	topical report
TS	technical Specifications
UFSAR	updated final safety analysis report
USAR	updated safety analysis report
USE	upper-shelf energy
UV	ultraviolet



# INTRODUCTION

1

2 The Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear  
3 Power Plants (SRP-SLR) provides guidance to U.S. Nuclear Regulatory Commission (NRC) staff  
4 reviewers in the Office of Nuclear Reactor Regulation (NRR). These reviewers perform safety  
5 reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the  
6 *Code of Federal Regulations* (10 CFR) Part 54, “Requirements for Renewal of Operating Licenses  
7 for Nuclear Power Plant,” hereafter referred to as the Rule. The NRC regulations in 10 CFR 54.29  
8 establish the standards for issuance of a renewed license. For nuclear power plants that have  
9 received a renewed license, the regulations in 10 CFR 54.31(d) state that “a renewed license may  
10 be subsequently renewed in accordance with all applicable requirements.” The NRC has stated  
11 in the Statements of Consideration, “Nuclear Power Plant License Renewal,” 56 FR 64943,  
12 64964-65 (December 13, 1991), that the requirements for subsequent license renewal (SLR)  
13 “include the provisions of [P]art 54 (unless the Commission subsequently adopts special  
14 provisions applicable only to subsequent renewals).” To date, the NRC has not adopted special  
15 provisions that apply only to subsequent renewal, so that the requirements in 10 CFR Part 54  
16 continues to govern SLR.

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

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

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

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

44 The SRP-SLR references the Generic Aging Lessons Learned for Subsequent License Renewal  
45 (GALL-SLR) Report, which evaluates existing programs generically, to document (i) the conditions

1 under which existing programs are considered adequate to manage identified aging effects  
2 without change and (ii) the conditions under which existing programs should be augmented for  
3 this purpose. The SRP-SLR also includes the NRC staff's resolutions of License Renewal Interim  
4 Staff Guidance (LR-ISG) from 2011 through 2016 as listed below.

- 5 • LR-ISG-2011-01: Aging Management of Stainless Steel Structures and Components in  
6 Treated Borated Water, Revision 1. Agencywide Documents Access and Management  
7 System (ADAMS) Accession No. ML12286A275. December 18, 2012.
- 8 • LR-ISG-2011-02: Aging Management Program for Steam Generators. ADAMS  
9 Accession No. ML11297A085. December 1, 2011.
- 10 • LR-ISG-2011-03: Generic Aging Lessons Learned (GALL) Report Revision 2 Aging  
11 Management Program (AMP) XI.M41, "Buried and Underground Piping and Tanks."  
12 ADAMS Accession No. ML12138A296. August 2, 2012.
- 13 • LR-ISG-2011-04: Updated Aging Management Criteria for Reactor Vessel Internal  
14 Components of Pressurized Water Reactors. ADAMS Accession No. ML12270A436.  
15 June 3, 2013.
- 16 • LR-ISG-2011-05: Ongoing Review of Operating Experience. ADAMS Accession  
17 No. ML12044A215. March 16, 2012.
- 18 • LR-ISG-2012-01: Wall Thinning Due to Erosion Mechanisms. ADAMS Accession  
19 No. ML12352A057. May 1, 2013.
- 20 • LR-ISG-2012-02: Aging Management of Internal Surfaces, Fire Water Systems,  
21 Atmospheric Storage Tanks, and Corrosion Under Insulation. ADAMS Accession  
22 No. ML13227A361. November 22, 2013.
- 23 • LR-ISG-2013-01: Aging Management of Loss of Coating or Lining Integrity for Internal  
24 Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks.  
25 ADAMS Accession No. ML14225A059. November 14, 2014.
- 26 • LR-ISG-2015-01: Changes to Buried and Underground Piping and Tank  
27 Recommendations. ADAMS Accession No. ML15308A018. February 4, 2016.
- 28 • LR-ISG-2016-01: Changes to Aging Management Guidance for Various Steam Generator  
29 Components. ADAMS Accession No. ML16237A383. December 7, 2016.

30 Under the LR-ISG process the NRC staff, industry, or stakeholders can propose a change to  
31 certain license renewal guidance documents. The NRC staff evaluates the issue, develops  
32 proposed interim staff guidance (ISG), and issues an ISG for public comment. The NRC reviews  
33 any comments received, and, as appropriate, issues a final ISG. The ISG is then used until the  
34 NRC staff incorporates it into a formal license renewal guidance document revision.

35 The GALL-SLR Report should be treated as an approved topical report. The NRC reviewers  
36 should not re-review a matter described in the GALL-SLR Report, but should find an application  
37 acceptable with respect to such a matter when the application references the GALL-SLR Report  
38 and when the evaluation of the matter in the GALL-SLR Report applies to the plant. However,  
39 reviewers should ensure that the material presented in the GALL-SLR Report is applicable to the

1 specific plant involved and that the applicant has identified specific programs, as described and  
2 evaluated in the GALL-SLR Report, if they rely on the report for SLR.

3 The SRP-SLR is divided into five major chapters:

4 Chapter 1—Administrative Information

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

7 Chapter 3—Aging Management Review Results

8 Chapter 4—Time-Limited Aging Analyses

9 Chapter 5—Technical Specifications Changes and Additions

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

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

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

31 **1. Areas of Review**

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

1    **2.     Acceptance Criteria**

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

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

10   **3.     Review Procedures**

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

14   **4.     Evaluation Findings**

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

25   **5.     Implementation**

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

27   **6.     References**

28   This subsection lists the references used in the review process.

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

1 **1 ADMINISTRATIVE INFORMATION**

2 **1.1 Docketing of Timely and Sufficient Renewal Application**

3 **Review Responsibilities**

4 **Primary**—Branch responsible for subsequent license renewal projects

5 **Secondary**—Branches responsible for technical review, as appropriate

6 **1.1.1 Areas of Review**

7 This section addresses (i) the review of the acceptability of a subsequent license renewal  
8 application (SLRA) for docketing in accordance with Title 10 of the *Code of Federal Regulations*  
9 (10 CFR) 2.101 and the requirements of 10 CFR Part 54 and (ii) whether an application is timely  
10 and sufficient, which allows the provisions of 10 CFR 2.109(b) to apply. Application of this  
11 regulation, written to comply with the Administrative Procedures Act, means that the current  
12 license will not expire until the U.S. Nuclear Regulatory Commission (NRC) makes a final  
13 determination on the SLRA.

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

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

25 *1.1.1.1 Docketing and Sufficiency of Application*

26 The SLRA is reviewed for acceptability for docketing as a sufficient application in accordance with  
27 10 CFR 2.101, 10 CFR Part 51, and 10 CFR Part 54.

28 *1.1.1.2 Timeliness of Application*

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

30 **1.1.2 Acceptance Criteria**

31 *1.1.2.1 Docketing and Sufficiency of Application*

32 The NRC staff determines acceptance for docketing and sufficiency on the basis of the required  
33 contents of an application, established in 10 CFR 2.101, 10 CFR 51.53(c), 54.17, 54.19, 54.21,  
34 54.22, 54.23, 54.29 and 54.4. An application is sufficient if it contains the reports, analyses, and  
35 other documents required in such an application.

1    1.1.2.2    *Timeliness of Application*

2    In accordance with 10 CFR 2.109(b), if the licensee of a nuclear power plant licensed under  
3    10 CFR 50.21(b) or 50.22 files a sufficient application for renewal of either an operating license or  
4    a combined license at least 5 years before the expiration of the existing license, the existing  
5    license will not be deemed to have expired until the application has been finally determined.

6    **1.1.3    Review Procedures**

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

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

15   1.1.3.1    *Docketing and Sufficiency of Application*

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

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

24   Items II, III, and IV in the checklist address scoping, technical information, the Final Safety  
25   Analysis Report supplement, and technical specification changes, respectively. Chapters 2, 3, 4,  
26   and 5 of the Standard Review Plan for Review of Subsequent License Renewal Applications for  
27   Nuclear Power Plants (SRP-SLR) provide information regarding the technical review. Although  
28   the purpose of the docketing and sufficiency review is not to determine the technical adequacy of  
29   the application, the reviewer should determine whether the applicant has provided reasonably  
30   complete information in the application to address the renewal rule requirements. The reviewer  
31   may request assistance from appropriate technical review branches to determine whether the  
32   application provides sufficient information to address the items in the checklist so that the NRC  
33   staff can begin their technical review. The reviewer should check the “Yes” column for a checklist  
34   item if the applicant has provided reasonably complete information in the application to address  
35   the checklist item.

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

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

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

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

18 If the reviewer is able to answer “Yes” to the applicable items in the checklist, the application is  
19 acceptable for docketing as a sufficient renewal application. The applicant should be notified by  
20 letter that the application is accepted for docketing. Normally, the letter should be issued within  
21 30 days of receipt of a renewal application. A notice of acceptance for docketing of the  
22 application and notice of opportunity for a hearing regarding renewal of the license is published in  
23 the *Federal Register*.

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

### 27 1.1.3.2 *Timeliness of Application*

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

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

1 **1.1.4 Evaluation Findings**

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

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

13 **1.1.5 Implementation**

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

16 **1.1.6 References**

- 17 1. NRC. NUREG-1555, Supplement1, Revision 1, "Standard Review Plans for  
18 Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License  
19 Renewal." (ESRP.) ADAMS Accession No. ML13106A246. Washington, DC:  
20 U.S. Nuclear Regulatory Commission. June 2013.

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

	Yes	No
<b>I. General Information</b>		
1. Application identifies specific unit(s) applying for subsequent license renewal	<input type="checkbox"/>	<input type="checkbox"/>
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	<input type="checkbox"/>	<input type="checkbox"/>
B. 10 CFR 50.4		
a. Application is addressed to the Document Control Desk as specified in 10 CFR 50.4(a)	<input type="checkbox"/>	<input type="checkbox"/>
b. A signed original application and hard copies are provided to the Document Control Desk. One copy is provided to the appropriate Regional Office and one copy to the Regional Inspectors in accordance with the NRC docketing requirement in 10 CFR 50.4.	<input type="checkbox"/>	<input type="checkbox"/>
c. Form of the application meets the requirements of 10 CFR 50.4(c)	<input type="checkbox"/>	<input type="checkbox"/>
C. 10 CFR 50.30		
a. Application is filed in accordance with 10 CFR 50.4 (10 CFR 50.30(a)(1))	<input type="checkbox"/>	<input type="checkbox"/>
b. Application is submitted under oath or affirmation (10 CFR 50.30(b))	<input type="checkbox"/>	<input type="checkbox"/>
3. Applicant is eligible to apply for a license and is not a foreign-owned or foreign-controlled entity (10 CFR 54.17(b))	<input type="checkbox"/>	<input type="checkbox"/>
4. Application is not submitted earlier than 20 years before expiration of current license (10 CFR 54.17(c))	<input type="checkbox"/>	<input type="checkbox"/>
5. Application states whether it contains applications for other kinds of licenses (10 CFR 54.17(d))	<input type="checkbox"/>	<input type="checkbox"/>
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))	<input type="checkbox"/>	<input type="checkbox"/>
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))	<input type="checkbox"/>	<input type="checkbox"/>
8. If the application contains restricted data, written agreement on the control of accessibility to such information is provided (10 CFR 54.17(g))	<input type="checkbox"/>	<input type="checkbox"/>
9. Information specified in 10 CFR 50.33(a) through (e), (h), and (i) is provided or referenced (10 CFR 54.19(a)):	<input type="checkbox"/>	<input type="checkbox"/>
A. Name of applicant	<input type="checkbox"/>	<input type="checkbox"/>
B. Address of applicant	<input type="checkbox"/>	<input type="checkbox"/>
C. Business description	<input type="checkbox"/>	<input type="checkbox"/>
D. Citizenship and ownership details	<input type="checkbox"/>	<input type="checkbox"/>
E. License information	<input type="checkbox"/>	<input type="checkbox"/>
F. Construction or alteration dates	<input type="checkbox"/>	<input type="checkbox"/>
G. Regulatory agencies and local publications	<input type="checkbox"/>	<input type="checkbox"/>
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))	<input type="checkbox"/>	<input type="checkbox"/>

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

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

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

	Yes	No
<b>III An FSAR Supplement (10 CFR 54.21(d)) is provided and contains the following information:</b>		
1. Summary description of the AMPs and activities for managing the effects of aging	<input type="checkbox"/>	<input type="checkbox"/>
2. Summary description of the evaluation of TLAAs	<input type="checkbox"/>	<input type="checkbox"/>
<b>IV. Technical Specification Changes</b>		
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)	<input type="checkbox"/>	<input type="checkbox"/>
<b>V. Environmental Information</b>		
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)	<input type="checkbox"/>	<input type="checkbox"/>
<b>VI. Timeliness Provision</b>		
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	<input type="checkbox"/>	<input type="checkbox"/>
<b>VII. Conclusions Regarding Acceptance of Application for Docketing</b>		
The application is reasonably complete and meets the Acceptance Review Checklist criteria I through V and is recommended for docketing	<input type="checkbox"/>	<input type="checkbox"/>

1 **1.2 Integrated Plant Assessments and Aging Management Reviews**

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

17 Review of the AMPs requires assessment of 10 program elements as defined in this SRP-SLR.  
18 The NRC division assigned the AMP reviews the 10 program elements to verify their technical  
19 adequacy. For 3 of the 10 program elements (corrective actions, confirmation process, and  
20 administrative controls), the NRC division responsible for review of the quality assurance (QA)  
21 aspects of the application verifies that the applicant has documented a commitment in the Final  
22 Safety Analysis Report (FSAR) Supplement to expand the scope of its 10 CFR Part 50,  
23 Appendix B program to address the associated program elements for each AMP. If the applicant  
24 chooses alternate means of addressing these three program elements, (i.e., use of a process  
25 other than the applicant's 10 CFR Part 50, Appendix B program) the NRC division assigned to  
26 review the AMP should request that the division responsible for QA review the applicant's  
27 proposal on a case-specific basis.

28 **1.2.1 Background on the Types of Reviews**

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

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

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

- 1 • New (N), Modified (M), Deleted (D), Edited (E) Item: The description of this column  
2 identifies whether the AMR line item is new, was modified, deleted, or edited. The NRC  
3 will publish the technical bases for these new, modified, and deleted AMR items in a  
4 NUREG containing the disposition of public comments and the technical bases for  
5 changes in the guidance documents after the final subsequent license renewal (SLR)  
6 guidance documents are published.
- 7 • “ID” column: The description for this column provides an identification number for the  
8 AMR item of a given commodity grouping of components that have common materials of  
9 fabrication, environmental conditions, and aging effects.
- 10 • “Type” column: The description for this column identifies whether the specific AMR item in  
11 the table is applicable to BWR, PWR, or both plant designs.
- 12 • “Component” column: The description for this column identifies the specific components  
13 that are within the scope of the commodity grouping in the AMR item and the materials of  
14 fabrication and environmental conditions that are applicable to the components in the  
15 AMR item.
- 16 • “Aging Effect/Mechanism” column: The description for this column identifies the aging  
17 effects and mechanisms that are applicable to the material-environmental combinations for  
18 the components in the commodity grouping of the AMR item.
- 19 • “Aging Management Program/TLAA” column: The description for this column provides  
20 AMPs or TLAA that may be used to manage the aging effects that apply to the  
21 components in the commodity grouping of the AMR item and to demonstrate compliance  
22 with the aging management requirement in 10 CFR 54.21(a)(3).
- 23 • “Further Evaluation” column: The description for this column identifies whether the AMP  
24 or TLAA recommended in the “Aging Management Program/TLAA” column of the AMR  
25 item requires additional evaluation (further evaluation) by an applicant adopting the AMR  
26 item. This column also references the specific subsection(s) in SRP-SLR Chapter 3  
27 applicable to the evaluation of the components in the commodity grouping of the  
28 AMR item.
- 29 • “GALL-SLR Item” column: The description for this column identifies the component-  
30 specific AMR items in the Generic Aging Lessons Learned for Subsequent License  
31 Renewal (GALL-SLR) Report that derives from the commodity-group-based item in the  
32 SRP-SLR AMR table.

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

- 35 • Line item citations that were missed in the SRP SLR Table 3.X-1.
- 36 • Deleting whether the environment is internal or external from the description of the  
37 environment because based on the material, environment, aging effect, and AMP  
38 combination, it is obvious that the environment could only be on either the inside or  
39 outside of the component.

- 1 • Deletion of the term “piping element” from aging management review items that do not cite  
2 glass as a material. Piping elements were defined in the GALL Report as components  
3 constructed of glass.
- 4 • Line item changes that only involved removing detail related to a Further Evaluation  
5 Recommended column was removed after it was verified that the identical information was  
6 included in the SRP LR further evaluation section.
- 7 • Line item changes that only involved renumbering further evaluation sections.
- 8 • Aging effects changed from “and” to “or.” This could appear to be a technical change;  
9 however, this is not the case because the staff confirmed that is was never the intent that  
10 both aging effects were occurring. For example, the “and” in cracking due to stress  
11 corrosion cracking and cyclic loading was replaced with “or.”
- 12 • Deleting the term “environment” from the description of the environment in the  
13 “Environment” column when the phrase “any environment” was used because it was  
14 obvious and redundant.
- 15 • Descriptors for the AMPs in the “Aging Management Program/TLAA” column were  
16 simplified if the information was provided elsewhere.
- 17 • Minor edits to component descriptions, examples: (a) deleting “elastomer” from  
18 “elastomer, elastomer seals;” (b) adding “piping” or “ducting” in front of the term  
19 “component.”
- 20 • Adding the term “electrical” to Structure and/or Component and Aging Effect/Mechanism  
21 description.

22

23 The GALL-SLR Report is a technical basis document to the SRP-SLR and provides generic AMR  
24 and AMP guidance that may be used as part of the bases for developing an SLRA. As such, the  
25 GALL-SLR Report contains an acceptable method that may be used to assist an applicant in:  
26 (a) developing the integrated plant assessment (IPA) for an SLRA, as required by  
27 10 CFR 54.21(a); (b) identifying those components and structures that are required to be within  
28 the scope of an AMR, as required by 10 CFR 54.21(a)(1); and (c) managing those aging effects  
29 that are applicable to these SSCs, as required by 10 CFR 54.21(a)(3). An applicant may propose  
30 an alternative method for performing the IPA. Therefore, the use of the GALL-SLR Report is not  
31 required; however, its use should facilitate both preparation of an SLRA by an applicant and  
32 timely, uniform review by the NRC staff. If the GALL-SLR Report is used for the development of  
33 an SLRA, the GALL-SLR Report should be treated as an NRC-approved topical report.

34 The GALL-SLR Report contains an AMR evaluation of a large number of structures and  
35 components (SCs) that may be in the scope of a typical SLRA and may need to be the subject of  
36 an AMR in accordance with requirements in 10 CFR 54.21(a)(1). The AMR results documented  
37 in the GALL-SLR Report indicate that many existing, typical generic AMPs are adequate to  
38 manage aging effects for particular structures or components without change. The GALL-SLR  
39 Report also contains recommendations on specific areas for which generic existing programs  
40 should be augmented for SLRAs and documents the technical basis for each such determination.  
41 In addition, the GALL-SLR Report identifies certain SCs that may or may not be subject to

1 particular aging effects, and for which industry groups are developing generic AMPs or  
2 investigating whether aging management is warranted. The ultimate generic resolution of such an  
3 issue may need NRC review and approval for plant-specific implementation, as indicated in a  
4 plant-specific FSAR supplement, and reflected in the safety evaluation report (SER) associated  
5 with a particular SLRA.

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

13 Conversely, the omission of a certain structure or component in the GALL-SLR Report does not  
14 mean that a particular structure or component in the plant design is not within the scope of the  
15 SLRA or does not need to be the subject of an AMR in accordance with the requirements in  
16 10 CFR 54.21(a)(1). The AMR line items in the SRP-SLR and GALL-SLR Report may not provide  
17 a comprehensive list of all structures or components that need to be within the subject of an AMR  
18 or a comprehensive list of all potential aging effects that may be applicable to those structures or  
19 components as being the subject of an AMR. Therefore, as has been the practice for initial  
20 license renewal applications, plant-specific AMRs should be performed if additional aging effects  
21 (not referenced in the SRP-SLR and GALL-SLR reports) are applicable to the design of a specific  
22 structure or component subject to an AMR.

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

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

45 As part of the development of the SLRA, the applicant should assess the AMPs in the GALL-SLR  
46 Report. The applicant may choose to use an AMP that is consistent with the GALL-SLR Report

1 AMP, or may choose a plant-specific AMP. An applicant may reference the GALL-SLR Report in  
2 an SLRA to designate which programs at the applicant's facility will be used to manage the effects  
3 of aging for specific structures or components, and how those programs correspond to the AMPs  
4 reviewed and approved in the GALL-SLR Report. If an applicant does take credit for a program in  
5 the GALL-SLR Report, it is incumbent on the applicant to ensure that the conditions and operating  
6 experience (OE) at the plant is bounded by the conditions and OE for which the GALL-SLR  
7 Report program was evaluated. If these bounding conditions are not met it is incumbent on the  
8 applicant to address the additional effects of aging and augment the AMP(s) in the GALL-SLR  
9 Report in the SLRA, as appropriate.

10 If a GALL-SLR Report AMP is selected to manage aging, the applicant may take one or more  
11 exceptions to specific GALL-SLR Report AMP program elements. Exceptions are portions of the  
12 GALL-SLR Report AMP that the applicant does not intend to implement, which the staff will review  
13 on a case-by-case basis. Any deviation or exception to the GALL-SLR Report AMP should be  
14 described and justified. The applicant may identify that the exception was previously approved for  
15 the plant under review. The applicant may also use precedence from another plant to justify their  
16 exception. In both these cases the reviewer is to confirm that the justifications for the previously  
17 approved exceptions are acceptable for the subsequent period of extended operation. For  
18 example, a previously approved exception may have been acceptable for operation up to  
19 60 years, but not past 60 years.

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

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

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

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

41 Reviews are also performed to address those AMRs or AMPs related to emergent issues, stated  
42 to be not consistent with the GALL-SLR Report, or based on an NRC-approved precedent  
43 (e.g., AMRs and AMPs addressed in an NRC SER of a previous SLRA) or technical or topical  
44 report. SRP-SLR Section 1.2.3 provides additional guidance on reviewing those GALL-based or  
45 plant-specific AMPs that are based on NRC-endorsed technical or topical reports. As a result of

1 the criteria established in 10 CFR Part 54, the guidance provided in SRP-SLR, GALL-SLR Report,  
2 and the applicant's exceptions and/or enhancements to a GALL-SLR Report AMP, the following  
3 types of AMRs and AMPs are audited or reviewed by the NRC staff.

#### 4 **AMRs**

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

#### 8 **AMPs**

- 9 • Consistent with the GALL-SLR Report AMPs
- 10 • Plant-specific AMPs

#### 11 **FSAR Supplement**

- 12 • Each SLRA AMP will provide an FSAR Supplement which defines changes to the FSAR  
13 that will be made as a condition of a renewed license. This FSAR Supplement defines the  
14 AMPs the applicant is crediting to satisfy 10 CFR 54.21(a)(3).
- 15 • The FSAR Supplement should also contain a commitment to implement the SLRA AMP  
16 enhancement prior to the subsequent period of extended operation.

#### 17 **1.2.2 Applications With Approved Extended Power Uprates**

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

#### 32 **1.2.3 Aging Management Programs that Rely on Implementation of Nuclear Regulatory** 33 **Commission-Approved Technical or Topical Reports**

34 The NRC Office Instruction LIC-500, Revision 5, establishes the NRC's current process  
35 expectations for applying the methodology in an NRC-endorsed or NRC-approved technical report  
36 or topical report (TR) to the CLB or current design basis of a licensed U.S. light-water reactor  
37 facility. The LIC-500 office instruction identifies that the use of such reports may be subject to  
38 specific limitations or actions, which are identified and issued in the NRC's safety evaluations  
39 (SEs) that evaluate the TR methodologies. The LIC-500 office instruction states that it is the  
40 NRC's expectation that licensees or applicants applying these types of reports to their CLBs or

1 design bases will address or respond to those action items or limitations that were issued in the  
2 NRC staff's SEs regarding the TR methodologies.

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

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

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

1       **2 SCOPING AND SCREENING METHODOLOGY FOR IDENTIFYING**  
2                   **STRUCTURES AND COMPONENTS SUBJECT TO AGING**  
3                   **MANAGEMENT REVIEW AND IMPLEMENTATION RESULTS**

4       **2.1 Scoping and Screening Methodology**

5       **Review Responsibilities**

6       **Primary**—Assigned branch(es)

7       **Secondary**—None

8       **2.1.1 Areas of Review**

9       This section addresses the scoping and screening methodology for subsequent license renewal  
10       (SLR). As required by Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(a)(2), the  
11       applicant, in its integrated plant assessment (IPA), is to describe and justify methods used to  
12       identify systems, structures, and components (SSCs) subject to an aging management review  
13       (AMR). The SSCs subject to AMR are those that perform an intended function, as described on  
14       10 CFR 54.4, and meet two criteria in 10 CFR 54.21(a)(1)(i) and (ii). Are those structures and  
15       components

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

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

19       Such structures and components are denoted as “passive,” “long-lived” in this Standard  
20       Review Plan.

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

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

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

28       **2.1.1.1 Scoping**

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

31       **2.1.1.2 Screening**

32       The methodology used by the applicant to implement the screening requirements of  
33       10 CFR 54.21(a)(1) is reviewed.

1 **2.1.2 Acceptance Criteria**

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

- 3 • 10 CFR 54.4(a) as it relates to the identification of plant SSCs within the scope of the Rule
- 4 • 10 CFR 54.4(b) as it relates to the identification of the intended functions of plant SSCs  
5 determined to be within the scope of the Rule
- 6 • 10 CFR 54.21(a)(1) and (a)(2) as they relate to the methods utilized by the applicant to  
7 identify plant SCs subject to an AMR

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

10 **2.1.2.1 Scoping**

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

17 **2.1.2.2 Screening**

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

21 **2.1.3 Review Procedures**

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

- 24 • The SER that was issued on the facility's license renewal. This review is conducted for  
25 the purpose of familiarization with the principal design criteria for the facility and its current  
26 licensing basis (CLB), as defined in 10 CFR 54.3(a).
- 27 • Chapters 1 through 12 of the updated final safety analysis report (UFSAR) and the  
28 facility's technical specifications for the purposes of familiarization with the facility design  
29 and the nomenclature that is applied to SSCs within the facility (including the bases for  
30 such nomenclature). During this review, the SSCs should be identified that are relied  
31 upon to remain functional during and after design basis events (DBEs), as defined in  
32 10 CFR 50.49(b)(1)(ii), for which the facility was designed, to ensure that the functions  
33 described in 10 CFR 54.4(a)(1) are successfully accomplished. This review should also  
34 yield information regarding seismic Category I SSCs as defined in RG 1.29, "Seismic  
35 Design Classification for Nuclear Power Plants" (Ref. 2). For a newer plant, this  
36 information is typically contained in Section 3.2.1, "Seismic Classification," of the UFSAR  
37 consistent with the Standard Review Plan (NUREG-0800) (Ref. 3).

- 1 • Chapter 15 (or equivalent) of the UFSAR to identify the anticipated operational  
2 occurrences and postulated accidents that are explicitly evaluated in the accident analyses  
3 for the facility. During this review, the SSCs that are relied upon to remain functional  
4 during and following design basis events (as defined in 10 CFR 50.49(b)(1)) to ensure the  
5 functions described in 10 CFR 54.4(a)(1) should be identified.
  
- 6 • The set of DBEs as defined in the Rule is not limited to Chapter 15 (or equivalent) of the  
7 UFSAR. Examples of DBEs that may not be described in this chapter include external  
8 events, such as floods, storms, earthquakes, tornadoes, or hurricanes, and internal  
9 events, such as a high-energy line break. Information regarding DBEs as defined in  
10 10 CFR 50.49(b)(1) may be found in any chapter of the facility UFSAR, the Commission's  
11 regulations, NRC orders, exemptions, or license conditions within the CLB. These  
12 sources should also be reviewed to identify SSCs that are relied upon to remain functional  
13 during and following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the functions  
14 described in 10 CFR 54.4(a)(1).
  
- 15 • The facility's Probabilistic Risk Analysis (PRA) Summary Report that was prepared by the  
16 licensee in response to Generic Letter (GL) 88-20, "Individual Plant Examination for  
17 Severe Accident Vulnerabilities—10 CFR 50.54(f)," dated November 23, 1988 (Ref. 4).  
18 This review should yield additional information regarding the impact of the individual plant  
19 examination (IPE) on the CLB for the facility. While the license renewal (LR) Rule is  
20 "deterministic," the NRC in the Statements of Consideration (SOC) accompanying the  
21 Rule also states that "In license renewal, probabilistic methods may be most useful, on a  
22 plant-specific basis, in helping to assess the relative importance of structures and  
23 components that are subject to an AMR by helping to draw attention to specific  
24 vulnerabilities (e.g., results of an IPE or [individual plant examination of external events]  
25 IPEEE)" (60 FR 22468). For example, the reviewer should focus on IPE information  
26 pertaining to plant changes or modifications that are initiated by the licensee in  
27 accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.
  
- 28 • The results of the facility's IPEEE study conducted as a follow-up to the IPE performed as  
29 a result of GL 88-20 to identify any changes or modifications made to the facility in  
30 accordance with the requirements of 10 CFR 50.59 or 10 CFR 50.90.
  
- 31 • The applicant's docketed correspondence related to the following regulations:
  - 32 (a) 10 CFR 50.48, "Fire Protection"
  - 33 (b) 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to  
34 Safety for Nuclear Power Plants"
  - 35 (c) 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against  
36 Pressurized Thermal Shock Events" or 10 CFR 50.61a, "Alternate Fracture  
37 Toughness Requirements for Protection Against Pressurized Thermal Shock  
38 Events," in accordance with the applicant's CLB (applicable only to pressurized  
39 water reactor (PWR) plants)
  - 40 (d) 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients  
41 without Scram Events for Light-Water-Cooled Nuclear Power Plants"
  - 42 (e) 10 CFR 50.63, "Loss of All Alternating Current Power" (applicable to PWR plants)

1 Other NRC staff members may be reviewing the applicant's scoping and screening results  
2 separately following the guidance in Sections 2.2 through 2.5. The reviewer should keep these  
3 other NRC staff members informed of findings that may affect their review of the applicant's  
4 scoping and screening results. The reviewer should coordinate this sharing of information through  
5 the SLR project manager.

#### 6 2.1.3.1 Scoping

7 Once the information delineated above has been gathered, the NRC staff reviews the applicant's  
8 methodology to determine whether its depth and breadth are sufficiently comprehensive to  
9 identify the SSCs within the scope of SLR, and the SCs requiring an AMR. Because "[t]he CLB  
10 represents the evolving set of requirements and commitments for a specific plant that are modified  
11 as necessary over the life of a plant to ensure continuation of an adequate level of safety"  
12 (60 FR 22465, May 8, 1995), the regulations, orders, license conditions, exemptions, and  
13 technical specifications (TS) defining functional requirements for facility SSCs that make up an  
14 applicant's CLB should be considered as the initial input into the scoping process. DBEs are  
15 defined in 10 CFR 50.49 as conditions of normal operation, including anticipated operational  
16 occurrences and design basis accidents (DBAs). DBAs, external events, and natural phenomena  
17 for which the plant must be designed to ensure (1) the integrity of the reactor pressure boundary,  
18 (2) the capability to shut down the reactor and maintain it in safe shutdown condition, or (3) the  
19 capability to prevent or mitigate the consequences of accidents that could result in potential offsite  
20 exposures comparable to those referred to in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as  
21 applicable. Therefore, to determine the safety-related SSCs that are within the scope of the Rule  
22 under 10 CFR 54.4(a)(1), the applicant must identify those SSCs that are relied upon to remain  
23 functional during and following these DBEs, consistent with the CLB of the facility. Most licensees  
24 have developed lists or databases that identify SSCs relied on for compliance with other  
25 regulations in a manner consistent with the CLB of their facilities. Consistent with the licensing  
26 process and regulatory criteria used to develop such lists or databases, licensees should build  
27 upon these information sources to satisfy 10 CFR Part 54 requirements.

28 With respect to TS, the NRC has stated (60 FR 22467):

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

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

44 For licensee commitments, such as licensee responses to NRC Bulletins, GLs, or enforcement  
45 actions, and those documented in NRC staff safety evaluations or licensee event reports, and

1 which make up the remainder of an applicant's CLB, many of the associated SSCs need not be  
2 considered under SLR. Generic communications, safety evaluations, and other similar  
3 documents found on the docket are not regulatory requirements, and commitments made by a  
4 licensee to address any associated safety concerns are not typically considered to be design  
5 requirements. However, any generic communication, safety evaluation, or licensee commitment  
6 that specifically identifies or describes a function associated with a SSC necessary to fulfill the  
7 requirement of a particular regulation, order, license condition, and/or exemption may need to be  
8 considered when scoping for SLR. For example, NRC Bulletin 88-11, "Pressurizer Surge Line  
9 Thermal Stratification," (Agencywide Documents Access and Management System (ADAMS)  
10 Accession No. ML031220290) states:

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

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

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

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

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

#### 32 2.1.3.1.1       *Safety-Related*

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

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

6 **2.1.3.1.2 Nonsafety-Related**

7 The applicant's methodology is reviewed to ensure that nonsafety-related SSCs whose  
8 failure could prevent satisfactory accomplishment of any of the functions identified in  
9 10 CFR 54.4(a)(1) are identified as being within the scope of SLR.

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

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

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

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

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

39 In part, 10 CFR 54.4(a)(2) requires that the applicant consider all nonsafety-related SSCs whose  
40 failure could prevent satisfactory accomplishment of any of the functions identified in  
41 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

1 SLR. By letters dated December 3, 2001, and March 15, 2002, the NRC issued a staff position to  
2 NEI that provided NRC staff guidance for determining what SSCs meet the 10 CFR 54.4(a)(2)  
3 criterion. The December 3, 2001, letter, "License Renewal Issue: Scoping of Seismic III/I Piping  
4 Systems," provided specific examples of OE that identified pipe failure events [summarized in  
5 Information Notice (IN) 2001-09, "Main Feedwater System Degradation in Safety-Related ASME  
6 Code Class 2 Piping Inside the Containment of a Pressurized Water Reactor" (ADAMS Accession  
7 No. ML011490408)] and the approaches the NRC considers acceptable to determine which piping  
8 systems should be included in scope based on the 10 CFR 54.4(a)(2) criterion.

9 The March 15, 2002, letter, "License Renewal Issue: Guidance on the Identification and  
10 Treatment of Structures, Systems, and Components Which Meet 10 CFR 54.4(a)(2)," (ADAMS  
11 Accession No. ML020770026) further described the NRC staff's recommendations for the  
12 evaluation of nonpiping SSCs to determine which additional nonsafety-related SSCs are within the  
13 scope of SLR. The position states that the applicants should not consider hypothetical failures,  
14 but rather should base their evaluation on the plant's CLB, engineering judgment and analyses,  
15 and relevant OE. The paper further describes OE as all documented plant-specific and  
16 industrywide experience that can be used to determine the plausibility of a failure. Documentation  
17 would include NRC generic communications and event reports, plant-specific condition reports,  
18 industry reports such as significant OE reports (SOERs) or INPO Event Reports (IERs), and  
19 engineering evaluations.

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

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

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

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

#### 4 2.1.3.1.3 “Regulated Events”

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

11 The scoping criteria in 10 CFR 54.4(a)(3) require an applicant to consider “all systems, structures,  
12 and components relied on in safety analyses or plant evaluations to perform a function that  
13 demonstrates compliance with the Commission’s regulations for [FP, EQ, PTS, ATWS and SBO].”  
14 In addition, Section III.c(iii) (60 FR 22467) of the SOC states that the NRC intended to limit the  
15 potential for unnecessary expansion of the review for SSCs that meet the scoping criteria under  
16 10 CFR 54.4(a)(3) and provides additional guidance that qualifies what is meant by “those SSCs  
17 relied on in safety analyses or plant evaluations to perform a function that demonstrates  
18 compliance with the Commission regulations” in the following statement:

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

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

36 In addition, the last sentence of the second paragraph in Section III.c(iii) of the SOC  
37 provides the following guidance for limiting the application of the scoping criterion under  
38 10 CFR 54.4(a)(3) as it applies to the use of hypothetical failures: Consideration of hypothetical  
39 failures that could result from system interdependencies, that are not part of the current licensing  
40 bases and that have not been previously experienced is not required. (60 FR 22467)

41 The SOC does not provide any additional guidance relating to the use of hypothetical failures  
42 or the need to consider second-, third-, or fourth-level support systems for scoping under  
43 10 CFR 54.4(a)(3). Therefore, in the absence of any guidance, an applicant need not consider  
44 hypothetical failures or second-, third-, or fourth-level support systems in determining the SSCs

1 within the scope of the Rule under 10 CFR 54.4(a)(3). For example, if a nonsafety-related diesel  
2 generator is relied upon only to remain functional to demonstrate compliance with the NRC SBO  
3 regulation, the applicant need not consider the following SSCs: (1) an alternate/backup cooling  
4 water system, (2) nonseismically-qualified building walls, or (3) an overhead segment of  
5 nonseismically-qualified piping (in a Seismic III configuration). This guidance is not intended to  
6 exclude any support system (whether identified by an applicant's CLB, or as indicated from actual  
7 plant-specific experience, industrywide experience (as applicable), safety analyses, or plant  
8 evaluations) that is specifically relied upon for compliance with the applicable NRC regulation. For  
9 example, if analysis of a nonsafety-related diesel generator (relied upon to demonstrate  
10 compliance with an applicable NRC regulation) specifically relies upon a second cooling system to  
11 cool the diesel generator jacket water cooling system for the generator to be operable, then both  
12 cooling systems must be included within the scope of the Rule under 10 CFR 54.4(a)(3).

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

17 For environmental qualification, the reviewer verifies that the applicant has indicated that the  
18 environmental qualification equipment is the equipment already identified by the licensee under  
19 10 CFR 50.49(b), that is, equipment relied upon in safety analyses or plant evaluations to  
20 demonstrate compliance with NRC regulations for environmental qualification (10 CFR 50.49).

21 For SBO, the reviewer verifies that the applicant's methodology would include those SSCs relied  
22 upon during the "coping duration" and "recovery" phase of an SBO event. In addition, because  
23 10 CFR 50.63(c)(1)(ii) and its associated guidance in RG 1.155 include procedures to recover  
24 from an SBO that include offsite and onsite power, the offsite power system that is used to  
25 connect the plant to the offsite power source should also be included within the scope of the Rule.  
26 However, the NRC staff's review is based on the plant-specific CLB, regulatory requirements, and  
27 offsite power design configurations.

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

### 30 2.1.3.2 *Screening*

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

#### 34 2.1.3.2.1 *"Passive"*

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

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

7 Table 2.1-5 provides a list of typical SCs identifying whether they meet 10 CFR 54.21(a)(1)(i).  
8 10 CFR 54.21(a)(1)(i) explicitly excludes instrumentation, such as pressure transmitters, pressure  
9 indicators, and water level indicators, from an AMR. The applicant does not have to identify  
10 pressure-retaining boundaries of this instrumentation because 10 CFR 54.21(a)(1)(i) excludes this  
11 instrumentation without exception, unlike pumps and valves. Further, instrumentation is sensitive  
12 equipment and degradation of its pressure retaining boundary would be readily determinable by  
13 surveillance and testing. If an applicant determines that certain SCs listed in Table 2.1-5 as  
14 meeting 10 CFR 54.21(a)(1)(i) do not meet that requirement for its plant, the reviewer reviews the  
15 applicant’s basis for that determination.

16 2.1.3.2.2 “Long-Lived”

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

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

24 In sum, a structure or component that is not replaced either (i) on a specified  
25 interval based upon the qualified life of the structure or component or  
26 (ii) periodically in accordance with a specified time period, is deemed by  
27 § 54.21(a)(1)(ii) of this rule to be “long-lived,” and therefore subject to the  
28 § 54.21(a)(3) aging management review [60 FR 22478].

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

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

35 It is important to note, however, that the Commission has decided not to  
36 generically exclude passive structures and components that are replaced based  
37 on performance or condition from an aging management review. Absent the  
38 specific nature of the performance or condition replacement criteria and the fact  
39 that the Commission has determined that the components with “passive”  
40 functions are not as readily monitorable as components with active functions,  
41 such generic exclusion is not appropriate. However, the Commission does not  
42 intend to preclude a license renewal applicant from providing site-specific  
43 justification in a license renewal application that a replacement program on the

1 basis of performance or condition for a passive structure or component provides  
2 reasonable assurance that the intended function of the passive structure or  
3 component will be maintained in the period of extended operation.  
4 [60 FR 22478]

5 **2.1.4 Evaluation Findings**

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

10 On the basis of its review, as discussed above, the NRC staff concludes that  
11 there is reasonable assurance that the applicant's methodology for identifying the  
12 systems, structures, and components within the scope of subsequent license  
13 renewal and the SCs requiring an AMR is consistent with the requirements of  
14 10 CFR 54.4 and 10 CFR 54.21(a)(1).

15 **2.1.5 Implementation**

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

21 **2.1.6 References**

- 22 1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of  
23 10 CFR Part 54--The License Renewal Rule." Revision 6. Agencywide Documents  
24 Access and Management System (ADAMS) Accession No. ML051860406.  
25 Washington, DC: Nuclear Energy Institute. June 2005.
- 26 2. NRC. Regulatory Guide 1.29, "Seismic Design Classification for Nuclear Power Plants."  
27 Revision 5. ADAMS Accession No. ML16118A148. Washington, DC: U.S. Nuclear  
28 Regulatory Commission. July 2016.
- 29 3. NRC. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports  
30 for Nuclear Power Plants." ADAMS Accession No. ML070630046. Washington, DC:  
31 U.S. Nuclear Regulatory Commission. March 2007.
- 32 4. NRC. Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident  
33 Vulnerabilities-10 CFR 50.54(f)." ADAMS Accession No. ML031150465.  
34 Washington, DC: U.S. Nuclear Regulatory Commission. November 1988.
- 35 5. NRC. Regulatory Guide 1.188, "Standard Format and Content for Applications to  
36 Renew Nuclear Power Plant Operating Licenses." Revision 1. ADAMS Accession  
37 No. ML051920430. Washington, DC: U.S. Nuclear Regulatory Commission.  
38 September 2005.

<b>Table 2.1-1. Sample Listing of Potential Information Sources</b>
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

<b>Table 2.1-2. Specific Staff Guidance on Scoping</b>	
<b>Issue</b>	<b>Guidance</b>
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, 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	<p>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).</p> <p>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% 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:</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>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</li> </ol>

<b>Table 2.1-2. Specific Staff Guidance on Scoping</b>	
<b>Issue</b>	<b>Guidance</b>
	<p>the instrument air header to the device on the skid is part of the instrument air system.</p> <p>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 switch, etc.) that indicates the alarm condition. The cables are part of the annunciator system.</p> <p>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.</p>
Hypothetical failures	<p>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 OE, and (3) industrywide OE 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.</p> <p>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.</p>
Cascading	<p>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.</p>

<b>Issue</b>	<b>Guidance</b>
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.

<b>Table 2.1-4(a). Typical “Passive” Structure-Intended Functions</b>	
<b>Structures</b>	
<b>Intended Function</b>	<b>Description</b>
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.

<b>Table 2.1-4(b). Typical “Passive” Component-Intended Functions</b>	
<b>Components</b>	
<b>Intended Function</b>	<b>Description</b>
Absorb Neutrons	Absorb neutrons
Electrical Continuity	Provide electrical connections to specified sections of an electrical circuit to deliver voltage, current, or signals
Filter	Provide filtration
Heat Transfer	Provide heat transfer
Insulate (electrical)	Insulate and support an electrical conductor
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**

<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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
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)

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

<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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	Pressurizer	Yes
33	Non-Class 1 Piping Components	Underground Piping	Yes
34	Non-Class 1 Piping Components	Piping in Low Temperature Demineralized Water Service	Yes
35	Non-Class 1 Piping Components	Piping in High Temperature Single Phase Service	Yes
36	Non-Class 1 Piping Components	Piping in Multiple Phase Service	Yes
37	Non-Class 1 Piping Components	Service Water Piping	Yes
38	Non-Class 1 Piping Components	Low Temperature Gas Transport Piping	Yes
39	Non-Class 1 Piping Components	Stainless Steel Tubing	Yes
40	Non-Class 1 Piping Components	Instrument Tubing	Yes
41	Non-Class 1 Piping Components	Expansion Joints	Yes
42	Non-Class 1 Piping Components	Ductwork	Yes
43	Non-Class 1 Piping Components	Sprinkler Heads	Yes
44	Non-Class 1 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)

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

<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
53	Turbines	Gas Turbines	Yes (Casing)
54	Turbines	Controls (Actuator and Overspeed Trip)	No
55	Engines	Fire Pump Diesel Engines	No
56	Emergency Diesel Generators	Emergency Diesel Generators	No
57	Heat Exchangers	Condensers	Yes
58	Heat Exchangers	Heating, ventilation, and air conditioning (HVAC) Coolers (including housings)	Yes
59	Heat Exchangers	Primary Water System Heat Exchangers	Yes
60	Heat Exchangers	Treated Water System Heat Exchangers	Yes
61	Heat Exchangers	Closed Cooling Water System Heat Exchangers	Yes
62	Heat Exchangers	Lubricating Oil System Heat Exchangers	Yes
63	Heat Exchangers	Raw Water System Heat Exchangers	Yes
64	Heat Exchangers	Containment Atmospheric System Heat Exchangers	Yes
65	Miscellaneous Process Components	Gland Seal Blower	No
66	Miscellaneous Process Components	Recombiners	The applicant shall identify the intended function and apply the 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
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

<b>Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment</b>			
<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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
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

<b>Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment</b>			
<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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
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

<b>Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment</b>			
<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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
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**

<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
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)
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)

<b>Table 2.1-5. Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment</b>			
<b>Item</b>	<b>Category</b>	<b>Structure, Component, or Commodity Grouping</b>	<b>Structure, Component, or Commodity Group Meets 10 CFR 54.21(a)(1)(i) (Yes/No)</b>
126	Miscellaneous	Emergency Lighting	No
127	Miscellaneous	Hose Stations	Yes

1

1 **2.2 Plant-Level Scoping Results**

2 **Review Responsibilities**

3 **Primary**—Assigned branch(es)

4 **Secondary**—None

5 **2.2.1 Areas of Review**

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

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

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

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

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

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

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

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

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

9 *2.2.1.1 Systems and Structures Within the Scope of Subsequent License Renewal*

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

12 **2.2.2 Acceptance Criteria**

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

18 *2.2.2.1 Systems and Structures Within the Scope of Subsequent License Renewal*

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

- 20 • Safety-related systems and structures that are relied upon to remain functional during and  
21 following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the following functions:
  - 22 – The integrity of the reactor coolant pressure boundary,
  - 23 – The capability to shut down the reactor and maintain it in a safe shutdown  
24 condition, or
  - 25 – The capability to prevent or mitigate the consequences of accidents that could  
26 result in potential offsite exposure comparable to the guidelines in  
27 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable.
- 28 • All nonsafety-related systems and structures whose failure could prevent satisfactory  
29 accomplishment of any of the functions identified in 10 CFR 54.4(a)(1) above.
- 30 • All systems and structures relied on in safety analyses or plant evaluations to perform  
31 a function that demonstrates compliance with NRC regulations for fire protection  
32 (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock  
33 (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62), and station blackout  
34 (SBO) (10 CFR 50.63).

1 **2.2.3 Review Procedures**

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

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

12 *2.2.3.1 Systems and Structures Within the Scope of Subsequent License Renewal*

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

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

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

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

- 30 • The applicant does not identify the radiation monitoring system as being within the scope  
31 of SLR. The reviewer may review the UFSAR to verify that this particular system does not  
32 perform any intended functions at the applicant’s plant.
- 33 • The applicant does not identify the polar crane as being within the scope of SLR. The  
34 reviewer may review the UFSAR to verify that this particular structure is not “Seismic II  
35 over I,” denoting a structure that is not seismic Category I interacting with a seismic  
36 Category I structure as described in Position C.2 of Regulatory Guide 1.29, “Seismic  
37 Design Classification for Nuclear Power Plants” (Ref. 1).
- 38 • The applicant does not identify the fire protection pump house as within the scope of SLR.  
39 The reviewer may review the plant’s commitments to the fire protection regulation  
40 (10 CFR 50.48) to verify that this particular structure does not perform any intended  
41 functions at the plant.

- 1 • The applicant uses the “spaces” approach for scoping electrical equipment and elects to  
2 include all electrical equipment onsite to be within the scope of SLR except for the 525 kV  
3 switchyard and the 230 kV transmission lines. The reviewer may review the UFSAR and  
4 commitments to the SBO regulation (10 CFR 50.63) to verify that the 525 kV switchyard  
5 and the 230 kV transmission lines do not perform any intended functions at the  
6 applicant’s plant.

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

13 Section 2.1 contains additional guidance on the following:

- 14 • Commodity groups
- 15 • Complex assemblies
- 16 • Hypothetical failure
- 17 • Cascading

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

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

#### 25 **2.2.4 Evaluation Findings**

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

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

#### 33 **2.2.5 Implementation**

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

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

3 **2.2.6 References**

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

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

<b>Example</b>	<b>Disposition</b>
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.

1 **2.3 Scoping and Screening Results: Mechanical Systems**

2 **Review Responsibilities**

3 **Primary**—Assigned branch(es)

4 **Secondary**—None

5 **2.3.1 Areas of Review**

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

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

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

31 An applicant should list all plant-level systems and structures. On the basis of the design basis  
32 events (DBEs) considered in the plant’s current licensing basis (CLB) and other CLB information  
33 relating to nonsafety-related systems and structures and certain regulated events, the applicant  
34 should identify those plant-level systems and structures within the scope of SLR, as defined in  
35 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for SLR. The NRC  
36 staff reviews the applicant’s plant-level “scoping” results separately following the guidance in  
37 Section 2.2.

38 For a mechanical system that is within the scope of SLR, the applicant should identify the portions  
39 of the system that perform an intended function, as defined in 10 CFR 54.4(b). The applicant may

1 identify these particular portions of the system in marked-up piping and instrument diagrams  
2 (P&IDs) or in other media. This is “scoping” of mechanical components in a system to identify  
3 those that are within the scope of SLR for a system.

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

9 The applicant has the flexibility to determine the set of SCs for which an AMR is performed,  
10 provided that this set includes the SCs for which the NRC has determined that an AMR is  
11 required. This is based on the Statements of Consideration for the license renewal rule  
12 (60 FR 22478). Therefore, the reviewer need not review all components that the applicant has  
13 identified as subject to an AMR because the applicant has the option to include more components  
14 than those required to be subject to an AMR pursuant to 10 CFR 54.21(a)(1).

### 15 **2.3.2 Acceptance Criteria**

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

#### 21 *2.3.2.1 Components Within the Scope of Subsequent License Renewal*

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

- 23 • Safety-related systems, structures, and components (SSCs) that are relied upon to remain  
24 functional during and following DBEs [as defined in 10 CFR 50.49(b)(1)] to ensure the  
25 following functions:
  - 26 — The integrity of the reactor coolant pressure boundary;
  - 27 — The capability to shut down the reactor and maintain it in a safe shut down  
28 condition; or
  - 29 — The capability to prevent or mitigate the consequences of accidents that could  
30 result in potential offsite exposure comparable to the guidelines in  
31 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- 32 • All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of  
33 any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii).
- 34 • All SSCs relied on in safety analyses or plant evaluations to perform a function that  
35 demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48),  
36 environmental qualification (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61),  
37 anticipated transients without scram (10 CFR 50.62), and station blackout (10 CFR 50.63).

1    2.3.2.2    *Components Subject to an Aging Management Review*

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

6    **2.3.3    Review Procedures**

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

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

18   2.3.3.1    *Components Within the Scope of Subsequent License Renewal*

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

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

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

40   Further, the reviewer should select system functions described in the UFSAR that are required by  
41   10 CFR 54.4 to verify that components having intended functions were not omitted from the scope  
42   of the Rule.

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

9 Section 2.1 contains additional guidance on the following:

- 10 • Commodity groups
- 11 • Complex assemblies
- 12 • Hypothetical failure
- 13 • Cascading

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

17 Table 2.3-1 provides examples of mechanical components scoping lessons learned from the  
18 review of the initial license renewal (LR) applications and the basis for their disposition.

#### 19 2.3.3.2 *Components Subject to an Aging Management Review*

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

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

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

1 Section 2.1 contains additional guidance on screening the following:

- 2 • Consumables
- 3 • Heat exchanger-intended functions
- 4 • Multiple functions

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

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

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

#### 14 **2.3.4 Evaluation Findings**

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

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

#### 25 **2.3.5 Implementation**

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

#### 32 **2.3.6 References**

33 None

<b>Example</b>	<b>Disposition</b>
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.

<b>Table 2.3-2. Examples of Mechanical Components Screening and Basis for Disposition</b>	
<b>Example</b>	<b>Disposition</b>
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.

<b>Table 2.3-3. Examples of Mechanical Component-Intended Functions</b>	
<b>Component</b>	<b>Intended Function*</b>
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.	

1

1 **2.4 Scoping and Screening Results: Structures**

2 **Review Responsibilities**

3 **Primary**—Assigned branch(es)

4 **Secondary**—None

5 **2.4.1 Areas of Review**

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

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

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

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

29 An applicant should list all plant-level systems and structures. On the basis of the design basis  
30 events (DBEs) considered in the plant’s current licensing basis (CLB) and other CLB information  
31 relating to nonsafety-related systems and structures and certain regulated events, the applicant  
32 should identify those plant-level systems and structures within the scope of SLR, as defined in  
33 10 CFR 54.4(a). This is “scoping” of the plant-level systems and structures for SLR. The NRC  
34 staff reviews the applicant’s plant-level “scoping” results separately following the guidance in  
35 Section 2.2.

36 For structures that are within the scope of SLR, an applicant must identify the SCs that are  
37 “passive” and “long-lived” in accordance with 10 CFR 54.21(a)(1)(i) and (ii). These “passive,”

1 “long-lived” SCs are subject to an AMR (“screening”). The applicant’s methodology  
2 implementation results for identifying SCs subject to an AMR is the area of review.

3 The applicant has the flexibility to determine the set of SCs for which an AMR is performed,  
4 provided that this set includes the SCs for which the NRC has determined that an AMR is  
5 required. This flexibility is described in the Statements of Consideration for the License Renewal  
6 Rule (60 FR 22478). Therefore, the reviewer should not focus the review on structural  
7 components that the applicant has already identified as subject to an AMR because it is  
8 an applicant’s option to include more SCs than those subject to an AMR, pursuant to  
9 10 CFR 54.21(a)(1). Rather, the reviewer should focus on those SCs that are not included by the  
10 applicant as subject to an AMR to ensure that they do not perform an intended function as defined  
11 in 10 CFR 54.4(b) or are not “passive” and “long-lived.”

## 12 **2.4.2 Acceptance Criteria**

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

### 17 *2.4.2.1 Structural Components Subject to an Aging Management Review*

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

- 19 • Safety-related systems, structures, and components that are relied upon to remain  
20 functional during and following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the  
21 following functions:
  - 22 — The integrity of the reactor coolant pressure boundary;
  - 23 — The capability to shut down the reactor and maintain it in a safe shutdown  
24 condition; or
  - 25 — The capability to prevent or mitigate the consequences of accidents that  
26 could result in potential offsite exposure comparable to the guidelines in  
27 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2), or 10 CFR 100.11, as applicable.
- 28 • All nonsafety-related systems, structures and components whose failure could prevent  
29 satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii),  
30 or (iii).
- 31 • All systems, structures, and components relied on in safety analyses or plant evaluations  
32 to perform a function that demonstrates compliance with NRC regulations for fire  
33 protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized  
34 thermal shock (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62), and  
35 station blackout (10 CFR 50.63).

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

1 **2.4.3 Review Procedures**

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

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

13 *2.4.3.1 Structural Components Within the Scope of Subsequent License Renewal*

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

26 *2.4.3.2 Structural Components Subject to an Aging Management Review*

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

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

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

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

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

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

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

- 26 • Commodity groups
- 27 • Hypothetical failure
- 28 • Cascading
- 29 • Consumables
- 30 • Multiple functions

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

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

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

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

1 **2.4.4 Evaluation Findings**

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

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

10 **2.4.5 Implementation**

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

17 **2.4.6 References**

- 18 1. NRC. NUREG-1211, "Regulatory Analysis for Resolution of Unresolved Safety Issue  
19 A-46, Seismic Qualification of Equipment in Operating Plants." Agencywide Documents  
20 Access and Management System (ADAMS) Accession No. ML0311503.  
21 Washington, DC: U.S. Nuclear Regulatory Commission. February 1987.
- 22 2. NRC. NUREG-0933, "Resolution of Generic Safety Issues." Supplement 34. ADAMS  
23 Accession No. ML11353A382. Washington, DC: U.S. Nuclear Regulatory Commission.  
24 December 2011.

<b>Table 2.4-1. Examples of Structural Components Scoping/Screening and Basis for Disposition</b>	
<b>Example</b>	<b>Disposition</b>
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	Groundwater leakage into the auxiliary building could occur as a result of degradation to the water-stops. This leakage may cause flooding of equipment within the scope of subsequent license renewal. (The plant's 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.

## 1 **2.5 Scoping and Screening Results: Electrical and Instrumentation and** 2 **Controls Systems**

### 3 **Review Responsibilities**

4 **Primary**—Assigned branch(es)

5 **Secondary**—None

### 6 **2.5.1 Areas of Review**

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

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

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

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

36 Under the “plant spaces” approach, an applicant would identify all “passive,” “long-lived” electrical  
37 equipment within a specified plant space as subject to an AMR, regardless of whether these  
38 components perform any intended functions. For example, an applicant could identify all  
39 “passive,” “long-lived” electrical equipment located within the turbine building (“plant space”) as  
40 subject to an AMR for SLR. In the subsequent AMR, the applicant would evaluate the  
41 environment of the turbine building to determine the appropriate aging management activities for  
42 this equipment. The applicant has options to further refine this encompassing scope on an

1 as-needed basis. For this example, if the applicant identified elevated temperatures in a particular  
2 area within the turbine building, the applicant may elect to further refine the scope in this particular  
3 area by (1) identifying electrical equipment that is not subject to an AMR and (2) excluding this  
4 equipment from the AMR. In this case, the excluded electrical equipment would be reported in the  
5 application as not being subject to an AMR.

6 10 CFR 54.21(a)(1)(i) provides many examples of electrical and I&C components that are not  
7 considered to be “passive” and are not subject to an AMR for SLR. Therefore, the applicant is  
8 expected to identify only a few electrical and I&C components, such as electrical penetrations,  
9 cables, and connections that are “passive” and subject to an AMR. However, the time-limited  
10 aging analysis (TLAA) evaluation requirements in 10 CFR 54.21(c) apply to environmental  
11 qualification of electrical equipment, which is not limited to “passive” components.

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

## 18 **2.5.2 Acceptance Criteria**

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

### 24 *2.5.2.1 Components Within the Scope of Subsequent License Renewal*

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

- 27 • Safety-related systems, structures, and components (SSCs) that are relied upon to remain  
28 functional during and following DBEs (as defined in 10 CFR 50.49(b)(1)) to ensure the  
29 following functions:
  - 30 — The integrity of the reactor coolant pressure boundary;
  - 31 — The capability to shut down the reactor and maintain it in a safe shutdown  
32 condition; or
  - 33 — The capability to prevent or mitigate the consequences of accidents that could  
34 result in potential offsite exposure comparable to the guidelines in  
35 10 CFR 50.34(a)(1), 10 CFR 50.67(b)(2) or 10 CFR 100.11, as applicable.
- 36 • All nonsafety-related SSCs whose failure could prevent satisfactory accomplishment of  
37 any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii) or (iii).

- 1 • All SSCs relied on in safety analyses or plant evaluations to perform a function that  
2 demonstrates compliance with NRC regulations for fire protection (10 CFR 50.48),  
3 environmental qualification (EQ) (10 CFR 50.49), pressurized thermal shock  
4 (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62), and station blackout  
5 (SBO) (10 CFR 50.63).

#### 6 2.5.2.1.1 *Components Within the Scope of SBO (10 CFR 50.63)*

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

- 9 • The onsite power system meeting the requirements under 10 CFR 54.4(a)(1)  
10 (safety-related systems).
- 11 • Equipment that is required to cope with an SBO (e.g., alternate ac power sources) meeting  
12 the requirements under 10 CFR 54.4(a)(3).
- 13 • The plant system portion of the offsite power system that is used to connect the plant to  
14 the offsite power source meeting the requirements under 10 CFR 54.4(a)(3). The  
15 electrical distribution equipment out to the first circuit breaker with the offsite distribution  
16 system (i.e., equipment in the switchyard). This path typically includes the circuit breakers  
17 that connect to the offsite system power transformers (startup transformers), the  
18 transformers themselves, the intervening overhead or underground circuits between circuit  
19 breaker and transformer and transformer and onsite electrical distribution system, and the  
20 associated control circuits and structures. However, the NRC staff's review is based on  
21 the plant-specific CLB, regulatory requirements, and offsite power design configurations.

#### 22 2.5.2.2 *Components Subject to an Aging Management Review*

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

### 27 **2.5.3 Review Procedures**

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

38 The reviewer should verify that an applicant has identified in the SLR application the electrical and  
39 I&C components that are subject to an AMR for its plant. The review procedures are presented  
40 below and assume that the applicant has performed "scoping" and "screening" of electrical and  
41 I&C system components in that sequence. However, the applicant may elect to perform

1 “screening” before “scoping,” which is acceptable because, regardless of the sequence, the end  
2 result should encompass the electrical and I&C components that are subject to an AMR.

3 Some of the electrical equipment that is in the scope of 10 CFR 50.49 that have a qualified life of  
4 40 years or greater are also within the scope of SLR under 10 CFR 54.4(a)(3). They have already  
5 been identified by licenses under 10 CFR 50.49(b). Licensees may rely upon their listing of EQ  
6 equipment, as required by 10 CFR 50.49(d), for the purposes of identifying electrical equipment  
7 satisfying 10 CFR 54.4(a)(3) that is also within the scope of 10 CFR 50.49 (60 FR 22466).  
8 However, the license renewal rule has a requirement (10 CFR 54.21(c)) on the evaluation of  
9 TLAAAs, including EQ (10 CFR 50.49). EQ equipment is not limited to “passive” equipment. The  
10 applicant may identify EQ equipment separately for TLAA evaluation and not include such  
11 equipment as subject to an AMR under 10 CFR 54.21(a)(1). The EQ equipment identified for  
12 TLAA evaluation would include the “passive” EQ equipment subject to an AMR. The TLAA  
13 evaluation would ensure that the EQ equipment would be functional for the subsequent period of  
14 extended operation. The NRC staff reviews the applicant’s EQ TLAA evaluation separately  
15 following the guidance in Section 4.4.

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

#### 17 2.5.3.1 *Components Within the Scope of Subsequent License Renewal*

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

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

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

41 The applicant would use the “plant spaces” approach for the subsequent AMR of the electrical  
42 and I&C components. The applicant would evaluate the environment of the “plant spaces” to  
43 determine the appropriate aging management activities for equipment located there. The  
44 applicant has the option to further refine this encompassing scope on an as-needed basis. For

1 example, if the applicant identified elevated temperatures in a particular area within a building  
2 (“plant space”), the applicant may elect to identify only those “passive,” “long-lived” electrical and  
3 I&C components that perform an intended function in this particular area as subject to an AMR.  
4 This approach of limiting the “plant spaces” is consistent with the “plant spaces” approach. In this  
5 case, the reviewer verifies that the applicant has specifically identified the electrical and I&C  
6 components that may be within the scope of SLR in these limited “plant spaces.” The reviewer  
7 should verify that the electrical and I&C components that the applicant has elected to further  
8 exclude do not indeed have any intended functions as defined in 10 CFR 54.4(b).

9 Section 2.1 contains additional guidance on scoping the following:

- 10 • Commodity groups
- 11 • Complex assemblies
- 12 • Scoping events
- 13 • Hypothetical failure
- 14 • Cascading

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

#### 18 2.5.3.2 *Components Subject to an Aging Management Review*

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

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

35 Section 2.1 contains additional guidance on screening the following:

- 36 • Consumables
- 37 • Multiple intended functions

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

1 **2.5.4 Evaluation Findings**

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

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

10 **2.5.5 Implementation**

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

17 **2.5.6 References**

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

<b>Table 2.5-1. Examples of “Plant Spaces” Approach for Electrical and I&amp;C Scoping and Corresponding Review Procedures</b>	
<b>Example</b>	<b>Review Procedures</b>
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.

1

# 3 AGING MANAGEMENT REVIEW

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

### Review Responsibilities

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

**Secondary**—None

### 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 Boiler and Pressure Vessel Code (ASME Code) Class 1 component. The connected systems for PWRs include the residual heat removal or low pressure injection system, core flood spray or safety injection tank, chemical and volume control system or high-pressure injection system, and sampling system.

The responsible review organization is to review the following subsequent license renewal application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

### AMRs

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

1 **AMPs**

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

- 3 • Plant-specific AMPs

4 **FSAR Supplement**

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

7 **3.1.2 Acceptance Criteria**

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

11 **3.1.2.1 *Aging Management Review Results Consistent With the Generic Aging Lessons***  
12 ***Learned for Subsequent License Renewal Report***

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

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

23 **3.1.2.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by***  
24 ***the Generic Aging Lessons Learned for Subsequent License Renewal Report***

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

31 **3.1.2.2.1 *Cumulative Fatigue Damage***

32 Evaluations involving time-dependent fatigue or cyclical loading parameters may be time-limited  
33 aging analyses (TLAAs), as defined in 10 CFR 54.3. TLAAs are required to be evaluated in  
34 accordance with 10 CFR 54.21(c)(1). These types of TLAAs are addressed separately in  
35 Section 4.3, "Metal Fatigue," of this SRP-SLR Report. For plant-specific cumulative usage factor  
36 calculations that are based on stress-based input methods, the methods are to be appropriately  
37 defined and discussed in the applicable TLAAs.

1 3.1.2.2.2 *Loss of Material Due to General, Pitting, and Crevice Corrosion*

2 1. Loss of material due to general, pitting, and crevice corrosion could occur in the steel  
3 PWR SG upper and lower shell and transition cone exposed to secondary feedwater and  
4 steam. The existing program relies on control of water chemistry to mitigate corrosion  
5 and inservice inspection (ISI) to detect loss of material. The extent and schedule of the  
6 existing SG inspections are designed to ensure that flaws cannot attain a depth sufficient  
7 to threaten the integrity of the welds. However, according to NRC Information Notice  
8 (IN) 90-04, "Cracking of the Upper Shell-to-Transition Cone Girth Welds in Steam  
9 Generators," the program may not be sufficient to detect pitting and crevice corrosion if  
10 general and pitting corrosion of the shell is known to exist. Augmented inspection is  
11 recommended to manage this aging effect. Furthermore, this issue is limited to  
12 Westinghouse Model 44 and 51 Steam Generators, where a high-stress region exists at  
13 the shell to transition cone weld. Acceptance criteria are described in Branch Technical  
14 Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

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

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

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

1 3.1.2.2.3 *Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement*

2 1. Neutron irradiation embrittlement is a TLAA to be evaluated for the subsequent period of  
3 extended operation for all ferritic materials that have a neutron fluence greater than  
4  $10^{17}$  n/cm<sup>2</sup> (E >1 MeV) at the end of the subsequent period of extended operation.  
5 Certain aspects of neutron irradiation embrittlement are TLAAs as defined in  
6 10 CFR 54.3. TLAAs are required to be evaluated in accordance with  
7 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.2, "Reactor Vessel  
8 Neutron Embrittlement Analysis," of this SRP-SLR Report.

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

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

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

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

35 3.1.2.2.4 *Cracking Due to Stress Corrosion Cracking and Intergranular Stress*  
36 *Corrosion Cracking*

37 1. Cracking due to stress corrosion cracking (SCC) and intergranular stress corrosion  
38 cracking (IGSCC) could occur in stainless steel (SS) and nickel alloy reactor vessel (RV)  
39 flange leak detection lines of BWR light-water reactor facilities. The plant-specific  
40 operating experience (OE) and condition of the RV flange leak detection lines are  
41 evaluated to determine if SCC or IGSCC has occurred. The aging effect of cracking in  
42 SS and nickel alloy RV flange leak detection lines is not applicable and does not require  
43 management if: (a) the plant-specific OE does not reveal a history of SCC or IGSCC  
44 and (b) a one-time inspection demonstrates that the aging effect is not occurring. The

1 applicant documents the results of the plant-specific OE review in the SLRA. GALL-SLR  
2 Report AMP XI.M32, "One-Time Inspection," describes an acceptable program to  
3 demonstrate that cracking is not occurring. If cracking has occurred, GALL-SLR Report  
4 AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," describes an  
5 acceptable program to manage cracking in RV flange leak detection lines.

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

15 3.1.2.2.5 *Crack Growth Due to Cyclic Loading*

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

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

25 3.1.2.2.6 *Cracking Due to Stress Corrosion Cracking*

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

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

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<sup>2</sup>Refer to the GALL-SLR Report, Chapter I, for applicability of other editions of the ASME Code, Section XI.

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

#### 12 3.1.2.2.7 *Cracking Due to Cyclic Loading*

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

#### 20 3.1.2.2.8 *Loss of Material Due to Erosion*

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

#### 25 3.1.2.2.9 *Aging Management of Pressurized Water Reactor Vessel Internals (Applicable to* 26 *Subsequent License Renewal Periods Only)*

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

41 The EPRI MRP's functionality analysis and failure modes, effects, and criticality analysis bases for  
42 grouping Westinghouse-designed, B&W-designed and Combustion Engineering (CE)-designed  
43 RVI components into these inspection categories was based on an assessment of aging effects  
44 and relevant time-dependent aging parameters through a cumulative 60-year licensing period

1 (i.e., 40 years for the initial operating license period plus an additional 20 years during the initial  
2 period of extended operation). The EPRI MRP has not assessed whether operation of  
3 Westinghouse-designed, B&W-designed and CE-designed reactors during an SLR operating  
4 period would have any impact on the existing susceptibility rankings and inspection  
5 categorizations for the RVI components in these designs, as defined in MRP-227-A or its  
6 applicable MRP background documents (e.g., MRP-191 for Westinghouse-designed or  
7 CE-designed RVI components or MRP-189 for B&W-designed components).

8 As described in GALL-SLR Report AMP XI.M16A, the applicant may use the MRP-227-A based  
9 AMP as an initial reference basis for developing and defining the AMP that will be applied to the  
10 RVI components for the subsequent period of extended operation. However, to use this  
11 alternative basis, GALL-SLR Report AMP XI.M16A recommends that the MRP-227-A based AMP  
12 be enhanced to include a gap analysis of the components that are within the scope of the AMP.  
13 The gap analysis is a basis for identifying and justifying changes to the MRP-227-A based  
14 program that are necessary to provide reasonable assurance that the effects of age-related  
15 degradation will be managed during the subsequent period of extended operation. The criteria for  
16 the gap analysis are described in GALL-SLR Report AMP XI.M16A.

17 Alternatively, the PWR SLRA may define a plant-specific AMP for the RVI components to  
18 demonstrate that the RVI components will be managed in accordance with the requirements of  
19 10 CFR 54.21(a)(3) during the proposed subsequent period of extended operation. Components  
20 to be inspected, parameters monitored, monitoring methods, inspection sample size, frequencies,  
21 expansion criteria, and acceptance criteria are justified in the SLRA. The NRC staff will assess  
22 the adequacy of the plant-specific AMP against the criteria for the 10 AMP program elements that  
23 are defined in Section A.1.2.3 of SRP-SLR Appendix A.1.

#### 24 3.1.2.2.10 *Loss of Material Due to Wear*

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

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

1 3.1.2.2.11 *Cracking Due to Primary Water Stress Corrosion Cracking*

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

8 All but one of these instances of cracking has been detected in divider plate assemblies  
9 that are approximately 1.3 inches in thickness. For the cracks in the 1.3-inch thick divider  
10 plate assemblies, the cracks tend to be parallel to the divider-plate-to-stub-runner weld  
11 (i.e., run horizontally in parallel to the lower surface of the tubesheet). For the one  
12 instance of cracking in a divider plate assembly with a thickness greater than 1.3 inches,  
13 the cracking occurred in a divider plate assembly with a thickness of approximately  
14 2.4 inches near manufacturing marks on the upper end of the stub runner used for locating  
15 tubesheet holes. These flaws were estimated to be approximately 0.08-inch deep.

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

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

- 29 • For units with divider plate assemblies fabricated of Alloy 690 and Alloy 690 type  
30 weld materials, a plant-specific AMP is not necessary.
- 31 • For units with divider plate assemblies fabricated of Alloy 600 or Alloy 600 type  
32 weld materials, if the analyses performed by the industry (EPRI 3002002850) are  
33 applicable and bounding for the unit, a plant-specific AMP is not necessary.
- 34 • For units with divider plate assemblies fabricated of Alloy 600 or Alloy 600 type  
35 weld materials, if the industry analyses (EPRI 3002002850) are not bounding for  
36 the applicant's unit, a plant-specific AMP is necessary or a rationale is necessary  
37 for why such a program is not needed. A plant-specific AMP (one beyond the  
38 primary water chemistry and the steam generator programs) may include a  
39 one-time inspection that is capable of detecting cracking to verify the effectiveness  
40 of the water chemistry and steam generator programs and the absence of PWSCC  
41 in the divider plate assemblies.

42 The existing programs rely on control of reactor water chemistry to mitigate cracking  
43 due to PWSCC and general visual inspections of the channel head interior surfaces

1 (included as part of the steam generator program). The GALL-SLR Report recommends  
2 further evaluation for a plant-specific AMP to confirm the effectiveness of the primary  
3 water chemistry and steam generator programs as described in this section. Acceptance  
4 criteria for a plant-specific AMP are described in BTP RLSB-1 (Appendix A.1 of this  
5 SRP-SLR). In place of a plant-specific AMP, the applicant may provide a rationale to  
6 justify why a plant-specific AMP is not necessary.

7 2. Cracking due to PWSCC could occur in SG nickel alloy tube-to-tubesheet welds  
8 exposed to reactor coolant. The acceptance criteria for this review are:

- 9 • For units with Alloy 600 SG tubes for which an alternate repair criterion such as C\*,  
10 F\*, H\*, or W\* has been permanently approved for both the hot- and cold-leg side of  
11 the steam generator, the weld is no longer part of the reactor coolant pressure  
12 boundary and a plant-specific AMP is not necessary;
- 13 • For units with Alloy 600 steam generator tubes, if there is no permanently  
14 approved alternate repair criteria such as C\*, F\*, H\*, or W\*, or permanent  
15 approval applies to only either the hot- or cold-leg side of the steam generator,  
16 a plant-specific AMP is necessary;
- 17 • For units with thermally treated Alloy 690 SG tubes and with tubesheet cladding  
18 using Alloy 690 type material, a plant-specific AMP is not necessary;
- 19 • For units with thermally treated Alloy 690 SG tubes and with tubesheet cladding  
20 using Alloy 600 type material, a plant-specific AMP is necessary unless the  
21 applicant confirms that the industry's analyses for tube-to-tubesheet weld cracking  
22 (e.g., chromium content for the tube-to-tubesheet welds is approximately  
23 22 percent and the tubesheet primary face is in compression as discussed in  
24 EPRI 3002002850) are applicable and bounding for the unit, and the applicant will  
25 perform general visual inspections of the tubesheet region looking for evidence of  
26 cracking (e.g., rust stains on the tubesheet cladding) as part of the steam  
27 generator program. In lieu of a plant-specific AMP, the applicant may provide a  
28 rationale for why a plant-specific AMP is not necessary.

29 The existing programs rely on control of reactor water chemistry to mitigate cracking due  
30 to PWSCC and visual inspections of the steam generator head interior surfaces. Along  
31 with the primary water chemistry and steam generator programs, a plant-specific AMP  
32 should be evaluated to confirm the effectiveness of the primary water chemistry and  
33 steam generator programs in certain circumstances. A plant-specific AMP may include  
34 a one-time inspection that is capable of detecting cracking to confirm the absence of  
35 PWSCC in the tube-to-tubesheet welds. Acceptance criteria for a plant-specific  
36 AMP are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR). In place of a  
37 plant-specific AMP, the applicant may provide a rationale to justify why a plant-specific  
38 AMP is not necessary.

1 3.1.2.2.12 *Cracking Due to Irradiation-Assisted Stress Corrosion Cracking*

2 GALL-SLR Report AMP XI.M9, "BWR Vessel Internals," manages aging degradation of nickel  
3 alloy and SS, including associated welds, which are used in BWR vessel internal components.  
4 When exposed to the BWR vessel environment, these materials can experience cracking due to  
5 IASCC. The existing Boiling Water Reactor Vessel and Internals Project (BWRVIP) examination  
6 guidelines are mainly based on aging evaluation of BWR vessel internals for operation up to  
7 60 years. However, increases in neutron fluence during the SLR term may need to be assessed  
8 for supplemental inspections of BWR vessel internals to adequately manage cracking due to  
9 IASCC. Therefore, the applicant should perform an evaluation to determine whether  
10 supplemental inspections are necessary in addition to those recommended in the existing  
11 BWRVIP examination guidelines. If the applicant determines that supplemental inspections are  
12 not necessary, the applicant should provide adequate technical justification for the determination.  
13 If supplemental inspections are determined necessary for BWR vessel internals, the applicant  
14 identifies the components to be inspected and performs supplemental inspections to adequately  
15 manage IASCC. In addition, the applicant should confirm the adequacy of any necessary  
16 supplemental inspections and enhancements to the BWRVIP.

17 3.1.2.2.13 *Loss of Fracture Toughness Due to Neutron Irradiation or Thermal*  
18 *Aging Embrittlement*

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

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

38 3.1.2.2.14 *Loss of Preload Due to Thermal or Irradiation-Enhanced Stress Relaxation*

39 GALL-SLR Report AMP XI.M9 manages loss of preload due to thermal or irradiation-enhanced  
40 stress relaxation in BWR core plate rim holddown bolts. The issue is applicable to BWR-designed  
41 light water reactors that employ rim holddown bolts as the means for protecting the reactor's core  
42 plate from the consequences of lateral movement. The potential for such movement, if left  
43 unmanaged, could impact the ability of the reactor to be brought to a safe shutdown condition  
44 during an anticipated transient occurrence or during a postulated design-basis accident or seismic  
45 event. This issue is not applicable to BWR reactor designs that use wedges as the means of

1 precluding lateral movement of the core plate because the wedges are fixed in place and are not  
2 subject to this type of aging effect and mechanism combination.

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

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

25 *3.1.2.2.15 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
26 *Stress Corrosion Cracking*

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

40 If the following conditions are met, loss of material is not considered to be an applicable aging  
41 effect for steel: (a) attributes of the concrete are consistent with American Concrete Institute  
42 (ACI) 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment)  
43 as cited in NUREG-1557; (b) plant-specific OE indicates no degradation of the concrete that  
44 could lead to penetration of water to the metal surface; and (c) the piping is not potentially  
45 exposed to groundwater. For SS components loss of material and cracking due to SCC are not  
46 considered to be applicable aging effects as long as the piping is not potentially exposed to

1 groundwater. Where these conditions are not met, loss of material due to general (steel only),  
2 crevice or pitting corrosion and cracking due to SCC (SS only) are identified as applicable aging  
3 effects. GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes  
4 an acceptable program to manage these aging effects.

5 *3.1.2.2.16 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
6 *Nickel Alloys*

7 Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and  
8 nickel alloy piping, piping components, and tanks exposed to any air, condensation, or  
9 underground environment when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity  
10 of insulated components; or (d) in the vicinity of potentially transportable halogens. Loss of  
11 material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments  
12 containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

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

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

31 The GALL-SLR Report recommends further evaluation of SS and nickel alloy piping and piping  
32 components exposed to an air, condensation, or underground environment to determine whether  
33 an AMP is needed to manage the aging effect of loss of material due to pitting and crevice  
34 corrosion. GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an acceptable  
35 program to demonstrate that loss of material due to pitting and crevice corrosion is not occurring  
36 at a rate that will affect the intended function of the components. If loss of material due to pitting  
37 or crevice corrosion has occurred and is sufficient to potentially affect the intended function of an  
38 SSC, GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components,"  
39 describes an acceptable program to manage loss of material due to pitting or crevice corrosion.  
40 The timing of the one-time or periodic inspections is consistent with that recommended in the  
41 AMP selected by the applicant during the development of the SLRA. For example, one-time  
42 inspections would be conducted between the 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by  
43 the "detection of aging effects" program element in AMP XI.M32.

1 The applicant may establish that loss of material due to pitting and crevice corrosion is not an  
2 aging effect requiring management by demonstrating that a barrier coating isolates the component  
3 from aggressive environments. Acceptable barriers include coatings that have been  
4 demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides.  
5 If a barrier coating is credited for isolating a component from a potentially aggressive environment,  
6 then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment.  
7 GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping  
8 Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the  
9 integrity of a barrier coating.

10 *3.1.2.2.17 Quality Assurance for Aging Management of Nonsafety-Related Components*

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

12 *3.1.2.2.18 Ongoing Review of Operating Experience*

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

15 *3.1.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
16 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

18 *3.1.2.4 Aging Management Programs*

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

25 If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
26 Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of  
27 10 CFR 54.21(a)(3) would still be met. The reviewer should then confirm that the SLRA AMP with  
28 all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the SLRA AMP,  
29 the reviewer identifies a difference between the SLRA AMP and the GALL-SLR Report AMP that  
30 should have been identified as an exception to the GALL-SLR Report AMP, the difference should  
31 be reviewed and properly dispositioned. The reviewer should document the disposition of all  
32 SLRA-defined exceptions and NRC staff-identified differences.

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

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

4 **3.1.2.5 Final Safety Analysis Report Supplement**

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

14 **3.1.3 Review Procedures**

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

16 **3.1.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons**  
17 **Learned for Subsequent License Renewal Report**

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

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

32 **3.1.3.2 Aging Management Review Results for Which Further Evaluation Is Recommended by**  
33 **the Generic Aging Lessons Learned for Subsequent License Renewal Report**

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

1 3.1.3.2.1 *Cumulative Fatigue Damage*

2 Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAAs,  
3 as defined in 10 CFR 54.3. TLAAAs are required to be evaluated in accordance with  
4 10 CFR 54.21(c)(1).

5 The staff reviews the information on a case-by-case basis consistent with the review procedures  
6 in SRP-SLR Section 4.3 to determine whether the applicant has provided a sufficient basis for  
7 dispositioning the TLAAAs in accordance with the acceptance criteria in 10 CFR 54.21(c)(1)(i), (ii),  
8 or (iii). This includes staff's review of those cumulative usage factor analyses that qualify as  
9 TLAAAs and are based on plant-specific, stress-based calculation methods.

10 3.1.3.2.2 *Loss of Material Due to General, Pitting, and Crevice Corrosion*

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

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

44 The reviewer verifies that the applicant has described the surface condition and the  
45 resultant flow near the new transition cone closure weld (e.g., weld crown, ground flush,

1 etc.) and how these parameters could affect the susceptibility of this weld to this aging  
2 effect, relative to that of the upper and lower transition welds. Based on this information,  
3 the reviewer verifies whether any additional aging management of the new transition weld  
4 is necessary. If additional aging management is necessary, the reviewer verifies whether  
5 the applicant has described an AMP of the new transition cone closure weld (including  
6 examination frequency and technique) that will be effective in managing an aging effect,  
7 such as the loss of material due to general, pitting, and crevice corrosion during the  
8 subsequent period of extended operation for the new transition cone closure weld.

9 **3.1.3.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement**

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

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

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

35 3. Reduction in Fracture Toughness for B&W reactor internals is a TLAA as defined  
36 in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with  
37 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this TLAA following the  
38 guidance in Section 4.7 of this SRP-SLR consistent with the action item documented in  
39 the NRC staff's safety evaluation for B&W Owners Group report number BAW-2248,  
40 which is included in BAW-2248A, March 2000.

41 **3.1.3.2.4 Cracking Due to Stress Corrosion Cracking and Intergranular Stress**  
42 **Corrosion Cracking**

43 1. Cracking due to SCC and IGSCC could occur in stainless steel and nickel alloy RV  
44 flange leak detection lines of BWR light-water reactor facilities. The reviewer

1 independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If  
2 the review of plant-specific OE reveals that SCC and IGSCC is not applicable, the  
3 reviewer verifies that AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR  
4 line items. If the review of plant-specific OE reveals that SCC or IGSCC is applicable,  
5 the reviewer verifies that GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring  
6 of Mechanical Components," is cited for all applicable AMR line items. The reviewer  
7 should ensure that the inspection method proposed for the inspection of the components  
8 is capable of providing indications of cracking prior to a loss of intended function in  
9 the lines.

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

18 3.1.3.2.5 *Crack Growth Due to Cyclic Loading*

19 Further evaluation is recommended of programs to manage crack growth due to cyclic loading in  
20 reactor vessel shell forgings clad with SS using a high-heat-input welding process. Growth  
21 of intergranular separations (underclad cracks) in the heat affected zone under austenitic SS  
22 cladding is a TLAA to be evaluated for the subsequent period of extended operation for all the  
23 SA-508-CI-2 forgings where the cladding was deposited with a high-heat-input welding process.  
24 The methodology for evaluating the underclad flaw should be consistent with the current  
25 well-established flaw evaluation procedure and criterion in the ASME Code Section XI. The  
26 SRP-SLR, Section 4.7 provides generic guidance for meeting the requirements of  
27 10 CFR 54.21(c). The NRC staff reviews the evaluation of this TLAA separately following the  
28 guidance in Section 4.7 of this SRP-SLR Report.

29 3.1.3.2.6 *Cracking Due to Stress Corrosion Cracking*

- 30 1. A plant-specific AMP should be evaluated to manage cracking due to SCC in PWR SS  
31 bottom-mounted instrument guide tubes exposed to reactor coolant. The reviewer  
32 reviews the applicant's proposed program on a case-by-case basis to ensure that an  
33 adequate program will be in place for the management of these aging effects.
- 34 2. A plant-specific AMP should be evaluated to manage cracking due to SCC in CASS  
35 PWR Class 1 reactor coolant system piping and piping components exposed to reactor  
36 coolant that do not meet the carbon and ferrite content guidelines of NUREG-0313. The  
37 reviewer reviews the applicant's proposed program on a case-by-case basis to ensure  
38 that an adequate program will be in place for the management of these aging effects.
- 39 3. Cracking due to SCC could occur in SS or nickel alloy RV flange leak detection lines of  
40 PWR light-water reactor facilities. The reviewer independently verifies the sufficiency of  
41 the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals  
42 that SCC is not applicable, the reviewer verifies that AMP XI.M32, "One-Time  
43 Inspection," is cited for all applicable AMR line items. If the review of plant-specific OE  
44 reveals that SCC is applicable, the reviewer verifies that GALL-SLR Report

1 AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," is cited for all  
2 applicable AMR line items. The reviewer should ensure that the inspection method  
3 proposed for the inspection of the components is capable of providing indications of  
4 cracking prior to a loss of intended function in the lines.

5 3.1.3.2.7 *Cracking Due to Cyclic Loading*

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

16 3.1.3.2.8 *Loss of Material Due to Erosion*

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

22 3.1.3.2.9 *Aging Management of PWR Reactor Vessel Internals (Applicable to Subsequent*  
23 *License Renewal Periods Only)*

24 EPRI TR-1022863, "Materials Reliability Program: Pressurized Water Reactor Internals  
25 Inspection and Evaluation Guidelines (MRP-227-A)" (ADAMS Accession Nos. ML12017A191  
26 through ML12017A197 and ML12017A199), provides the industry's current aging management  
27 recommendations for the RVI components that are included in the design of a PWR facility, based  
28 on an analysis of plant operation for 60 years. In this report, the EPRI MRP identified that the  
29 following aging mechanisms may be applicable to the design of the RVI components in these  
30 types of facilities: (a) SCC, (b) IASCC, (c) fatigue, (d) wear, (e) neutron irradiation embrittlement,  
31 (f) thermal aging embrittlement, (g) void swelling and irradiation growth, or (h) thermal or  
32 irradiation-enhanced stress relaxation or irradiation enhanced creep. The methodology in  
33 MRP-227-A was approved by the NRC in a safety evaluation dated December 16, 2011 (ADAMS  
34 Accession No. ML11308A770), which includes those plant-specific applicant/licensee action items  
35 that a licensee or applicant applying the MRP-227-A report would need to address and resolve  
36 and apply to its licensing basis.

37 The assessments of RVI components in the MRP-227-A report and the MRP-defined background  
38 reports for MRP-227-A have not been updated based on an assessment of aging effects over an  
39 80-year operating period.

40 If a plant-specific AMP is proposed for the RVI components, the reviewer evaluates the adequacy  
41 of the applicant's AMP on a case-by-case basis against the criteria for plant-specific AMP  
42 program elements defined in Sections A.1.2.3.1 through A.1.2.3.10 of SRP-SLR Appendix A.1.  
43 The reviewer verifies that the applicant has defined both the type of performance monitoring,

1 condition monitoring, preventative monitoring, or mitigative monitoring AMP that will be used for  
2 aging management of the RVI components and the specific program element criteria for the AMP  
3 that will be used to manage age-related effects in the RVI components during the subsequent  
4 period of extended operation.

5 If a PWR applicant for SLR proposes to use GALL-SLR Report AMP XI.M16A, "PWR Vessel  
6 Internals," as the basis for aging management, the staff reviews the program elements of the AMP  
7 against the program element criteria defined in AMP XI.M16A. The staff verifies that the proposed  
8 program includes a gap analysis that provides the identification and justification of:

- 9 • Components that screen in for additional aging effects or mechanisms when assessed  
10 for aging through the end of the subsequent period of extended operation
- 11 • Components that previously screened in for an aging effect or mechanism and the  
12 severity of that aging effect or mechanism could significantly increase during the  
13 subsequent period of extended operation
- 14 • Changes to the existing MRP-227-A program characteristics or criteria, including but not  
15 limited to changes in inspection categories, inspection criteria, or primary-to-expansion  
16 component criteria and relationships

17 The staff evaluates the adequacy and justification of the gap analysis, specifically:

- 18 • The gap analysis methodology
- 19 • The components that screened in for additional aging effects or mechanisms when  
20 assessed for aging through the end of the subsequent period of extended operation
- 21 • The components for which a previously screened in aging effect or mechanism has been  
22 identified as potentially more severe during the subsequent period of extended operation
- 23 • Proposed changes to the aging management program characteristics or criteria  
24 identified in the SLRA

25 For those RVI components that screened in for additional aging effects or mechanisms, the  
26 staff also confirms that the applicant has included and justified appropriate AMR line items for  
27 the components.

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

### 32 *3.1.3.2.10 Loss of Material Due to Wear*

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

1 analysis for aging management. The reviewer also confirms whether inspections are necessary  
2 to ensure the adequacy of the analysis.

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

#### 9 *3.1.3.2.11 Cracking Due to Primary Water Stress Corrosion Cracking*

10 A plant-specific AMP should be evaluated, along with the primary water chemistry and steam  
11 generator programs, to manage cracking due to PWSCC in nickel alloy divider plate assemblies.  
12 For divider plate assemblies fabricated of Alloy 690 and Alloy 690 type welding materials, a  
13 plant-specific AMP is not necessary. For divider plate assemblies made of Alloy 600 or Alloy 600  
14 type welding materials, the reviewer verifies that the applicant has an adequate basis for  
15 concluding that the analyses performed by the industry (EPRI 3002002850) assessing the  
16 significance of divider plate cracking are applicable and bounding for the conditions at its unit. If  
17 the industry's analyses are not bounding, the reviewer evaluates the applicant's plant-specific  
18 AMP on a case-by-case basis to ensure that an adequate plant-specific AMP will be in place for  
19 the management of this aging effect or the reviewer reviews the applicant's rationale (e.g., a more  
20 detailed plant-specific evaluation than performed by the industry) for why such a plant-specific  
21 AMP is not necessary.

22 A plant-specific AMP should be evaluated, along with the primary water chemistry and steam  
23 generator programs, to manage cracking due to PWSCC in nickel alloy steam generator tube-to-  
24 tubesheet welds exposed to reactor coolant. The reviewer verifies the combination of materials of  
25 construction of the steam generator tubes and tubesheet cladding and the classification of the  
26 tube-to-tubesheet weld (i.e., whether it is part of the reactor coolant pressure boundary). If the  
27 combination and classification requires a plant-specific AMP, the reviewer reviews the applicant's  
28 proposed program on a case-by-case basis to ensure adequate management of this aging effect.  
29 Alternatively, the reviewer evaluates applicant's rationale for why a plant-specific AMP is not  
30 necessary.

#### 31 *3.1.3.2.12 Cracking Due to Irradiation-Assisted Stress Corrosion Cracking*

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

1 3.1.3.2.13 *Loss of Fracture Toughness Due to Neutron Irradiation or Thermal Aging*  
2 *Embrittlement*

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

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

16 3.1.3.2.14 *Loss of Preload Due to Thermal or Irradiation-Enhanced Stress Relaxation*

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

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

38 For SLRAs that apply to BWRs with core plate rim holddown bolts, the reviewer assesses whether  
39 the SLRA has included an enhanced augmented inspection basis for plants' core plate rim  
40 holddown bolts as applicable, and has justified the augmented inspection basis that will be applied  
41 to the components, as appropriate. If an existing NRC-approved analysis for the bolts exists in  
42 the CLB and conforms to the definition of a TLAA, the reviewer assesses whether the applicant  
43 has identified the analysis as a TLAA for the SLRA and has demonstrated why the analysis is  
44 acceptable in accordance with either 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, if a new  
45 analysis will be performed to support an updated 80-year augmented inspection basis for the bolts

1 for the subsequent period of extended operation, the NRC staff reviews the applicant's  
2 augmented inspection and evaluation basis to determine whether the FSAR Supplement for the  
3 SLRA has included a license commitment to submit both the inspection plan and the supporting  
4 loss of preload analysis to the NRC staff at least 2 years prior to entering into the subsequent  
5 period of extended operation for the facility.

6 *3.1.3.2.15 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
7 *Stress Corrosion Cracking*

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

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

24 *3.1.3.2.16 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
25 *Nickel Alloys*

26 The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting  
27 and crevice corrosion of SS and nickel alloy piping and piping components exposed to any air,  
28 condensation, or underground environment when the component is: (a) uninsulated;  
29 (b) insulated; (c) in the vicinity of insulated components where the presence of sufficient  
30 halides (e.g., chlorides) and moisture is possible; or (d) in the vicinity of potentially  
31 transportable halogens.

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

37 An applicant may refine its OE search, and subsequent one time inspections, by binning  
38 plant-specific environments into subcategories. For example, the applicant could categorize the  
39 indoor air locations as those where leakage could impinge on the SS component's surface  
40 (e.g., leakage from mechanical connections) and those where there is not a potential for leakage.  
41 When the applicant chooses to conduct its OE search in this manner, the reviewer is to also  
42 confirm that the applicant has adequately addressed the potential for the periodic introduction of  
43 either moisture or halides from secondary sources. Secondary sources of moisture or halides  
44 should be considered for all environments including indoor conditioned air. Typical secondary

1 sources of moisture or halides include: leakage from mechanical connections, leakage into  
2 vaults, and insulation containing halides. Grouping of environments consistent with that described  
3 in the detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection  
4 of Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

5 *3.1.3.2.17 Quality Assurance for Aging Management of Nonsafety-Related Components*

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

16 *3.1.3.2.18 Ongoing Review of Operating Experience*

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

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

27 *3.1.3.3 Aging Managing Review Results Not Consistent With or Not Addressed in the Generic*  
28 *Aging Lessons Learned for Subsequent License Renewal Report*

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

34 *3.1.3.4 Aging Management Programs*

35 The reviewer confirms that the applicant has identified the appropriate AMPs as described and  
36 evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its  
37 SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this  
38 enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR  
39 Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program  
40 elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the  
41 exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not  
42 identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP, with which the

1 SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference  
2 satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting  
3 enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report  
4 pertinent to the reactor vessel, internals, and reactor coolant system are summarized in  
5 Table 3.1-1 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in  
6 the GALL-SLR Report, Chapter IV, presenting detailed information summarized by this row.

#### 7 3.1.3.5 *Final Safety Analysis Report Supplement*

8 The reviewer confirms that the applicant has provided in its FSAR Supplement information for  
9 aging management of the reactor vessel, internals, and reactor coolant system. Table 3.1-2 lists  
10 the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the  
11 applicant has provided information for Subsection 3.1.3.3, "Aging Management Review Results  
12 Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent  
13 License Renewal Report."

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

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

#### 27 **3.1.4 Evaluation Findings**

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

31 On the basis of its review, as discussed above, the NRC staff concludes that the  
32 applicant has demonstrated that the aging effects associated with the reactor  
33 vessel, internals, and reactor coolant system components will be adequately  
34 managed so that the intended functions will be maintained consistent with the  
35 CLB for the subsequent period of extended operation, as required by  
36 10 CFR 54.21(a)(3).

37 The NRC staff also reviewed the applicable FSAR Supplement program  
38 summaries and concludes that they adequately describe the AMPs credited for  
39 managing aging of the reactor vessel, internals and reactor coolant system, as  
40 required by 10 CFR 54.21(d).

### 1 3.1.5 Implementation

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

### 7 3.1.6 References

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	001	BWR/PWR	Steel reactor vessel closure flange assembly components exposed to air-indoor uncontrolled	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.RP-201 IV.A2.RP-54
M	002	PWR	Nickel alloy tubes and sleeves exposed to reactor coolant, secondary feedwater/steam	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.D1.R-46 IV.D2.R-46
M	003	BWR/PWR	Stainless steel, nickel alloy reactor vessel internal components exposed to reactor coolant, neutron flux	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.B1.R-53 IV.B2.RP-303 IV.B3.RP-339 IV.B4.R-53
M	004	BWR/PWR	Steel pressure vessel support skirt and attachment welds	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.R-70 IV.A2.R-70
M	005	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, cyclic 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	006	BWR	Stainless steel, steel (with or without nickel alloy or stainless steel cladding), nickel alloy reactor coolant pressure boundary components: piping, piping components; other pressure retaining components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C1.R-220

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	007	BWR	Stainless steel, steel (with or without nickel alloy or stainless steel cladding), 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, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A1.R-04
M	008	PWR	Stainless steel, steel (with or without nickel alloy or stainless steel cladding), nickel alloy steam generator components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.D1.R-221 IV.D2.R-222
M	009	PWR	Stainless steel, steel (with or without nickel alloy or stainless steel cladding), nickel alloy reactor coolant pressure boundary piping, piping components; other pressure retaining components exposed to reactor coolant	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C2.R-223
M	010	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, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.A2.R-219

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	011	BWR/PWR	Steel or stainless steel pump and valve closure bolting exposed to high temperatures and thermal cycles	Cumulative fatigue damage: cracking due to fatigue, cyclic loading	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.1.2.2.1)	IV.C1.RP-44 IV.C2.RP-44
E	012	PWR	Steel steam generator components: upper and lower shells, transition cone; new transition cone closure weld exposed to secondary feedwater or steam	Loss of material due to general, pitting, crevice corrosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Sections 3.1.2.2.1 and 3.1.2.2.2)	IV.D1.RP-368
M	013	BWR/PWR	Steel (with or without stainless steel or nickel alloy cladding) reactor vessel beltline shell, nozzle, and weld components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, SRP-SLR Section 4.2 "Reactor Vessel Neutron Embrittlement"	Yes (SRP-SLR Section 3.1.2.2.3.1)	IV.A1.R-62 IV.A2.R-84
M	014	BWR/PWR	Steel (with or without cladding) reactor vessel beltline shell, nozzle, and weld components; exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement	AMP XI.M31, "Reactor Vessel Material Surveillance," and X.M2, "Neutron Fluence Monitoring"	Yes (SRP-SLR Section 3.1.2.2.3.2)	IV.A1.RP-227 IV.A2.RP-229
M	015	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 TLAA's"	Yes (SRP-SLR Section 3.1.2.2.3.3)	IV.B4.RP-376
M	016	BWR	Stainless steel or nickel alloy reactor vessel top head enclosure flange leakage detection line exposed to air-indoor uncontrolled, reactor coolant leakage	Cracking due to SCC, IGSCC	AMP XI.M32, "One-Time Inspection," or AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.1.2.2.4.1)	IV.A1.R-61a IV.A1.R-61b

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	017	BWR	Stainless steel isolation condenser components exposed to reactor coolant	Cracking due to SCC, IGSCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.4.2)	IV.C1.R-15
E	018	PWR	Reactor vessel shell fabricated of SA508-CI 2 forgings clad with stainless steel using a high-heat-input welding process exposed to reactor coolant	Crack growth due to cyclic loading	TLAA, SRP-SLR Section 4.7 "Other Plant-Specific TLAAs"	Yes (SRP-SLR Section 3.1.2.2.5)	IV.A2.R-85
M	019	PWR	Stainless steel reactor vessel bottom-mounted instrument guide tubes (external to reactor vessel) exposed to reactor coolant	Cracking due to SCC	Plant-specific aging management program	Yes (SRP-SLR Section 3.1.2.2.6.1)	IV.A2.RP-154
E	020	PWR	Cast austenitic stainless steel Class 1 piping, piping components exposed to reactor coolant	Cracking due to SCC	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
E	021	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
E	022	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	025	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 coolant	Cracking due to primary water SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators." In addition, a plant-specific program is to be evaluated.	Yes (SRP-SLR Sections 3.1.2.2.11.1 and 3.1.2.2.11.2)	IV.D1.RP-367 IV.D1.RP-385 IV.D2.RP-185

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	028	PWR	"Existing Programs" components: Stainless steel, nickel alloy Westinghouse control rod guide tube support pins, and Combustion Engineering thermal shield positioning pins; Zircaloy-4 Combustion Engineering incore instrumentation thimble tubes exposed to reactor coolant and neutron flux	Loss of material due to wear; cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-356 IV.B3.RP-357 IV.B3.RP-400
M	029	BWR	Nickel alloy core shroud and core plate access hole cover (welded covers) exposed to reactor coolant	Cracking due to SCC, IGSCC, irradiation-assisted SCC	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12)	IV.B1.R-94
E	030	BWR	Stainless steel, nickel alloy penetration: drain line exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry" (SCC, IGSCC mechanisms only)	No	IV.A1.RP-371
M	031	BWR	Steel and stainless steel isolation condenser components exposed to reactor coolant	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C1.RP-39

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	032	PWR	Stainless steel, nickel alloy, or CASS reactor vessel internals, core support structure (not already referenced as ASME Section XI Examination Category B-N-3 core support structure components in MRP-227-A), exposed to reactor coolant and neutron flux	Cracking, loss of material due to wear	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.B2.RP-382 IV.B3.RP-382 IV.B4.RP-382
E	033	PWR	Stainless steel, steel with stainless steel cladding Class 1 reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.R-09 IV.C2.R-217 IV.C2.RP-344 IV.D1.RP-232
E	034	PWR	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 SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.RP-231
E	035	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	036	PWR	Steel, stainless steel pressurizer integral support exposed to any environment	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.C2.R-19
E	037	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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	038	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"	No	IV.C1.R-08 IV.C2.R-08
M	039	BWR/PWR	Stainless steel, steel (with or without nickel alloy or stainless steel cladding), nickel alloy Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to SCC (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), IGSCC (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), or thermal, mechanical, or vibratory loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," AMP XI.M2, "Water Chemistry," and XI.M35, "ASME Code Class 1 Small-Bore Piping"	No	IV.C1.RP-230 IV.C2.RP-235
M	040	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
E	040a	PWR	Nickel alloy core support pads; core guide lugs exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.A2.RP-57
M	041	BWR	Nickel alloy core shroud and core plate access hole cover (mechanical covers) exposed to reactor coolant	Cracking due to SCC, IGSCC, irradiation-assisted SCC	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12)	IV.B1.R-95
E	042	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 SCC, primary water SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.C2.R-25 IV.D2.RP-47

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	043	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, IWC, and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.B1.RP-26
M	044	PWR	Steel steam generator secondary manways and handholds (cover only) exposed to air – indoor uncontrolled	Loss of material due to erosion	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.D2.R-31
	045	PWR	Nickel alloy, steel with nickel alloy cladding reactor coolant pressure boundary components exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry," 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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	046	PWR	Stainless steel, nickel alloy control rod drive head penetration pressure housings, reactor vessel nozzles, nozzle safe ends and welds exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry," and, for nickel-alloy, AMP XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced corrosion in RCPB Components (PWRs Only)"	No	IV.A2.RP-234
	047	PWR	Stainless steel, nickel alloy control rod drive head penetration pressure housing exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD," and AMP XI.M2, "Water Chemistry"	No	IV.A2.RP-55
	048	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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	049	PWR	Steel reactor vessel, piping, piping components in the reactor coolant pressure boundary of PWRs, and applicable exterior attachments, or steel steam generators in PWRs: external surfaces or closure bolting exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	IV.A2.R-17 IV.C2.R-17 IV.C2.RP-167 IV.D1.R-17 IV.D2.R-17
M	050	BWR/PWR	Cast austenitic stainless steel Class 1 piping, piping components (including pump casings and control rod drive pressure housings) exposed to reactor coolant >250 °F (>482 °C)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	IV.A2.R-77 IV.C1.R-52 IV.C2.R-52
M	051a	PWR	Stainless steel, nickel alloy Babcock & Wilcox reactor internal "Primary" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-241 IV.B4.RP-241a IV.B4.RP-242a IV.B4.RP-247 IV.B4.RP-247a IV.B4.RP-248 IV.B4.RP-248a IV.B4.RP-249a IV.B4.RP-252a IV.B4.RP-256 IV.B4.RP-256a IV.B4.RP-258a IV.B4.RP-259a IV.B4.RP-261 IV.B4.RP-400

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	051b	PWR	Stainless steel, nickel alloy Babcock & Wilcox reactor internal "Expansion" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue, overload	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-244 IV.B4.RP-244a IV.B4.RP-245 IV.B4.RP-245a IV.B4.RP-246 IV.B4.RP-246a IV.B4.RP-254 IV.B4.RP-254a IV.B4.RP-260a IV.B4.RP-262 IV.B4.RP-352 IV.B4.RP-250a
M	052a	PWR	Stainless steel, nickel alloy Combustion Engineering reactor internal "Primary" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-312 IV.B3.RP-314 IV.B3.RP-322 IV.B3.RP-324 IV.B3.RP-326a IV.B3.RP-327 IV.B3.RP-328 IV.B3.RP-342 IV.B3.RP-358 IV.B3.RP-362a IV.B3.RP-363 IV.B3.RP-338 IV.B3.RP-343
M	052b	PWR	Stainless steel, nickel alloy Combustion Engineering reactor internal "Expansion" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-313 IV.B3.RP-316 IV.B3.RP-323 IV.B3.RP-325 IV.B3.RP-329 IV.B3.RP-330 IV.B3.RP-333 IV.B3.RP-335 IV.B3.RP-362c

<b>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</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	052c	PWR	Stainless steel, nickel alloy Combustion Engineering reactor internal "Existing Programs" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-320 IV.B3.RP-334
M	053a	PWR	Stainless steel, nickel alloy Westinghouse reactor internal "Primary" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-270a IV.B2.RP-271 IV.B2.RP-275 IV.B2.RP-276 IV.B2.RP-280 IV.B2.RP-298 IV.B2.RP-302 IV.B2.RP-387
M	053b	PWR	Stainless steel Westinghouse reactor internal "Expansion" components exposed to reactor coolant and neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-273 IV.B2.RP-278 IV.B2.RP-286 IV.B2.RP-291 IV.B2.RP-291a IV.B2.RP-291b IV.B2.RP-293 IV.B2.RP-294 IV.B2.RP-387a
M	053c	PWR	Stainless steel, nickel alloy Westinghouse reactor internal "Existing Programs" components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, fatigue	AMP XI.M16A, "PWR Vessel Internals," and AMP XI.M2, "Water Chemistry" (for SCC mechanisms only)	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-289 IV.B2.RP-301 IV.B2.RP-346 IV.B2.RP-399 IV.B2.RP-355
M	054	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

<b>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</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	055a	PWR	Stainless steel, nickel alloy Babcock and Wilcox reactor internal "No Additional Measures" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal "No Additional Measures" components unless required by ASME Section XI, Examination Category B-N-3 or relevant operating experience exists	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-236
M	055b	PWR	Stainless steel, nickel alloy Combustion Engineering reactor internal "No Additional Measures" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal "No Additional Measures" components unless required by ASME Section XI, Examination Category B-N-3 or relevant operating experience exists	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-306
M	055c	PWR	Stainless steel, nickel alloy Westinghouse reactor internal "No Additional Measures" components exposed to reactor coolant, neutron flux	No additional aging management for reactor internal "No Additional Measures" components unless required by ASME Section XI, Examination Category B-N-3 or relevant operating experience exists	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-265
M	056a	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) or nickel alloy Combustion Engineering reactor internal "Primary" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-315 IV.B3.RP-318 IV.B3.RP-359 IV.B3.RP-360 IV.B3.RP-362 IV.B3.RP-364 IV.B3.RP-366 IV.B3.RP-365 IV.B3.RP-326

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	056b	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) Combustion Engineering "Expansion" reactor internal components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-317 IV.B3.RP-331 IV.B3.RP-359a IV.B3.RP-361 IV.B3.RP-362b IV.B3.R-455
M	056c	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) or nickel alloy Combustion Engineering reactor internal "Existing Programs" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B3.RP-319 IV.B3.RP-332 IV.B3.RP-334a IV.B3.RP-336
M	058a	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS), nickel alloy Babcock & Wilcox reactor internal "Primary" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; or changes in dimensions due to void swelling or distortion; or loss of preload due to wear; or loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-240 IV.B4.RP-240a IV.B4.RP-242 IV.B4.RP-247b IV.B4.RP-248b IV.B4.RP-249 IV.B4.RP-251 IV.B4.RP-251a IV.B4.RP-252 IV.B4.RP-256b IV.B4.RP-258 IV.B4.RP-259 IV.B4.RP-401

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	058b	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS), nickel alloy Babcock & Wilcox reactor internal "Expansion" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; or changes in dimensions due to void swelling, or distortion; or loss of preload due to thermal and irradiation-enhanced stress relaxation, or creep; or loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B4.RP-245b IV.B4.RP-246b IV.B4.RP-254b IV.B4.RP-260 IV.B4.RP-243 IV.B4.RP-243a IV.B4.RP-250
M	059a	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) or nickel alloy Westinghouse reactor internal "Primary" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-270 IV.B2.RP-272 IV.B2.RP-296 IV.B2.RP-297 IV.B2.RP-302a IV.B2.RP-354 IV.B2.RP-388 IV.B2.RP-300
M	059b	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) Westinghouse reactor internal "Expansion" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-274 IV.B2.RP-278a IV.B2.RP-287 IV.B2.RP-290 IV.B2.RP-290a IV.B2.RP-290b IV.B2.RP-292 IV.B2.RP-295 IV.B2.RP-388a

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	059c	PWR	Stainless steel (SS, including CASS, PH SS or martensitic SS) or nickel alloy Westinghouse reactor internal "Existing Programs" components exposed to reactor coolant and neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement and for CASS, martensitic SS, and PH SS due to thermal aging embrittlement; changes in dimensions due to void swelling, distortion; loss of preload due to thermal and irradiation-enhanced stress relaxation, creep; loss of material due to wear	AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.RP-285 IV.B2.RP-288 IV.B2.RP-299 IV.B2.RP-345
E	060	BWR	Steel piping, piping components exposed to reactor coolant	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	IV.C1.R-23
	061	PWR	Steel 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
M	062	BWR/PWR	High-strength steel, stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air – indoor uncontrolled	Cracking due to SCC	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-78 IV.C1.R-11 IV.C2.R-11 IV.D1.R-10 IV.D2.R-10
M	063	BWR	Steel or stainless steel closure bolting exposed to air – indoor uncontrolled	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M18, "Bolting Integrity"	No	IV.C1.RP-42
M	064	PWR	Steel or stainless steel closure bolting exposed to air – indoor uncontrolled	Loss of material due to general (steel only), pitting, crevice corrosion, wear	AMP XI.M18, "Bolting Integrity"	No	IV.C2.RP-166 IV.D1.RP-166 IV.D2.RP-166
M	065	PWR	Stainless steel control rod drive head penetration flange bolting exposed to air – indoor uncontrolled	Loss of material due to wear	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-79

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	066	PWR	Steel, stainless steel closure bolting; stainless steel control rod drive head penetration flange bolting exposed to air - indoor uncontrolled	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, "Bolting Integrity"	No	IV.A2.R-80 IV.C2.R-12
M	067	BWR/PWR	Steel or stainless steel closure bolting exposed to air – indoor uncontrolled (external)	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, "Bolting Integrity"	No	IV.C1.RP-43 IV.D1.RP-46 IV.D2.RP-46
	068	PWR	Nickel alloy 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
M	069	PWR	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Cracking due to outer diameter SCC, intergranular attack	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-47 IV.D2.R-47
	070	PWR	Nickel alloy steam generator tubes, repair sleeves, and tube plugs exposed to reactor coolant	Cracking due to primary water SCC	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	IV.D1.R-40 IV.D1.R-44 IV.D2.R-40 IV.D2.R-44
	071	PWR	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-vibration bars exposed to secondary feedwater or steam	Cracking due to SCC 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
E	072	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 general, pitting, crevice corrosion, erosion, ligament cracking due to corrosion	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry" (corrosion based aging effects and mechanisms only)	No	IV.D1.R-42 IV.D1.RP-161 IV.D2.R-42 IV.D2.RP-162

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	073	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
	074	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
	075	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	076	PWR	Steel, chrome plated steel, stainless steel, nickel alloy steam generator U-bend supports including anti-vibration bars exposed to secondary feedwater or steam	Loss of material due to wear, fretting	AMP XI.M19, "Steam Generators"	No	IV.D1.RP-225
	077	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
	078	PWR	Nickel alloy steam generator components such as, secondary side nozzles (vent, drain, and instrumentation) exposed to secondary feedwater or steam	Cracking due to SCC	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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	079	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
	080	PWR	Stainless steel or steel with stainless steel cladding pressurizer relief tank: tank shell and heads, flanges, nozzles (none-ASME Section XI components) exposed to treated borated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-383
	081	PWR	Stainless steel pressurizer spray head exposed to reactor coolant	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-41
	082	PWR	Nickel alloy pressurizer spray head exposed to reactor coolant	Cracking due to SCC, primary water SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	IV.C2.RP-40
	083	PWR	Steel 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
M	084	BWR	Steel top head enclosure (without cladding): top head, top head nozzles (vent, top head spray, RCIC, 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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	085	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
	086	PWR	Stainless steel steam generator primary side divider plate exposed to reactor coolant	Cracking due to SCC	AMP XI.M2, "Water Chemistry"	No	IV.D1.RP-17
	087	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
	088	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	089	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
D	090						
M	091	BWR	Steel (including high-strength steel) reactor vessel closure flange assembly components (including flanges, nut, studs, and washers) exposed to air - indoor uncontrolled	Cracking due to SCC; 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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	092	PWR	Steel (including high-strength steel) reactor vessel closure flange assembly components (including flanges, nut, studs, and washers) exposed to air-indoor uncontrolled	Cracking due to SCC, IGSCC; loss of material due to general, pitting, crevice corrosion, wear	AMP XI.M3, "Reactor Head Closure Stud Bolting"	No	IV.A2.RP-52 IV.A2.RP-53
M	093	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	094	BWR	Stainless steel and nickel alloy vessel shell attachment welds exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M4, "BWR Vessel ID Attachment Welds," and AMP XI.M2, "Water Chemistry" (SCC, IGSCC mechanisms only)	No	IV.A1.R-64
M	095	BWR	Steel (with or without stainless steel or nickel alloy cladding) feedwater nozzles exposed to reactor coolant	Cracking due to cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.A1.R-65
M	096	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 SCC, IGSCC, cyclic loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.A1.R-66

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	097	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 SCC, IGSCC	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	No	IV.A1.R-412 IV.C1.R-20 IV.C1.R-21
E	098	BWR	Stainless steel, nickel alloy penetrations: instrumentation and standby liquid control exposed to reactor coolant	Cracking due to SCC, IGSCC, cyclic loading	AMP XI.M8, "BWR Penetrations," and AMP XI.M2, "Water Chemistry" (SCC, IGSCC mechanisms only)	No	IV.A1.RP-369
M	099	BWR	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
	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, SCC, IGSCC; loss of material due to wear	AMP XI.M9, "BWR Vessel Internals"	No	IV.B1.RP-155

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	102	BWR	Stainless steel fuel supports and control rod drive assemblies control rod drive housing exposed to reactor coolant	Cracking due to SCC, IGSCC	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	No	IV.B1.R-104
M	103	BWR	Stainless steel, nickel alloy reactor internal components exposed to reactor coolant and neutron flux	Cracking due to SCC, IGSCC, irradiation-assisted SCC	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.1.2.2.12)	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 IGSCC	AMP XI.M9, "BWR Vessel Internals," and AMP XI.M2, "Water Chemistry"	No	IV.B1.RP-381
M	105	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.15)	IV.E.RP-353
M	106	BWR/PWR	Nickel alloy piping, piping components exposed to air with borated water leakage	None	None	No	IV.E.RP-378
M	107	BWR/PWR	Stainless steel piping, piping components exposed to gas, air with borated water leakage	None	None	No	IV.E.RP-05 IV.E.RP-07
E	110	BWR	Metallic piping, piping components exposed to reactor coolant	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	IV.C1.R-406
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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
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" (water chemistry-related or corrosion-related aging effect mechanisms only)	No	IV.A1.R-409
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 SCC, IGSCC (stainless steel, nickel alloy components only), cyclic 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," and AMP XI.M2, "Water Chemistry" (water chemistry-related or corrosion-related aging effect mechanisms only)	No	IV.E.R-444
N	115	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.1.2.2.15)	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
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

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	118	PWR	Stainless steel, nickel alloy PWR reactor vessel internal components exposed to reactor coolant, neutron flux	Cracking due to SCC, irradiation-assisted SCC, cyclic 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 TLAA's" (if an analysis is performed as part of the aging management basis and conforms to the definition of a TLAA in 10 CFR 54.3(a))	Yes (SRP-SLR Section 3.1.2.2.14)	IV.B1.R-420
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
D	122						
N	124	BWR/PWR	Steel piping, piping components exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	IV.C1.R-431 IV.C2.R-431

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	125	PWR	Nickel alloy steam generator tubes at support plate locations exposed to secondary feedwater or steam	Cracking due to flow-induced vibration, high-cycle fatigue	AMP XI.M19, "Steam Generators"	No	IV.D1.R-437 IV.D2.R-442
N	127	PWR	Steel (with stainless steel or nickel alloy cladding) steam generator heads and tubesheets exposed to reactor coolant	Loss of material due to boric acid corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators"	No	IV.D1.R-436 IV.D2.R-440
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 SCC, IGSCC	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	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD"	No	IV.C1.R-432
D	130						
N	133	BWR/PWR	Steel components exposed to treated water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	IV.A1.R-448 IV.C1.R-448
N	134	BWR/PWR	Non-metallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	IV.A1.R-450 IV.A2.R-450 IV.C1.R-450 IV.C2.R-450 IV.D1.R-450 IV.D2.R-450

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	135						
N	136	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.1.2.2.16)	IV.C1.R-452a IV.C1.R-452b IV.C1.R-452c IV.C1.R-452d IV.C2.R-452a IV.C2.R-452b IV.C2.R-452c IV.C2.R-452d
N	137	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	IV.E.R-453
D	138						
N	139	PWR	Stainless steel, nickel alloy reactor vessel top head enclosure flange leakage detection line exposed to air-indoor uncontrolled, reactor coolant leakage	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," or AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.1.2.2.6.3)	IV.A2.R-74a IV.A2.R-74b

<b>Table 3.1-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Reactor Vessel, Internals, and Reactor Coolant System</b>	
<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP X.M1	Fatigue Monitoring
AMP X.M2	Neutron Fluence 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	BWR Vessel ID Attachment Welds
AMP XI.M5	Deleted
AMP XI.M6	Deleted
AMP XI.M7	BWR Stress Corrosion Cracking
AMP XI.M8	BWR Penetrations
AMP XI.M9	BWR Vessel Internals
AMP XI.M10	Boric Acid Corrosion
AMP XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs Only)
AMP XI.M12	Thermal Aging of Cast Austenitic Stainless Steel (CASS)
AMP XI.M16A	PWR Vessel Internals
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M19	Steam Generators
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M31	Reactor Vessel Surveillance
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M35	ASME Code Class 1 Small Bore-Piping
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M37	Flux Thimble Tube Inspection
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
GALL-SLR Report Appendix A	Quality Assurance for 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)

1 **3.2 Aging Management of Engineered Safety Features**

2 **Review Responsibilities**

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

5 **Secondary**—None

6 **3.2.1 Areas of Review**

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

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

18 The responsible review organization is to review the following subsequent license renewal  
19 application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

20 **AMRs**

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

25 **AMPs**

- 26 • Consistent with the GALL-SLR Report AMPs
- 27 • Plant-specific AMPs

28 **FSAR Supplement**

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

31 **3.2.2 Acceptance Criteria**

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

1 3.2.2.1 *AMR Results Consistent With the Generic Aging Lessons Learned for Subsequent*  
2 *License Renewal Report*

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

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

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

13 3.2.2.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by*  
14 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

22 3.2.2.2.1 *Cumulative Fatigue Damage*

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

30 3.2.2.2.2 *Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
31 *Nickel Alloys*

32 Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and  
33 nickel alloy piping, piping components, and tanks exposed to any air, condensation, or  
34 underground environment when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity  
35 of insulated components; or (d) in the vicinity of potentially transportable halogens. Loss of  
36 material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments  
37 containing sufficient halides (e.g., chlorides) in the presence of moisture.

38 Insulated SS and nickel alloy components exposed to air, condensation, or underground  
39 environments are susceptible to loss of material due to pitting or crevice corrosion if the insulation  
40 contains certain contaminants. Leakage of fluids through mechanical connections such as bolted  
41 flanges and valve packing can result in contaminants leaching onto the component surface or the

1 surfaces of other components below the component. For outdoor insulated SS and nickel alloy  
2 components, rain and changing weather conditions can result in moisture intrusion into  
3 the insulation.

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

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

15 The GALL-SLR Report recommends further evaluation of SS and nickel alloy piping, piping  
16 components, and tanks exposed to an air, condensation, or underground environment to  
17 determine whether an AMP is needed to manage the aging effect of loss of material due to pitting  
18 and crevice corrosion. The GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an  
19 acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not  
20 occurring at a rate that affects the intended function of the components. If loss of material due to  
21 pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function  
22 of systems, structures, and components (SSCs), the following AMPs describe acceptable  
23 programs to manage loss of material due to pitting or crevice corrosion: (a) the GALL-SLR Report  
24 AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," for tanks; (b) the  
25 GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," for  
26 external surfaces of piping and piping components; (c) the GALL-SLR Report AMP XI.M41,  
27 "Buried and Underground Piping and Tanks," for underground piping, piping components and  
28 tanks; and (d) the GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in  
29 Miscellaneous Piping and Ducting Components," for internal surfaces of components that are not  
30 included in other AMPs. The timing of the one-time or periodic inspections is consistent with that  
31 recommended in the AMP selected by the applicant during the development of the SLRA. For  
32 example, a one-time inspection would be conducted between the 50th and 60th year of operation,  
33 as recommended by the "detection of aging effects" program element in AMP XI.M32.

34 The applicant may establish that loss of material due to pitting and crevice corrosion is not an  
35 aging effect requiring management by demonstrating that a barrier coating isolates the component  
36 from aggressive environments. Acceptable barriers include coatings that have been  
37 demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides.  
38 If a barrier coating is credited for isolating a component from a potentially aggressive environment,  
39 then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment.  
40 GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping  
41 Components, Heat Exchangers, and Tanks," describes an acceptable program to manage the  
42 integrity of a barrier coating.

1    3.2.2.2.3       *Loss of Material Due to General Corrosion and Flow Blockage Due to Fouling*

2    Loss of material due to general corrosion and flow blockage due to fouling can occur in the spray  
3    nozzles and flow orifices in the drywell and suppression chamber spray system exposed to  
4    air-indoor uncontrolled. This aging effect and mechanism will apply since the carbon steel piping  
5    upstream of the spray nozzles and flow orifices is occasionally wetted, even though the majority of  
6    the time this system is in standby. The wetting and drying of these components can accelerate  
7    corrosion in the system and lead to flow blockage from an accumulation of corrosion products.  
8    Aging effects sufficient to result in a loss of intended function are not anticipated if: (a) the  
9    applicant identifies those portions of the system that are normally dry but subject to periodic  
10   wetting; (b) plant-specific procedures exist to drain the normally dry portions that have been  
11   wetted during normal plant operation or inadvertently; (c) the plant-specific configuration of the  
12   drains and piping allow sufficient draining to empty the normally dry pipe; (d) plant-specific OE has  
13   not revealed loss of material or flow blockage due to fouling; and (e) a one-time inspection is  
14   conducted to verify that loss of material or flow blockage due to fouling has not occurred. The  
15   GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an acceptable program to  
16   conduct the one-time inspections. The GALL-SLR Report AMP XI.M38, "Inspection of Internal  
17   Surfaces in Miscellaneous Piping and Ducting Components," describes an acceptable program to  
18   manage loss of material due to general corrosion and flow blockage due to fouling when the  
19   above conditions are not met.

20   3.2.2.2.4       *Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys*

21   Cracking due to stress corrosion cracking (SCC) could occur in indoor or outdoor SS piping,  
22   piping components, and tanks exposed to any air, condensation, or underground environment  
23   when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity of insulated components,  
24   or (d) in the vicinity of potentially transportable halogens. Cracking can occur in environments  
25   containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

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

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

39   The GALL-SLR Report recommends further evaluation of SS piping, piping components, and  
40   tanks exposed to an air, condensation, or underground environment to determine whether an  
41   AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32,  
42   "One-Time Inspection," describes an acceptable program to demonstrate that SCC is not  
43   occurring. If SCC is applicable, the following AMPs describe acceptable programs to manage  
44   loss of material due to SCC: (a) the GALL-SLR Report AMP XI.M29, "Outdoor and Large

1 Atmospheric Metallic Storage Tanks,” for tanks; (b) the GALL-SLR Report AMP XI.M36, “External  
2 Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping  
3 components; (c) the GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and  
4 Tanks,” for underground piping, piping components and tanks; and (d) the GALL-SLR Report  
5 AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,”  
6 for internal surfaces of components that are not included in other AMPs. The timing of the  
7 one-time or periodic inspections is consistent with that recommended in the AMP selected by the  
8 applicant during the development of the SLRA. For example, one-time inspections would be  
9 conducted between the 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the “detection of  
10 aging effects” program element in AMP XI.M32.

11 The applicant may establish that SCC is not an aging effect requiring management for all  
12 components, by demonstrating that a barrier coating isolates the component from aggressive  
13 environments. Acceptable barriers include tightly-adhering coatings that have been demonstrated  
14 to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier  
15 coating is credited for isolating a component from a potentially aggressive environment, then the  
16 barrier coating is evaluated to verify that it is impervious to the plant-specific environment. The  
17 GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping  
18 Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the  
19 integrity of a barrier coating.

#### 20 3.2.2.2.5 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

#### 23 3.2.2.2.6 *Ongoing Review of Operating Experience*

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

#### 26 3.2.2.2.7 *Loss of Material Due to Recurring Internal Corrosion*

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

37 The GALL-SLR Report recommends that the GALL-SLR Report AMP XI.M38, “Inspection of  
38 Internal Surfaces in Miscellaneous Piping and Ducting Components,” be evaluated for inclusion of  
39 augmented requirements to ensure the adequate management of any recurring aging effect(s).  
40 Alternatively, a plant-specific AMP may be proposed. Potential augmented requirements include:  
41 alternative examination methods (e.g., volumetric versus external visual), augmented inspections  
42 (e.g., a greater number of locations, additional locations based on risk insights based on  
43 susceptibility to aging effect and consequences of failure, a greater frequency of inspections), and

1 additional trending parameters and decision points where increased inspections would  
2 be implemented.

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

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

#### 23 3.2.2.2.8 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

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

33 Susceptible Material: If the material is not susceptible to SCC, then cracking is not an aging effect  
34 requiring management. The microstructure of an aluminum alloy, of which alloy composition is  
35 only one factor, is what determines if the alloy is susceptible to SCC. Therefore, determining  
36 susceptibility based on alloy composition alone is not adequate to conclude whether a particular  
37 material is susceptible to SCC. The temper, condition, and product form of the alloy is considered  
38 when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to  
39 SCC include:

- 40 • 2xxx series alloys in the F, W, O<sub>x</sub>, T3<sub>x</sub>, T4<sub>x</sub>, or T6<sub>x</sub> temper
- 41 • 5xxx series alloys with a magnesium content of 3.5 weight percent or greater
- 42 • 6xxx series alloys in the F temper
- 43 • 7xxx series alloys in the F, T5<sub>x</sub>, or T6<sub>x</sub> temper
- 44 • 2xx.x and 7xx.x series alloys

- 1 • 3xx.x series alloys that contain copper
- 2 • 5xx.x series alloys with a magnesium content of greater than 8 weight percent

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

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

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

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

45 An alternative strategy to demonstrating that an aggressive environment is not present is to  
46 isolate the aluminum alloy from the environment using a barrier to prevent SCC. Acceptable

1 barriers include tightly adhering coatings that have been demonstrated to be impermeable to  
2 aqueous solutions and air that contain halides. If a barrier coating is credited for isolating an  
3 aluminum alloy from a potentially aggressive environment, then the barrier coating is evaluated to  
4 verify that it is impervious to the plant-specific environment. The GALL-SLR Report AMP XI.M42,  
5 “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and  
6 Tanks,” describes an acceptable program to manage the integrity of a barrier coating for internal  
7 or external coatings.

8 *3.2.2.2.9 Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
9 *Stress Corrosion Cracking*

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

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

34 *3.2.2.2.10 Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

35 Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping  
36 components, and tanks exposed to an air, condensation, underground, raw water, or waste water  
37 environment for a sufficient duration of time. Environments that can result in pitting and/or crevice  
38 corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of  
39 moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are  
40 greatly dependent on geographical location and site-specific conditions. Moisture level and halide  
41 concentration should generally be considered high enough to facilitate pitting and/or crevice  
42 corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise.  
43 The periodic introduction of moisture or halides into an environment from secondary sources  
44 should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted  
45 flanges and valve packing); onto a component in indoor controlled air is an example of a  
46 secondary source that should be considered. Halide concentrations should generally be

1 considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous  
2 solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy  
3 components are evaluated to determine if prolonged exposure to the plant-specific air,  
4 condensation, underground, or water environments has resulted in pitting or crevice corrosion.  
5 Loss of material due to pitting and crevice corrosion is not an aging effect requiring management  
6 for aluminum alloys if: (a) plant-specific OE does not reveal a history of loss of material due to  
7 pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not  
8 occurring or is occurring so slowly that it will not affect the intended function of the components.  
9 The applicant documents the results of the plant-specific OE review in the SLRA.

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

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

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

42 *3.2.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
43 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

1    3.2.2.4    *Aging Management Programs*

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

5    If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
6    Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of  
7    10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA  
8    AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the  
9    SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR  
10   Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the  
11   difference should be reviewed and properly dispositioned. The reviewer should document the  
12   disposition of all SLRA-defined exceptions and NRC staff-identified differences.

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

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

23   3.2.2.5    *Final Safety Analysis Report Supplement*

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

33   **3.2.3   Review Procedures**

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

35   3.2.3.1    *Aging Management Review Results Consistent With the Generic Aging Lessons*  
36                *Learned for Subsequent License Renewal Report*

37   The applicant may reference the GALL-SLR Report in its SLRA, as appropriate, and demonstrate  
38   that the AMRs and AMPs at its facility are consistent with those reviewed and approved in the  
39   GALL-SLR Report. The reviewer should not conduct a re-review of the substance of the matters  
40   described in the GALL-SLR Report. If the applicant has provided the information necessary to  
41   adopt the finding of program acceptability as described and evaluated in the GALL-SLR Report,

1 the reviewer should find acceptable the applicant's reference to the GALL-SLR Report in its  
2 SLRA. In making this determination, the reviewer confirms that the applicant has provided a brief  
3 description of the system, components, materials, and environment. The reviewer also confirms  
4 that the applicable aging effects have been addressed based on the NRC staff's review of industry  
5 and plant-specific OE.

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

10 **3.2.3.2** *Aging Management Review Results for Which Further Evaluation Is Recommended by*  
11 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

17 **3.2.3.2.1** *Cumulative Fatigue Damage*

18 Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs,  
19 as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with  
20 10 CFR 54.21(c)(1).

21 The staff reviews the information on a case-by-case basis consistent with the review procedures  
22 in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided a  
23 sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in  
24 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage  
25 factor analyses that qualify as TLAAs and are based on plant-specific, stress-based  
26 calculation methods.

27 **3.2.3.2.2** *Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
28 *Nickel Alloys*

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

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

1 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
2 plant-specific environments into subcategories. For example, the OE search could be based on  
3 two environments including outdoor air and indoor air. The results could be that loss of material  
4 due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor  
5 air environment. The applicant could further categorize the indoor air locations as those where  
6 leakage could impinge on the SS or nickel alloy component's surface (e.g., leakage from  
7 mechanical connections) and those where there is not a potential for leakage. When the applicant  
8 chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant  
9 has adequately addressed the potential for the periodic introduction of either moisture or halides  
10 from secondary sources. Secondary sources of moisture or halides should be considered for all  
11 environments including indoor conditioned air. Typical secondary sources of moisture or halides  
12 include: leakage from mechanical connections; leakage into vaults; insulation containing halides;  
13 and outdoor air intrusion. Grouping of environments consistent with that described in the  
14 detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of  
15 Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

#### 16 3.2.3.2.3 *Loss of Material Due to General Corrosion and Flow Blockage Due to Fouling*

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

#### 32 3.2.3.2.4 *Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys*

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

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

44 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
45 plant-specific environments into subcategories. For example, the OE search could be based on

1 two environments including outdoor air and indoor air. The results could be that SCC has  
2 occurred in the outdoor air environment but not the indoor air environment. The applicant could  
3 further categorize the indoor air locations as those where leakage could impinge on the SS  
4 component's surface (e.g., leakage from mechanical connections) and those where there is not a  
5 potential for leakage. When the applicant chooses to conduct its OE search in this manner, the  
6 reviewer also is to confirm that the applicant has adequately addressed the potential for the  
7 periodic introduction of either moisture or halides from secondary sources. Secondary sources of  
8 moisture or halides should be considered for all environments including indoor conditioned air.  
9 Typical secondary sources of moisture or halides include: leakage from mechanical connections;  
10 leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of  
11 environments consistent with that described in the detection of aging effects program element of  
12 GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and  
13 Ducting Components," is appropriate.

#### 14 3.2.3.2.5 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

#### 25 3.2.3.2.6 *Ongoing Review of Operating Experience*

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

#### 34 3.2.3.2.7 *Loss of Material Due to Recurring Internal Corrosion*

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

1 The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should  
2 be augmented. For example, during a 10-year search of plant-specific OE, two instances of a  
3 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance  
4 of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded.  
5 Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage  
6 the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of  
7 inspections) to provide reasonable assurance that the CLB intended functions of the component  
8 will be met throughout the subsequent period of extended operation.

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

#### 11 3.2.3.2.8 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

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

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

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

1 If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive  
2 environment, then cracking due to SCC is not an aging effect requiring management. The  
3 reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions  
4 and air that the coating is intended to protect the alloy from being exposed to. If plant-specific OE  
5 is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify  
6 that the applicant has a program to manage loss of coating integrity equivalent to the GALL-SLR  
7 Report AMP XI.M42.

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

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

28 Documentation that may assist the reviewer in determining if cracking due to SCC is applicable  
29 and requires aging management include: (a) component drawings, (b) applicable codes  
30 or specifications used in the design, fabrication, and installation of the component,  
31 (c) material-specific material certification data and lot release data, (d) maintenance records,  
32 and (e) plant-specific OE.

33 If it is determined that cracking due to SCC is applicable, the reviewer is to evaluate the applicants  
34 proposed AMP to ensure that cracking is adequately managed so that the component's intended  
35 functions will be maintained consistent with the CLB for the subsequent period of extended  
36 operation. The GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic  
37 Storage Tanks," describes an acceptable program to manage cracking due to SCC of aluminum  
38 tanks. The GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical  
39 Components," describes an acceptable program to manage cracking due to SCC of aluminum  
40 piping and piping components. The GALL-SLR Report AMP XI.M41, "Buried and Underground  
41 Piping and Tanks," describes an acceptable program to manage cracking due to SCC of  
42 aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP  
43 XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"  
44 describes an acceptable program to manage cracking due to SCC of aluminum components that  
45 are not included in other AMPs.

1 3.2.3.2.9 *Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
2 *Stress Corrosion Cracking*

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

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

19 3.2.3.2.10 *Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

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

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

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

37 The grouping of alloys based on relative susceptibility to loss of material may also be appropriate.  
38 The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have  
39 a substantiated technical basis. The high strength heat treatable aluminum alloys (2xxx and 7xxx  
40 series) may be treated as a separate population when performing inspections and interpreting  
41 results due to their relatively lower corrosion resistance. The relative susceptibility of moderate  
42 and lower strength alloys varies based on composition (primarily weight percent Cu, Mg, and Fe)  
43 and temper designation.

1 The reviewer is to determine whether an adequate program is credited to manage the aging effect  
2 if the OE reveals that loss of material is applicable or the applicant elects to manage loss of  
3 material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of  
4 the AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping components, and tanks  
5 exposed to air, condensation, or underground environments when confirming that the aging effect  
6 is not applicable based on the OE evaluation. Alternatively, if the applicant states that it will utilize  
7 a strategy of isolating the aluminum components from the environment, verify that the aluminum  
8 components are coated and the GALL-SLR Report AMP XI.M42 has been cited to manage loss of  
9 coating integrity.

10 3.2.3.3 *Aging Management Review Results Not Consistent With or Not Addressed in the*  
11 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

17 3.2.3.4 *Aging Management Programs*

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

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

35 3.2.3.5 *Final Safety Analysis Report Supplement*

36 The reviewer confirms that the applicant has provided in its FSAR Supplement information for  
37 aging management of the engineered safety features. Table 3.2-2 lists the AMPs that are  
38 applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has  
39 provided information for Subsection 3.2.3.3, "Aging Management Review Results Not Consistent  
40 With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License  
41 Renewal Report."

42 The NRC staff expects to impose a license condition on any renewed license to require the  
43 applicant to update its FSAR to include this FSAR Supplement at the next update required

1 pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is  
2 complete, the applicant may make changes to the programs described in its FSAR Supplement  
3 without prior NRC approval, provided that the applicant evaluates each such change pursuant to  
4 the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR  
5 Supplement before the license is renewed, no condition will be necessary.

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

### 12 **3.2.4 Evaluation Findings**

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

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

21 The staff also reviewed the applicable FSAR Supplement program summaries  
22 and concludes that they adequately describe the AMPs credited for managing  
23 aging of the engineered safety features systems, as required by  
24 10 CFR 54.21(d).

### 25 **3.2.5 Implementation**

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

### 31 **3.2.6 References**

- 32 1. NRC. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports  
33 for Nuclear Power Plants, LWR Edition." Agencywide Documents Access and  
34 Management System (ADAMS) Accession No. ML070630046. Washington, DC:  
35 U.S. Nuclear Regulatory Commission. March 2007.
- 36 2. NRC. NUREG-1557, "Summary of Technical Information and Agreements from Nuclear  
37 Management and Resources Council Industry Reports Addressing License Renewal."  
38 Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.
- 39 3. ACI. ACI Standard 318-95, "Building Code Requirements for Reinforced Concrete and  
40 Commentary." Farmington Hills, Michigan: American Concrete Institute. 1995.

- 1 4. ACI. ACI Standard 349-85, "Code Requirements for Nuclear Safety-Related Concrete  
2 Structures." Farmington Hills, Michigan: American Concrete Institute. 1985.
- 3 5. ANSI. ANSI Standard H35.1/H35.1M, "Alloy and Temper Designation Systems for  
4 Aluminum." New York, New York: American National Standards Institute, Inc. 2013.
- 5 6. ASM. *Corrosion of Aluminum and Aluminum Alloys*. J. R. Davis, ed. Materials Park,  
6 Ohio: ASM International. 1999.
- 7 7. NRL. *Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum*  
8 *Alloys*. B. F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	001	BWR/PWR	Stainless steel, steel piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.2.2.2.1)	V.D1.E-13 V.D2.E-10
D	002						
D	003						
M	004	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to air, condensation (external)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.B.EP-107a V.B.EP-107b V.B.EP-107d V.C.EP-107a V.C.EP-107b V.C.EP-107d V.D1.EP-107a V.D1.EP-107b V.D1.EP-107d V.D2.EP-107a V.D2.EP-107b V.D2.EP-107d
M	005	PWR	Stainless steel orifice (miniflow recirculation when centrifugal HPSI pumps are used for normal charging) exposed to treated borated water	Loss of material due to erosion	AMP XI.M32, "One-Time Inspection"	No	V.D1.E-24
M	006	BWR	Steel drywell and suppression chamber spray system (internal surfaces): flow orifice; spray nozzles exposed to air – indoor uncontrolled	Loss of material due to general corrosion; flow blockage due to fouling	AMP XI.M32, "One-Time Inspection," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.2.2.2.3)	V.D2.EP-113a V.D2.EP-113b

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	007	BWR/PWR	Stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.4)	V.A.EP-103b V.A.EP-103c V.A.EP-103d V.A.EP-103e V.B.EP-103b V.B.EP-103c V.B.EP-103d V.B.EP-103e V.C.EP-103b V.C.EP-103c V.C.EP-103d V.C.EP-103e V.D1.EP-103b V.D1.EP-103c V.D1.EP-103d V.D1.EP-103e V.D2.EP-103b V.D2.EP-103c V.D2.EP-103d V.D2.EP-103e
M	008	PWR	Copper alloy (>15% Zn) piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	V.E.EP-38
M	009	PWR	Steel external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	V.E.E-28
M	010	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	011	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	V.C.E-09 V.D1.E-09 V.D2.E-07 V.D2.E-09

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	012	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to SCC; cyclic loading	AMP XI.M18, "Bolting Integrity"	No	V.E.E-03
D	013						
M	014	BWR/PWR	Stainless steel, steel, nickel alloy closure bolting exposed to air-indoor uncontrolled, air-outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	V.E.E-02
M	015	BWR/PWR	Metallic closure bolting exposed to any environment, soil underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, "Bolting Integrity"	No	V.E.EP-116
M	016	BWR/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	V.C.EP-62 V.D2.EP-60
M	017	BWR	Aluminum piping, piping components 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	V.D2.EP-71
D	018						
	019	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	020	PWR	Stainless steel, steel (with stainless steel or nickel alloy cladding) piping, piping components, tanks exposed to treated borated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.A.E-12 V.D1.E-12
D	021						

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	022	BWR/PWR	Nickel alloy, stainless steel heat exchanger components, piping, piping components, tanks exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.A.E-428 V.A.EP-41 V.C.EP-63 V.D1.E-428 V.D2.E-428 V.D1.EP-41 V.D2.EP-73
M	023	BWR/PWR	Steel heat exchanger components, piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.A.EP-90 V.C.E-22 V.D1.EP-90 V.D2.EP-90
M	024	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.C.E-34 V.D1.EP-55
M	025	BWR/PWR	Stainless steel heat exchanger components exposed to raw water	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	V.A.EP-91 V.D1.EP-91 V.D2.EP-91
D	026						
M	027	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-21 V.D2.E-23
M	028	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to SCC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-98 V.C.EP-98 V.D1.EP-98 V.D2.EP-98
M	029	BWR/PWR	Steel piping, piping components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.C.EP-99
M	030	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-92 V.D1.EP-92 V.D2.EP-92

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	031	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 V.D2.EP-95
M	032	BWR/PWR	Copper alloy heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	V.A.EP-94 V.A.EP-97 V.B.EP-97 V.D1.EP-94 V.D1.EP-97 V.D2.EP-94 V.D2.EP-97
	033	BWR/PWR	Copper alloy, 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	034	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	035	PWR	Gray cast iron motor cooler exposed to closed-cycle cooling water, treated water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.A.E-43 V.D1.E-43
M	036	PWR	Gray cast iron, ductile iron 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
M	037	BWR/PWR	Gray cast iron, ductile iron piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.B.EP-54 V.D1.EP-54 V.D2.EP-54

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	038	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.EP-59
D	039						
M	040	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-44
D	041						
M	042	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (external)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.EP-114b V.E.EP-114c V.E.EP-114d
M	043	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.B.EP-58 V.A.E-427 V.B.E-427 V.D1.E-427 V.D2.E-427
M	044	BWR/PWR	Steel piping, piping components, ducting, ducting components exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-29 V.B.E-25 V.D2.E-29

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	045	PWR	Steel encapsulation components exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.EP-42 V.C.EP-42 V.D1.EP-42
M	046	BWR/PWR	Steel piping, piping components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.B.E-27 V.D1.E-27 V.D2.E-27
M	047	PWR	Steel encapsulation components exposed to air with borated water leakage	Loss of material due to general, pitting, crevice, boric acid corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.EP-43 V.C.EP-43 V.D1.EP-43
M	048	BWR/PWR	Stainless steel, nickel alloy piping, piping components, tanks exposed to air, condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.A.EP-81a V.A.EP-81b V.A.EP-81c V.A.EP-81d V.D1.EP-81a V.D1.EP-81b V.D1.EP-81c V.D1.EP-81d V.D2.EP-61a V.D2.EP-61b V.D2.EP-61c V.D2.EP-61d

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	049	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-77 V.D1.EP-77 V.D2.EP-77
M	050	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-76 V.D1.EP-76 V.D1.EP-80 V.D2.EP-76
	051	BWR/PWR	Steel, copper alloy, stainless steel heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.EP-75 V.A.EP-78 V.A.EP-79 V.D1.EP-75 V.D1.EP-78 V.D1.EP-79 V.D2.EP-75 V.D2.EP-78 V.D2.EP-79
M	052	BWR/PWR	Steel piping, piping components exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.EP-111 V.E.EP-123
M	053	BWR/PWR	Stainless steel, nickel alloy piping, piping components, tanks, exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.EP-72
D	053a						
M	054	BWR	Stainless steel, nickel alloy piping, piping components greater than or equal to 4 NPS exposed to treated water >93°C (>200°F)	Cracking due to SCC, IGSCC	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	No	V.D2.E-37
M	055	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.9)	V.F.EP-112

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M	056	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (internal)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.A.EP-3b V.A.EP-3c V.A.EP-3d V.D1.EP-3b V.D1.EP-3c V.D1.EP-3d V.D2.EP-3b V.D2.EP-3c V.D2.EP-3d
M	057	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	V.F.EP-10
M	058	PWR	Copper alloy (>8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-12
M	059	BWR/PWR	Galvanized steel ducting, ducting components, piping, piping components exposed to air – indoor controlled	None	None	No	V.F.EP-14
M	060	BWR/PWR	Glass piping elements exposed to air, underground, lubricating oil, raw water, treated water, treated borated water, air with borated water leakage, condensation, gas, closed-cycle cooling water	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
D	061						

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	062	BWR/PWR	Nickel alloy piping, piping components exposed to air with borated water leakage	None	None	No	V.F.EP-115
M	063	BWR/PWR	Stainless steel piping, piping components exposed to air with borated water leakage, gas	None	None	No	V.F.EP-19 V.F.EP-22
M	064	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled, gas	None	None	No	V.F.EP-4 V.F.EP-7
M	065	BWR/PWR	Metallic piping, piping components exposed to treated water, treated borated water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	V.D1.E-407 V.D2.E-408
M	066	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.2.2.2.7)	V.A.E-400 V.B.E-400 V.C.E-400 V.D1.E-400 V.D2.E-400
M	067	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.D1.E-405 V.D2.E-405
M	068	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete, air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.D1.E-402 V.D2.E-402

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M	069	BWR/PWR	Insulated steel piping, piping components, tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" or AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.E.E-403a V.E.E-403b
M	070	BWR/PWR	Steel, stainless steel, aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to treated water, treated borated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, stainless steel only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.A.E-404 V.D1.E-404 V.D2.E-404
M	071	BWR/PWR	Insulated copper alloy (>15% Zn or >8% Al) piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-406
M	072	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage; loss of material or cracking for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	V.A.E-401 V.B.E-401 V.C.E-401 V.D1.E-401 V.D2.E-401
M	073	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	V.A.E-414 V.B.E-414 V.C.E-414 V.D1.E-414 V.D2.E-414

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	074	BWR/PWR	Gray cast iron, ductile iron piping, piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated 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	V.A.E-415 V.B.E-415 V.C.E-415 V.D1.E-415 V.D2.E-415
D	075						
N	076	BWR/PWR	Stainless steel, steel, nickel alloy, copper alloy closure bolting exposed to treated water, treated borated water, raw water, waste water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC (steel, copper alloy in raw water, waste water only)	AMP XI.M18, "Bolting Integrity"	No	V.E.E-418
D	077						
N	078	BWR/PWR	Stainless steel, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-420
N	079	BWR/PWR	Stainless steel closure bolting exposed to air, soil, concrete, underground	Cracking due to SCC	AMP XI.M18, "Bolting Integrity"	No	V.E.E-421
N	080	BWR/PWR	Stainless steel underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.4)	V.E.E-423a V.E.E-423b V.E.E-423c

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N	081	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-424
D	083						
D	084						
D	085						
D	086						
N	087	BWR/PWR	Non-metallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-422
D	089						
N	090	BWR/PWR	Steel components exposed to treated water, treated borated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	V.A.E-434 V.B.E-434 V.C.E-434 V.D1.E-434 V.D2.E-434
N	091	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.2.2.2.9)	V.F.EP-20
D	092						
D	095						
N	096	BWR/PWR	Steel, stainless steel piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.D1.E-439 V.D2.E-440
D	097						
N	098	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	V.D1.E-441 V.D2.E-441

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	099	BWR/PWR	Stainless steel, nickel alloy tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-442a V.E.E-442b V.E.E-442c V.E.E-442d
N	100	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (internal), raw water, waste water	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.8)	V.A.E-443b V.A.E-443c V.A.E-443d V.B.E-443b V.B.E-443c V.B.E-443d V.D1.E-443b V.D1.E-443c V.D1.E-443d V.D2.E-443b V.D2.E-443c V.D2.E-443d

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	101	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation (external)	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-444b V.E.E-444c V.E.E-444d
N	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.8)	V.D1.E-445a V.D1.E-445b V.D1.E-445c V.D2.E-445a V.D2.E-445b V.D2.E-445c
N	103	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.4)	V.D1.E-446a V.D1.E-446b V.D1.E-446c V.D2.E-446a V.D2.E-446b V.D2.E-446c

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	104	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.D1.E-447 V.D2.E-447
N	105	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.D1.E-448a V.D1.E-448b V.D1.E-448c V.D2.E-448a V.D2.E-448b V.D2.E-448c
N	106	BWR/PWR	Stainless steel, nickel alloy tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.D1.E-449a V.D1.E-449b V.D1.E-449c V.D2.E-449a V.D2.E-449b V.D2.E-449c

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	107	BWR/PWR	Insulated stainless steel, nickel alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-450a V.E.E-450b V.E.E-450c V.E.E-450d
N	108	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.4)	V.E.E-451a V.E.E-451b V.E.E-451c V.E.E-451d

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	109	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-452a V.E.E-452b V.E.E-452c V.E.E-452d
N	110	BWR/PWR	Aluminum underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.8)	V.E.E-453a V.E.E-453b V.E.E-453c
N	111	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-454a V.E.E-454b V.E.E-454c

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	112	BWR/PWR	Stainless steel, nickel alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-455a V.E.E-455b V.E.E-455c
D	113						
N	114	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to treated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	V.B.E-457 V.C.E-457 V.D2.E-457
N	115	BWR/PWR	Titanium 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	V.A.E-458 V.D1.E-458 V.D2.E-458
N	116	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	V.F.E-459
N	117	BWR/PWR	Titanium 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.E-460 V.D1.E-460 V.D2.E-460
N	118	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to closed-cycle cooling water	None	None	No	V.F.E-461

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	119	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-462a V.E.E-462b V.E.E-462c V.E.E-462d
N	120	BWR/PWR	Aluminum piping, piping components, tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-463
N	121	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.E.E-464a V.E.E-464b V.E.E-464c V.E.E-464d

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	122	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	V.E.E-465
N	123	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-466 V.B.E-466 V.C.E-466 V.D1.E-466 V.D2.E-466
N	124	BWR/PWR	Aluminum piping, piping components, tanks exposed to air with borated water leakage	None	None	No	V.F.E-467
N	125	BWR/PWR	Steel closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-468
N	126	BWR/PWR	Titanium, super austenitic piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to pitting, crevice corrosion, MIC (except for titanium; soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-469
N	127	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	V.F.E-470
N	128	BWR/PWR	Copper alloy piping, piping components exposed to soil, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	V.E.E-471
N	129	BWR/PWR	Stainless steel tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	V.D1.E-472 V.D2.E-472

<b>Table 3.2-1. Summary of Aging Management Programs for Engineered Safety Features Evaluated in Chapter V of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	130	BWR/PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	V.A.E-473 V.D1.E-473 V.D2.E-473
N	131	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	V.A.E-474 V.B.E-474 V.D1.E-474 V.D2.E-474

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

<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP XI.M2	Water Chemistry
AMP XI.M7	BWR 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	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

### 1 **3.3 Aging Management of Auxiliary Systems**

#### 2 **Review Responsibilities**

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

5 **Secondary**—None

#### 6 **3.3.1 Areas of Review**

7 This section addresses the aging management review (AMR) and the associated aging  
8 management program (AMP) of the auxiliary systems for subsequent license renewal (SLR). For  
9 a recent vintage plant, the information related to the auxiliary systems contained in Chapter 9,  
10 “Auxiliary Systems,” of the plant’s Final Safety Analysis Report (FSAR) consistent with the  
11 “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants”  
12 (NUREG–0800). The auxiliary systems contained in this review plan section are generally  
13 consistent with those contained in NUREG–0800 except for refueling water, chilled water, heat  
14 removal, condenser circulating water, and condensate storage system. For older plants, the  
15 location of applicable information is plant-specific because an older plant’s FSAR may have  
16 predated NUREG–0800.

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

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

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

1 **AMRs**

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

6 **AMPs**

- 7 • Consistent with GALL-SLR Report AMPs
- 8 • Plant-specific AMPs

9 **FSAR Supplement**

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

12 **3.3.2 Acceptance Criteria**

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

16 *3.3.2.1 Aging Management Review Results Consistent With the Generic Aging Lessons*  
17 *Learned for Subsequent License Renewal Report*

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

20 The applicant's subsequent license renewal application (SLRA) should provide sufficient  
21 information so that the NRC reviewer is able to confirm that the specific SLRA AMR item and the  
22 associated SLRA AMP are consistent with the cited GALL-SLR Report AMR item. The reviewer  
23 should then confirm that the SLRA AMR item is consistent with the GALL-SLR Report AMR item  
24 to which it is compared.

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

29 *3.3.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by*  
30 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

31 The basic acceptance criteria, defined in Subsection 3.3.2.1, need to be applied first for all of the  
32 AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item  
33 to which the SLRA AMR item is compared identifies that "further evaluation is recommended,"  
34 then additional criteria apply as identified by the GALL-SLR Report for each of the following aging  
35 effect/aging mechanism combinations. Refer to Table 3.3-1, comparing the "Further Evaluation

1 Recommended” and the “GALL-SLR Item” column, for the AMR items that reference the  
2 following subsections.

3 3.3.2.2.1 *Cumulative Fatigue Damage*

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

11 3.3.2.2.2 *Cracking Due to Stress Corrosion Cracking and Cyclic Loading*

12 Cracking due to stress corrosion cracking (SCC) and cyclic loading could occur in stainless steel  
13 (SS) PWR nonregenerative heat exchanger tubing exposed to treated borated water greater than  
14 60 degrees Celsius (°C) (140 degrees Fahrenheit (°F)) in the chemical and volume control  
15 system. The existing AMP for monitoring and control of primary water chemistry in PWRs  
16 (GALL-SLR Report AMP XI.M2, “Water Chemistry”) manages the aging effects of cracking due to  
17 SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic  
18 loading. Therefore, the effectiveness of the water chemistry control program should be verified to  
19 ensure that cracking is not occurring. If a search of plant-specific OE does not reveal that  
20 cracking has occurred in nonregenerative heat exchanger tubing, this aging effect can be  
21 considered to be adequately managed by GALL-SLR Report AMP XI.M2. However, if cracking  
22 has occurred in nonregenerative heat exchanger tubing, the GALL-SLR Report recommends that  
23 AMP XI.M21A, “Closed Treated Water Systems,” be evaluated for inclusion of augmented  
24 requirements to conduct temperature and radioactivity monitoring of the shell side water, and  
25 where component configuration permits, periodic eddy current testing of tubes.

26 3.3.2.2.3 *Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys*

27 Cracking due to stress corrosion cracking (SCC) could occur in indoor or outdoor SS piping,  
28 piping components, and tanks exposed to any air, condensation, or underground environment  
29 when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity of insulated components,  
30 or (d) in the vicinity of potentially transportable halogens. Cracking can occur in environments  
31 containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

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

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

4 The GALL-SLR Report recommends further evaluation of SS piping, piping components, and  
5 tanks exposed to an air, condensation, or underground environment to determine whether an  
6 AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32,  
7 “One-Time Inspection,” describes an acceptable program to demonstrate that SCC is not  
8 occurring. If SCC is applicable, the following AMPs describe acceptable programs to manage  
9 loss of material due to SCC: (a) GALL-SLR Report AMP XI.M29, “Outdoor and Large  
10 Atmospheric Metallic Storage Tanks,” for tanks; (b) GALL-SLR Report AMP XI.M36, “External  
11 Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping  
12 components; (c) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for  
13 underground piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38,  
14 “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal  
15 surfaces of components that are not included in other AMPs. The timing of the one-time or  
16 periodic inspections is consistent with that recommended in the AMP selected by the applicant  
17 during the development of the SLRA. For example, one-time inspections would be conducted  
18 between the 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the “detection of aging effects”  
19 program element in GALL-SLR Report AMP XI.M32.

20 The applicant may establish that SCC is not an aging effect requiring management for all  
21 components, by demonstrating that a barrier coating isolates the component from aggressive  
22 environments. Acceptable barriers include tightly-adhering coatings that have been demonstrated  
23 to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier  
24 coating is credited for isolating a component from a potentially aggressive environment, then the  
25 barrier coating is evaluated to verify that it is impervious to the plant-specific environment. The  
26 GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping  
27 Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the  
28 integrity of a barrier coating.

29 **3.3.2.2.4**      *Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
30 *Nickel Alloys*

31 Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and  
32 nickel alloy piping, piping components, and tanks exposed to any air, condensation, or  
33 underground environment when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity  
34 of insulated components; or (d) in the vicinity of potentially transportable halogens. Loss of  
35 material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments  
36 containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

44 Plant-specific OE and the condition of SS and nickel alloy components are evaluated to determine  
45 if prolonged exposure to the plant-specific environments has resulted in pitting or crevice

1 corrosion. Loss of material due to pitting and crevice corrosion is not an aging effect requiring  
2 management for SS and nickel alloy components if: (a) plant-specific OE does not reveal a  
3 history of loss of material due to pitting or crevice corrosion; and (b) a one-time inspection  
4 demonstrates that the aging effect is not occurring or is occurring so slowly that it will not affect  
5 the intended function of the components during the subsequent period of extended operation.  
6 The applicant documents the results of the plant-specific OE review in the SLRA.

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

10 The GALL-SLR Report recommends further evaluation of SS and nickel alloy piping, piping  
11 components, and tanks exposed to an air, condensation, or underground environment to  
12 determine whether an AMP is needed to manage the aging effect of loss of material due to pitting  
13 and crevice corrosion. GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an  
14 acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not  
15 occurring at a rate that affects the intended function of the components. If loss of material due to  
16 pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function  
17 of an SSC, the following AMPs describe acceptable programs to manage loss of material due to  
18 pitting or crevice corrosion: (a) GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric  
19 Metallic Storage Tanks," for tanks; (b) GALL-SLR Report AMP XI.M36, "External Surfaces  
20 Monitoring of Mechanical Components," for external surfaces of piping and piping components;  
21 (c) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground  
22 piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, "Inspection of  
23 Internal Surfaces in Miscellaneous Piping and Ducting Components," for internal surfaces of  
24 components that are not included in other AMPs. The timing of the one-time or periodic  
25 inspections is consistent with that recommended in the AMP selected by the applicant during the  
26 development of the SLRA. For example, one-time inspections would be conducted between the  
27 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the "detection of aging effects" program  
28 element in AMP XI.M32.

29 The applicant may establish that loss of material due to pitting and crevice corrosion is not an  
30 aging effect requiring management by demonstrating that a barrier coating isolates the component  
31 from aggressive environments. Acceptable barriers include coatings that have been  
32 demonstrated to be impermeable to aqueous solutions and atmospheric air that contain  
33 halides. If a barrier coating is credited for isolating a component from a potentially aggressive  
34 environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific  
35 environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping,  
36 Piping Components, Heat Exchangers, and Tanks," describes an acceptable program to manage  
37 the integrity of a barrier coating.

#### 38 3.3.2.2.5 *Quality Assurance for Aging Management of Nonsafety-Related Components*

39 Acceptance criteria are described in Branch Technical Position (BTP) IQMB-1  
40 (Appendix A.2, of this SRP-SLR Report.)

#### 41 3.3.2.2.6 *Ongoing Review of Operating Experience*

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

1 3.3.2.2.7 *Loss of Material Due to Recurring Internal Corrosion*

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

12 The GALL-SLR Report recommends that GALL-SLR Report AMP XI.M20, "Open-Cycle Cooling  
13 Water System," AMP XI.M27, "Fire Water System," or GALL-SLR Report AMP XI.M38,  
14 "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," be evaluated  
15 for inclusion of augmented requirements to ensure the adequate management of any recurring  
16 aging effect(s). Alternatively, a plant-specific AMP may be proposed. Potential augmented  
17 requirements include: alternative examination methods (e.g., volumetric versus external visual),  
18 augmented inspections (e.g., a greater number of locations, additional locations based on risk  
19 insights based on susceptibility to aging effect and consequences of failure, a greater frequency of  
20 inspections), and additional trending parameters and decision points where increased inspections  
21 would be implemented.

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

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

42 3.3.2.2.8 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

43 SCC is a form of environmentally assisted cracking which is known to occur in high and moderate  
44 strength aluminum alloys. The three conditions necessary for SCC to occur in a component are a  
45 sustained tensile stress, aggressive environment, and material with a susceptible microstructure.

1 Cracking due to SCC can be mitigated by eliminating one of the three necessary conditions. For  
2 the purposes of SLR, acceptance criteria for this further evaluation is being provided for  
3 demonstrating that the specific material is not susceptible to SCC or an aggressive environment  
4 is not present. Cracking due to SCC is an aging effect requiring management unless it is  
5 demonstrated by the applicant that one of the two necessary conditions discussed below  
6 is absent.

7 Susceptible Material: If the material is not susceptible to SCC then cracking is not an aging effect  
8 requiring management. The microstructure of an aluminum alloy, of which alloy composition is  
9 only one factor, is what determines if the alloy is susceptible to SCC. Therefore, determining  
10 susceptibility based on alloy composition alone is not adequate to conclude whether a particular  
11 material is susceptible to SCC. The temper, condition, and product form of the alloy is considered  
12 when assessing if a material is susceptible to SCC. Aluminum alloys that are susceptible to  
13 SCC include:

- 14 • 2xxx series alloys in the F, W, Ox, T3x, T4x, or T6x temper
- 15 • 5xxx series alloys with a magnesium content of 3.5 weight percent or greater
- 16 • 6xxx series alloys in the F temper
- 17 • 7xxx series alloys in the F, T5x, or T6x temper
- 18 • 2xx.x and 7xx.x series alloys
- 19 • 3xx.x series alloys that contain copper
- 20 • 5xx.x series alloys with a magnesium content of greater than 8 weight percent

21 The material is evaluated to verify that it is not susceptible to SCC and that the basis used to  
22 make the determination is technically substantiated. Tempers have been specifically developed  
23 to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper  
24 combination which are not susceptible to SCC when used in piping, piping component, and tank  
25 applications include 1xxx series, 3xxx series, 6061-T6x, and 5454-x. If it is determined that a  
26 material is not susceptible to SCC, the SLRA provides the components/locations where it is used,  
27 alloy composition, temper or condition, product form, and for tempers not addressed above, the  
28 basis used to determine the alloy is not susceptible and technical information substantiating  
29 the basis.

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

38 Halides could be present on the surface of the aluminum material if the component is  
39 encapsulated in a material such as insulation or concrete. In a controlled or uncontrolled indoor  
40 air, condensation, or underground environment, sufficient halide concentrations to cause  
41 SCC could be present due to secondary sources such as leakage from nearby components  
42 (e.g., leakage from insulated flanged connections or valve packing). If an aluminum component is  
43 exposed to a halide-free indoor air environment, not encapsulated in materials containing halides,  
44 and the exposure to secondary sources of moisture or halides is precluded, cracking due to SCC  
45 is not expected to occur. The plant-specific configuration can be used to demonstrate that  
46 exposure to halides will not occur. If it is determined that SCC will not occur because the

1 environment is not aggressive, the SLRA provides the components and locations exposed to the  
2 environment, a description of the environment, basis used to determine the environment is not  
3 aggressive, and technical information substantiating the basis. The GALL-SLR Report  
4 AMP XI.M32, "One-Time Inspection," and a review of plant-specific OE describe an acceptable  
5 means to confirm the absence of moisture or halides within the proximity of the aluminum  
6 component.

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

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

26 3.3.2.2.9 *Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
27 *Stress Corrosion Cracking*

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

41 If the following conditions are met, loss of material is not considered to be an applicable aging  
42 effect for steel: (a) attributes of the concrete are consistent with American Concrete Institute  
43 (ACI) 318 or ACI 349 (low water-to-cement ratio, low permeability, and adequate air entrainment)  
44 as cited in NUREG-1557; (b) plant-specific OE indicates no degradation of the concrete that  
45 could lead to penetration of water to the metal surface; and (c) the piping is not potentially  
46 exposed to groundwater. For SS components, loss of material and cracking due to SCC are not

1 considered to be applicable aging effects as long as the piping is not potentially exposed to  
2 groundwater. Where these conditions are not met, loss of material due to general (steel only),  
3 crevice, or pitting corrosion, and cracking due to SCC (SS only) are identified as applicable aging  
4 effects. GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes  
5 an acceptable program to manage these aging effects.

#### 6 3.3.2.2.10 *Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

7 Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping  
8 components, and tanks exposed to an air, condensation, underground, raw water, or waste water  
9 environment for a sufficient duration of time. Environments that can result in pitting and/or crevice  
10 corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of  
11 moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are  
12 greatly dependent on geographical location and site-specific conditions. Moisture level and halide  
13 concentration should generally be considered high enough to facilitate pitting and/or crevice  
14 corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise.  
15 The periodic introduction of moisture or halides into an environment from secondary sources  
16 should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted  
17 flanges and valve packing); onto a component in indoor controlled air is an example of a  
18 secondary source that should be considered. Halide concentrations should generally be  
19 considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous  
20 solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy  
21 components are evaluated to determine if prolonged exposure to the plant-specific air,  
22 condensation, underground, or water environments has resulted in pitting or crevice corrosion.  
23 Loss of material due to pitting and crevice corrosion is not an aging effect requiring management  
24 for aluminum alloys if: (a) plant-specific OE does not reveal a history of loss of material due to  
25 pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not  
26 occurring or is occurring so slowly that it will not affect the intended function of the components.  
27 The applicant documents the results of the plant-specific OE review in the SLRA.

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

32 The GALL-SLR Report recommends the further evaluation of aluminum piping, piping  
33 components, and tanks exposed to an air, condensation, or underground environment to  
34 determine whether an AMP is needed to manage the aging effect of loss of material due to pitting  
35 and crevice corrosion. GALL-SLR Report AMP XI.M32, "One-Time Inspection," describes an  
36 acceptable program to demonstrate that the aging effect of loss of material due to pitting and  
37 crevice corrosion is not occurring at a rate that will affect the intended function of the components.  
38 If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially  
39 affect the intended function of an SSC, the following AMPs describe acceptable programs to  
40 manage loss of material due to pitting and crevice corrosion: (i) GALL-SLR Report AMP XI.M29,  
41 "Outdoor and Large Atmospheric Metallic Storage Tanks," for tanks; (ii) GALL-SLR Report  
42 AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," for external surfaces of  
43 piping and piping components; (iii) GALL-SLR Report AMP XI.M41, "Buried and Underground  
44 Piping and Tanks," for underground piping, piping components and tanks; and (iv) GALL-SLR  
45 Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting  
46 Components" for internal surfaces of components that are not included in other AMPs. The timing  
47 of the one-time or periodic inspections is consistent with that recommended in the AMP selected

1 by the applicant during the development of the SLRA. For example, one-time inspections would  
2 be conducted between the 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the “detection of  
3 aging effects” program element in AMP XI.M32.

4 An alternative strategy to demonstrating that an aggressive environment is not present is to  
5 isolate the aluminum alloy from the environment using a barrier to prevent loss of material due to  
6 pitting and crevice corrosion. Acceptable barriers include tightly adhering coatings that have been  
7 demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides.  
8 If a barrier coating is credited for isolating an aluminum alloy from a potentially aggressive  
9 environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific  
10 environment. The GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping,  
11 Piping Components, Heat Exchangers, and Tanks,” or equivalent program, describes an  
12 acceptable program to manage the integrity of a barrier coating.

13 *3.3.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
14 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

16 *3.3.2.4 Aging Management Programs*

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

20 If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
21 Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of  
22 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA  
23 AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the  
24 SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR  
25 Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the  
26 difference should be reviewed and properly dispositioned. The reviewer should document the  
27 disposition of all SLRA-defined exceptions and NRC staff-identified differences.

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

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

38 *3.3.2.5 Final Safety Analysis Report Supplement*

39 The summary description of the programs and activities for managing the effects of aging for the  
40 subsequent period of extended operation in the FSAR Supplement should be sufficiently  
41 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description

1 should contain information associated with the bases for determining that aging effects will be  
2 managed during the subsequent period of extended operation. The description should also  
3 contain any future aging management activities, including enhancements and commitments, to be  
4 completed before the period of extended operation. Table X-01 and Table XI-01 of the  
5 GALL-SLR Report provide examples of the type of information to be included in the FSAR  
6 Supplement. Table 3.3-2 lists the programs that are applicable for this SRP-SLR subsection.

### 7 **3.3.3 Review Procedures**

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

#### 9 *3.3.3.1 Aging Management Review Results Consistent With the Generic Aging Lessons* 10 *Learned for Subsequent License Renewal Report*

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

21 Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the  
22 issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm  
23 that the applicant has identified those aging effects for the auxiliary system components that are  
24 contained in the GALL-SLR Report as applicable to its plant.

#### 25 *3.3.3.2 Aging Management Review Results for Which Further Evaluation Is Recommended by* 26 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

27 The basic review procedures defined in Subsection 3.3.3.1 need to be applied first for all of the  
28 AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which  
29 the SLRA AMR item is compared identifies that "further evaluation is recommended," then  
30 additional criteria apply as identified by the GALL-SLR Report for each of the following aging  
31 effect/aging mechanism combinations. Refer to Table 3.3-1 for the items that reference the  
32 following subsections.

##### 33 *3.3.3.2.1 Cumulative Fatigue Damage*

34 Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAs,  
35 as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with  
36 10 CFR 54.21(c)(1).

37 The staff reviews the information on a case-by-case basis consistent with the review procedures  
38 in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided  
39 a sufficient basis for dispositioning the TLAAs in accordance with the acceptance criteria in  
40 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage factor

1 analyses that qualify as TLAAAs and are based on plant-specific, stress-based  
2 calculation methods.

### 3 3.3.3.2.2 *Cracking Due to Stress Corrosion Cracking and Cyclic Loading*

4 The GALL-SLR Report recommends further evaluation of programs to manage cracking due to  
5 SCC and cyclic loading in the SS nonregenerative heat exchanger tubing in the chemical and  
6 volume control system (PWR) exposed to treated borated water >60 °C (>140 °F). The water  
7 chemistry program relies on monitoring and control of water chemistry to manage cracking due to  
8 SCC and cyclic loading. The GALL-SLR Report recommends the effectiveness of the chemistry  
9 control program be verified to ensure that cracking is not occurring. The absence of cracking due  
10 to SCC and cyclic loading is to be verified. An acceptable verification program is to include  
11 temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.  
12 The reviewer reviews plant-specific OE to determine whether cracking has occurred in the  
13 applicant's nonregenerative heat exchanger tubes. If cracking has occurred, the reviewer reviews  
14 the applicant's proposed changes to AMP XI.M21A to determine whether the proposed  
15 augmented features of the program will be adequate to manage these aging effects.

### 16 3.3.3.2.3 *Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys*

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

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

28 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
29 plant-specific environments into subcategories. For example, the OE search could be based on  
30 two environments including outdoor air and indoor air. The results could be that SCC has  
31 occurred in the outdoor air environment but not the indoor air environment. The applicant could  
32 further categorize the indoor air locations as those where leakage could impinge on the SS  
33 component's surface (e.g., leakage from mechanical connections) and those where there is not a  
34 potential for leakage. When the applicant chooses to conduct its OE search in this manner, the  
35 reviewer also is to confirm that the applicant has adequately addressed the potential for the  
36 periodic introduction of either moisture or halides from secondary sources. Secondary sources of  
37 moisture or halides should be considered for all environments including indoor conditioned air.  
38 Typical secondary sources of moisture or halides include: leakage from mechanical connections;  
39 leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of  
40 environments consistent with that described in the detection of aging effects program element of  
41 GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and  
42 Ducting Components," is appropriate.

1 3.3.3.2.4 *Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
2 *Nickel Alloys*

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

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

16 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
17 plant-specific environments into subcategories. For example, the OE search could be based on  
18 two environments including outdoor air and indoor air. The results could be that loss of material  
19 due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor  
20 air environment. The applicant could further categorize the indoor air locations as those where  
21 leakage could impinge on the SS and nickel alloy component's surface (e.g., leakage from  
22 mechanical connections) and those where there is not a potential for leakage. When the applicant  
23 chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant  
24 has adequately addressed the potential for the periodic introduction of either moisture or halides  
25 from secondary sources. Secondary sources of moisture or halides should be considered for all  
26 environments including indoor conditioned air. Typical secondary sources of moisture or halides  
27 include: leakage from mechanical connections; leakage into vaults; insulation containing halides;  
28 and outdoor air intrusion. Grouping of environments consistent with that described in the  
29 detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of  
30 Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

31 3.3.3.2.5 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

42 3.3.3.2.6 *Ongoing Review of Operating Experience*

43 The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant  
44 has appropriate programs or processes for the ongoing review of both plant-specific and industry

1 OE concerning age-related degradation and aging management. Such reviews are used to  
2 ensure that the AMPs are effective to manage the aging effects for which they are created. The  
3 AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined  
4 through the evaluation of OE that the effects of aging may not be adequately managed.  
5 Additional information is in Appendix A.4, "Operating Experience for Aging Management  
6 Programs."

#### 7 3.3.3.2.7 *Loss of Material Due to Recurring Internal Corrosion*

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

17 The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should  
18 be augmented. For example, during a 10-year search of plant-specific OE, two instances of  
19 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance  
20 of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded.  
21 Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage  
22 the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of  
23 inspections) to provide reasonable assurance that the CLB intended functions of the component  
24 will be met throughout the subsequent period of extended operation.

25 The reviewer determines whether a proposed program is adequate to manage recurring internal  
26 corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.3.2.2.7.

#### 27 3.3.3.2.8 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

28 The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping,  
29 piping components, and tanks) exposed to air, condensation, underground or aqueous solutions  
30 that contain halides to manage cracking due to SCC. The reviewer must first determine if  
31 cracking due to SCC is applicable and requires aging management. Cracking is to be considered  
32 applicable unless it is demonstrated that one of the two acceptance criteria are met by  
33 demonstrating that an aggressive environment is not present or the specific material is not  
34 susceptible, as discussed in Section 3.3.2.2.8. Additionally, guidance is also provided on the  
35 review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three  
36 conditions is evaluated based on the review procedures below.

37 If the material used to fabricate the component being evaluated is not susceptible to SCC then  
38 cracking due to SCC is not an aging effect requiring management. When determining if an  
39 aluminum alloy is susceptible to SCC the reviewer is to verify the material's (a) alloy composition,  
40 (b) condition or temper, and (c) product form. Additionally, if the material was produced using a  
41 process specifically developed to provide a SCC resistant microstructure then the reviewer will  
42 consider the effects of this processing in the review. Once the material information has been  
43 established the reviewer is to evaluate the technical justification used to substantiate that the  
44 material is not susceptible to SCC when exposed to an aggressive environment and sustained

1 tensile stress. The reviewer will evaluate all documentation and references used by the applicant  
2 as part of a technical justification.

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

17 If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive  
18 environment, then cracking due to SCC is not an aging effect requiring management. The  
19 reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions  
20 and air that the coating is intended to protect the alloy from being exposed to. If plant-specific OE  
21 is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify  
22 that the applicant has a program to manage loss of coating integrity equivalent to the GALL-SLR  
23 Report AMP XI.M42.

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

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

44 Documentation that may assist the reviewer in determining if cracking due to SCC is applicable  
45 and requires aging management include: (a) component drawings, (b) applicable codes  
46 or specifications used in the design, fabrication, and installation of the component,

1 (c) material-specific material certification data and lot release data, (d) maintenance records, and  
2 (e) plant-specific OE.

3 If it is determined that cracking due to SCC is applicable the reviewer is to evaluate the applicants  
4 proposed AMP to ensure that cracking is adequately managed so that the component's intended  
5 functions will be maintained consistent with the CLB for the subsequent period of extended  
6 operation. The GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic  
7 Storage Tanks," describes an acceptable program to manage cracking due to SCC of aluminum  
8 tanks. The GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical  
9 Components," describes an acceptable program to manage cracking due to SCC of aluminum  
10 piping and piping components. The GALL-SLR Report AMP XI.M41, "Buried and Underground  
11 Piping and Tanks," describes an acceptable program to manage cracking due to SCC of  
12 aluminum piping and tanks which are buried or underground. The GALL-SLR Report AMP  
13 XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"  
14 describes an acceptable program to manage cracking due to SCC of aluminum components that  
15 are not included in other AMPs.

16 3.3.3.2.9 *Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
17 *Stress Corrosion Cracking*

18 The GALL-SLR Report recommends that for steel piping and piping components exposed to  
19 concrete, if the following conditions are met, loss of material is not considered to be an applicable  
20 aging effect for steel: (a) attributes of the concrete are consistent with ACI 318 or ACI 349 (low  
21 water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557;  
22 (b) plant-specific OE indicates no degradation of the concrete that could lead to penetration of  
23 water to the metal surface; and (c) the piping is not potentially exposed to groundwater. For SS  
24 piping and piping components, loss of material and cracking due to SCC are not considered to be  
25 applicable aging effects as long as the piping is not potentially exposed to groundwater. Where  
26 these conditions are not met, loss of material due to general (steel only), crevice, or pitting  
27 corrosion and cracking due to SCC (SS only) are identified as applicable aging effects.  
28 GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an  
29 acceptable program to manage these aging effects.

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

34 3.3.3.2.10 *Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

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

40 The reviewer is to confirm that the applicant has adequately addressed the potential for the  
41 periodic introduction of either moisture or halides from secondary sources. Secondary sources of  
42 moisture or halides should be considered for all environments including indoor conditioned air.  
43 Typical secondary sources of moisture or halides include: leakage from mechanical connections;

1 leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of  
2 environments consistent with that found in the GALL-SLR Report Section IX.D is appropriate.

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

9 The grouping of alloys based on relative susceptibility to loss of material may also be appropriate.  
10 The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have  
11 a substantiated technical basis. The high strength heat treatable aluminum alloys (2xxx and 7xxx  
12 series) may be treated as a separate population when performing inspections and interpreting  
13 results due to their relatively lower corrosion resistance. The relative susceptibility of moderate  
14 and lower strength alloys varies based on composition (primarily weight percent Cu, Mg, and Fe)  
15 and temper designation.

16 The reviewer is to determine whether an adequate program is credited to manage the aging effect  
17 if the OE reveals that loss of material is applicable or the applicant elects to manage loss of  
18 material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of  
19 GALL-SLR Report AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping  
20 components, and tanks exposed to air, condensation, or underground environments when  
21 confirming that the aging effect is not applicable based on the OE evaluation. Alternatively, if the  
22 applicant states that it will utilize a strategy of isolating the aluminum components from the  
23 environment, verify that the aluminum components are coated and GALL-SLR Report AMP  
24 XI.M42 has been cited to manage loss of coating integrity.

25 *3.3.3.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
26 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

32 *3.3.3.4 Aging Management Programs*

33 The reviewer confirms that the applicant has identified the appropriate AMPs as described and  
34 evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its  
35 SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this  
36 enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR  
37 Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program  
38 elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the  
39 exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not  
40 identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the  
41 SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference  
42 satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting  
43 enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report  
44 pertinent to the auxiliary systems components are summarized in Table 3.3-1 of this SRP-SLR.

1 The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report,  
2 Chapter VII, presenting detailed information summarized by this row.

### 3 3.3.3.5 *Final Safety Analysis Report Supplement*

4 The reviewer confirms that the applicant has provided in its FSAR Supplement information on  
5 aging management of the auxiliary systems. Table 3.3-2 lists the AMPs that are applicable for  
6 this SRP-SLR subsection. The reviewer also confirms that the applicant has provided information  
7 for Subsection 3.3.3.3, "Aging Management Review Results Not Consistent With or Not  
8 Addressed in the Generic Aging Lessons Learned for Subsequent License Renewal Report."

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

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

### 22 3.3.4 Evaluation Findings

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

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

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

### 34 3.3.5 Implementation

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

1   **3.3.6 References**

- 2   1.    NRC. NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports  
3       for Nuclear Power Plants.” Agencywide Documents Access and Management System  
4       (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory  
5       Commission. March 2007.
- 6   2.    NEI. NEI 95-10, “Industry Guideline for Implementing the Requirements of  
7       10 CFR Part 54–The License Renewal Rule.” Revision 6. ADAMS Accession  
8       No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.
- 9   3.    ASME. ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant  
10       Components.” ASME Boiler and Pressure Vessel Code, 2004 Edition. New York,  
11       New York: The American Society of Mechanical Engineers.
- 12 4.    ASTM International. “Standard Test Method for Water in Petroleum Products and  
13       Bituminous Materials by Distillation.” D95-83. West Conshohocken, Pennsylvania:  
14       American Society for Testing and Materials. 1990.
- 15 5.    NRC. NUREG–1557, “Summary of Technical Information and Agreements from Nuclear  
16       Management and Resources Council Industry Reports Addressing License Renewal.”  
17       Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.
- 18 6.    ACI. ACI Standard 318-95, “Building Code Requirements for Reinforced Concrete and  
19       Commentary.” Farmington Hills, Michigan: American Concrete Institute. 1995.
- 20 7.    ACI. ACI Standard 349-85, “Code Requirements for Nuclear Safety-Related Concrete  
21       Structures.” Farmington Hills, Michigan: American Concrete Institute. 1985.
- 22 8.    ANSI. ANSI Standard H35.1/H35.1M, “Alloy and Temper Designation Systems for  
23       Aluminum.” New York, New York: American National Standards Institute, Inc. 2013.
- 24 9.    ASM. *Corrosion of Aluminum and Aluminum Alloys*. J. R. Davis, ed. Materials Park,  
25       Ohio: ASM International. 1999.
- 26 10.   NRL. *Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum*  
27       *Alloys*. B. F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	001	BWR/PWR	Steel cranes: bridges, structural members, structural components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.7 "Other Plant-Specific TLAA's"	Yes (SRP-SLR Section 3.3.2.2.1)	VII.B.A-06
M	002	BWR/PWR	Stainless steel, steel heat exchanger components and tubes, piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.3.2.2.1)	VII.E1.A-100 VII.E1.A-34 VII.E1.A-57 VII.E3.A-34 VII.E3.A-62 VII.E4.A-62
M	003	PWR	Stainless steel heat exchanger tubing, non-regenerative exposed to treated borated water >60°C (>140°F)	Cracking due to SCC; cyclic loading	AMP XI.M2, "Water Chemistry"	Yes (SRP-SLR Section 3.3.2.2.2)	VII.E1.A-69
N	003a	PWR	Stainless steel heat exchanger tubing, non-regenerative exposed to treated borated water >60°C (>140°F)	Cracking due to SCC; cyclic loading	AMP XI.M2, "Water Chemistry," and AMP XI.M21A, "Closed Treated Water Systems"	Yes (SRP-SLR Section 3.3.2.2.2)	VII.E1.A-69a
M	004	BWR/PWR	Stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C1.AP-209b VII.C1.AP-209c VII.C1.AP-209d VII.C1.AP-209e VII.C2.AP-209b VII.C2.AP-209c VII.C2.AP-209d VII.C2.AP-209e VII.C3.AP-209b VII.C3.AP-209c VII.C3.AP-209d

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report							
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
					Piping, Piping Components, Heat Exchangers, and Tanks"		VII.C3.AP-209e VII.D.AP-209b VII.D.AP-209c VII.D.AP-209d VII.E1.AP-209b VII.E1.AP-209c VII.E1.AP-209d VII.E4.AP-209b VII.E4.AP-209c VII.E4.AP-209d VII.E4.AP-209e VII.F1.AP-209b VII.F1.AP-209c VII.F1.AP-209d VII.F2.AP-209b VII.F2.AP-209c VII.F2.AP-209d VII.F3.AP-209b VII.F3.AP-209c VII.F3.AP-209d VII.F4.AP-209b VII.F4.AP-209c VII.F4.AP-209d VII.G.AP-209b VII.G.AP-209c VII.G.AP-209d VII.H1.AP-209b VII.H1.AP-209c VII.H1.AP-209d VII.H1.AP-209e VII.H2.AP-209b VII.H2.AP-209c VII.H2.AP-209d
D	005						
M	006	BWR/PWR	Stainless steel, nickel alloy piping, piping components	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components,"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C1.AP-221a VII.C1.AP-221b VII.C1.AP-221c VII.C1.AP-221d

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report							
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
			exposed to air, condensation		AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"		VII.C2.AP-221a VII.C2.AP-221b VII.C2.AP-221c VII.C2.AP-221d VII.C3.AP-221a VII.C3.AP-221b VII.C3.AP-221c VII.C3.AP-221d VII.D.AP-221a VII.D.AP-221b VII.D.AP-221c VII.D.AP-221d VII.E1.AP-221a VII.E1.AP-221b VII.E1.AP-221c VII.E1.AP-221d VII.E4.AP-221a VII.E4.AP-221b VII.E4.AP-221c VII.E4.AP-221d VII.F1.AP-221a VII.F1.AP-221b VII.F1.AP-221c VII.F1.AP-221d VII.F2.AP-221a VII.F2.AP-221b VII.F2.AP-221c VII.F2.AP-221d VII.F3.AP-221a VII.F3.AP-221b VII.F3.AP-221c VII.F3.AP-221d VII.F4.AP-221a VII.F4.AP-221b VII.F4.AP-221c VII.F4.AP-221d VII.G.AP-221a VII.G.AP-221b VII.G.AP-221c

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report							
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.G.AP-221d VII.H1.AP-221a VII.H1.AP-221b VII.H1.AP-221c VII.H1.AP-221d VII.H2.AP-221a VII.H2.AP-221b VII.H2.AP-221c VII.H2.AP-221d
	007	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
	008	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	009	PWR	Steel, copper alloy (>15% Zn) external surfaces, piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	VII.I.A-79 VII.I.AP-66
M	010	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to SCC; cyclic loading	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-04
D	011						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	012	BWR/PWR	Steel; stainless steel, nickel alloy closure bolting exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-03
D	013						
D	014						
M	015	BWR/PWR	Metallic closure bolting exposed to any environment, soil, underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, "Bolting Integrity"	No	VII.I.AP-124
M	016	BWR	Stainless steel piping, piping components outboard the second containment isolation valves with a diameter $\geq 4$ inches nominal pipe size exposed to treated water $>93^{\circ}\text{C}$ ( $>200^{\circ}\text{F}$ )	Cracking due to SCC, IGSCC	AMP XI.M2, "Water Chemistry," and AMP XI.M25, "BWR Reactor Water Cleanup System"	No	VII.E3.AP-283
	017	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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	018	BWR/PWR	Stainless steel high-pressure pump casing, piping, piping components, tanks exposed to treated borated water >60°C (>140°F), sodium pentaborate solution >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E1.AP-114 VII.E2.AP-181
M	019	BWR	Stainless steel regenerative heat exchanger components exposed to treated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.AP-120
	020	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 SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E1.AP-118 VII.E3.AP-112
M	021	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	022	BWR	Copper alloy piping, piping components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-140 VII.E3.AP-140 VII.E4.AP-140

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	023						
D	024						
M	025	BWR/PWR	Aluminum piping, piping components 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.C2.AP-130 VII.E3.AP-130 VII.E4.AP-130 VII.H2.AP-130
M	026	BWR	Steel (with stainless steel cladding) piping, piping components exposed to treated water	Loss of material due to general (only after cladding degradation), pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-108
	027	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	028	PWR	Stainless steel piping, piping components, tanks exposed to treated boric water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E1.AP-82
D	029						
M	030	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to raw water	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-250

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	030a	BWR/PWR	Fiberglass, HDPE piping, piping components exposed to raw water	Cracking, blistering, change in color due to water absorption; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-238 VII.C1.AP-239
D	031						
D	032						
D	032a						
D	033						
M	034	BWR/PWR	Nickel alloy, copper alloy piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-196 VII.C1.AP-206 VII.C3.AP-195 VII.C3.AP-206 VII.H2.AP-193
D	035						
D	036						
M	037	BWR/PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-194 VII.C3.AP-194 VII.H2.AP-194
M	038	BWR/PWR	Copper alloy, steel heat exchanger components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VII.C1.AP-179 VII.C1.AP-183
D	039						
M	040	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.C1.A-54 VII.C3.A-53 VII.H2.AP-55
D	041						
M	042	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," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.AP-187 VII.C3.AP-187 VII.G.AP-187 VII.H2.AP-187

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	043	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to SCC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-186 VII.E3.AP-186 VII.E4.AP-186
	044	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 SCC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.E3.AP-192
M	045	BWR/PWR	Steel piping, piping components, tanks exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water 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	046	BWR/PWR	Steel, copper alloy heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.A3.AP-189 VII.A3.AP-199 VII.A4.AP-189 VII.A4.AP-199 VII.C2.AP-189 VII.C2.AP-199 VII.E1.AP-189 VII.E1.AP-199 VII.E1.AP-203 VII.E3.AP-189 VII.E3.AP-199 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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
							VII.F3.AP-189 VII.F3.AP-199 VII.F3.AP-203 VII.F4.AP-189 VII.F4.AP-199 VII.H1.AP-199 VII.H2.AP-199
M	047	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	048	BWR/PWR	Aluminum piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.AP-254 VII.H2.AP-255
M	049	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
M	050	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 VII.F4.AP-205

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	051	BWR/PWR	Boraflex spent fuel storage racks: neutron-absorbing sheets (PWR), spent fuel storage racks: neutron-absorbing sheets (BWR) exposed to treated borated water, treated water	Reduction of neutron-absorbing capacity due to boraflex degradation	AMP XI.M22, "Boraflex Monitoring"	No	VII.A2.A-86 VII.A2.A-87
M	052	BWR/PWR	Steel cranes: rails, bridges, structural members, structural components exposed to air	Loss of material due to general corrosion, wear, deformation, cracking	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-07
D	053						
D	054						
M	055	BWR/PWR	Steel piping, piping components, tanks exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.D.A-26 VII.E5.A-26 VII.F1.A-26 VII.F2.A-26 VII.F3.A-26 VII.F4.A-26 VII.H2.A-26
D	056						
M	057	BWR/PWR	Elastomer fire barrier penetration seals exposed to air, condensation	Hardening, loss of strength, shrinkage due to elastomer degradation	AMP XI.M26, "Fire Protection"	No	VII.G.A-19

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	058	BWR/PWR	Steel halon/carbon dioxide fire suppression system piping, piping components exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M26, "Fire Protection"	No	VII.G.AP-150
M	059	BWR/PWR	Steel fire rated doors exposed to air	Loss of material due to wear	AMP XI.M26, "Fire Protection"	No	VII.G.A-21
M	060	BWR/PWR	Reinforced concrete structural fire barriers: walls, ceilings and floors exposed to air	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement; loss of material due to delamination, exfoliation, spalling, popout, or scaling	AMP XI.M26, "Fire Protection," and AMP XI.S6, "Structures Monitoring"	No	VII.G.A-90
D	061						
D	062						
M	063	BWR/PWR	Steel fire hydrants exposed to air – outdoor, raw water, raw water (potable), treated water	Loss of material due to general, pitting, crevice corrosion; flow blockage due to fouling (raw water, raw water (potable) only)	AMP XI.M27, "Fire Water System"	No	VII.G.AP-149

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	064	BWR/PWR	Steel, copper alloy piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to general (steel; copper alloy in raw water and raw water (potable)), pitting, crevice corrosion, MIC; flow blockage due to fouling (raw water; raw water (potable) for steel)	AMP XI.M27, "Fire Water System"	No	VII.G.A-33 VII.G.AP-197
M	065	BWR/PWR	Aluminum piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to pitting, crevice corrosion, MIC; fouling that leads to corrosion; flow blockage due to fouling (raw water only)	AMP XI.M27, "Fire Water System"	No	VII.G.AP-180
M	066	BWR/PWR	Stainless steel piping, piping components exposed to raw water, treated water, raw water (potable)	Loss of material due to pitting, crevice corrosion, MIC; flow blockage due to fouling (raw water only)	AMP XI.M27, "Fire Water System"	No	VII.G.A-55
D	067						
D	068						
M	069	BWR/PWR	Copper alloy piping, piping components exposed to fuel oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection," or AMP XI.M30, "Fuel Oil Chemistry"	No	VII.G.AP-132 VII.G.AP-132a VII.H1.AP-132 VII.H1.AP-132a VII.H2.AP-132 VII.H2.AP-132a
M	070	BWR/PWR	Steel piping, piping components, tanks exposed to fuel oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M30, "Fuel Oil Chemistry," and AMP XI.M32, "One-Time Inspection," or AMP XI.M30, "Fuel Oil Chemistry"	No	VII.H1.AP-105 VII.H1.AP-105a VII.H2.AP-105 VII.H2.AP-105a VII.G.AP-234 VII.G.AP-234a

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	071	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," or AMP XI.M30, "Fuel Oil Chemistry"	No	VII.G.AP-129 VII.G.AP-129a VII.G.AP-136 VII.G.AP-136a VII.H1.AP-129 VII.H1.AP-129a VII.H1.AP-136 VII.H1.AP-136a VII.H2.AP-129 VII.H2.AP-129a VII.H2.AP-136 VII.H2.AP-136a
M	072	BWR/PWR	Gray cast iron, ductile 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	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 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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
							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	073	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to air – outdoor	Cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, or scaling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.AP-253
D	074						
D	075						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	076	BWR/PWR	Elastomer piping, piping components, ducting, ducting components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.AP-102
D	077						
M	078	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-77
D	079						
M	080	BWR/PWR	Steel heat exchanger components, piping, piping components exposed to air – indoor uncontrolled, air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-24 VII.I.AP-40 VII.I.AP-41
D	081						
M	082	BWR/PWR	Elastomer, fiberglass piping, piping components, ducting, ducting components, seals exposed to air	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-719 VII.I.AP-113
M	083	BWR/PWR	Stainless steel diesel engine exhaust piping, piping components exposed to diesel exhaust	Cracking due to SCC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.H2.AP-128

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	085	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation, closed-cycle cooling water, treated borated water, treated water, raw water, waste water, gas, fuel oil, lubricating oil	Hardening or 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 VII.C1.AP-75 VII.C2.AP-259 VII.D.A-729 VII.E1.A-504 VII.E2.A-504 VII.E3.A-504 VII.E4.A-504 VII.E5.A-504 VII.E5.A-728 VII.F1.A-504 VII.F2.A-504 VII.F3.A-504 VII.F4.A-504 VII.G.A-504 VII.G.A-729 VII.G.AP-75 VII.H1.A-660 VII.H2.A-677
D	086						
M	088	BWR/PWR	Steel; stainless steel piping, piping components, diesel engine exhaust exposed to raw water (potable), diesel exhaust	Loss of material due to general (steel only), pitting, crevice corrosion, flow blockage due to fouling (steel only for raw water (potable) environment)	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-270 VII.H2.AP-104
M	089	BWR/PWR	Steel piping, piping components exposed to condensation (internal)	Loss of material due to general, pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.AP-143

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	090	BWR/PWR	Steel ducting, ducting components (internal surfaces) exposed to condensation	Loss of material due to general, pitting, crevice corrosion, MIC (for drip pans and drain lines)	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	091	BWR/PWR	Steel piping, piping components, heat exchanger components, tanks exposed to waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-281
D	092						
M	093	BWR/PWR	Copper alloy piping, piping components exposed to raw water (potable)	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-271
M	094	BWR/PWR	Stainless steel ducting, ducting components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.F1.AP-99a VII.F2.AP-99a VII.F3.AP-99a VII.F4.AP-99a VII.F1.AP-99b VII.F2.AP-99b VII.F3.AP-99b VII.F4.AP-99b VII.F1.AP-99c VII.F2.AP-99c VII.F3.AP-99c VII.F4.AP-99c

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	094a	BWR/PWR	Stainless steel ducting, ducting components exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.F1.A-781a VII.F2.A-781a VII.F3.A-781a VII.F4.A-781a VII.F1.A-781b VII.F2.A-781b VII.F3.A-781b VII.F4.A-781b VII.F1.A-781c VII.F2.A-781c VII.F3.A-781c VII.F4.A-781c
M	095	BWR/PWR	Copper alloy, stainless steel, nickel alloy piping, piping components, heat exchanger components, tanks exposed to waste water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.AP-272 VII.E5.AP-275 VII.E5.AP-276 VII.E5.AP-278 VII.E5.AP-279
M	096	BWR/PWR	Elastomer piping, piping components, seals exposed to air, raw water, waste water	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.AP-76 VII.E5.A-550 VII.F1.AP-103 VII.F2.AP-103 VII.F3.AP-103 VII.F4.AP-103 VII.G.AP-76
N	096a	BWR/PWR	Steel, aluminum, copper alloy, stainless steel, titanium heat exchanger tubes internal to components exposed to air, condensation (external)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-419 VII.F1.A-419 VII.F2.A-419 VII.F3.A-419 VII.F4.A-419

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	096b	BWR/PWR	Steel heat exchanger components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.C1.A-417 VII.F1.A-417 VII.F2.A-417 VII.F3.A-417 VII.F4.A-417
M	097	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.C1.AP-127 VII.C2.AP-127 VII.E1.AP-127 VII.E4.AP-127 VII.F1.AP-127 VII.F2.AP-127 VII.F3.AP-127 VII.F4.AP-127 VII.G.AP-127 VII.H2.AP-127
M	098	BWR/PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.H2.AP-131
M	099	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VII.C1.AP-133 VII.C2.AP-133 VII.E1.AP-133 VII.E4.AP-133 VII.G.AP-133 VII.G.AP-162 VII.H2.AP-133 VII.H2.AP-162
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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	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
M	103	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to soil, concrete	Cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, or scaling	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-157
M	104	BWR/PWR	HDPE, 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.I.AP-175 VII.I.AP-176

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	105	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to soil, concrete	Cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, or scaling	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-177
D	106						
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 only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-137
M	108	BWR/PWR	Titanium, super austenitic, copper alloy, stainless steel, nickel alloy piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC (super austenitic, copper alloy, stainless steel, nickel alloy; soil environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-171 VII.I.AP-172 VII.I.AP-174 VII.I.AP-243
M	109	BWR/PWR	Steel piping, piping components, closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-198 VII.I.AP-241 VII.I.AP-284
D	109a						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	110	BWR	Stainless steel, nickel alloy piping, piping components greater than or equal to 4 NPS exposed to treated water >93°C (>200°F)	Cracking due to SCC, IGSCC	AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry"	No	VII.E4.A-61
M	111	BWR/PWR	Steel structural steel exposed to air – indoor uncontrolled	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	VII.A1.A-94
M	112	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.9)	VII.J.AP-282
M	113	BWR/PWR	Aluminum piping, piping components exposed to air-dry, gas	None	None	No	VII.J.AP-134 VII.J.AP-37
M	114	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, air – dry, gas	None	None	No	VII.J.AP-144 VII.J.AP-9
M	115	BWR/PWR	Copper alloy (>8% Al) 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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	117	BWR/PWR	Glass piping elements exposed to air, lubricating oil, closed-cycle cooling water, fuel oil, raw water, treated water, treated borated water, air with borated water leakage, condensation, gas, underground	None	None	No	VII.J.AP-14 VII.J.AP-15 VII.J.AP-166 VII.J.AP-48 VII.J.AP-49 VII.J.AP-50 VII.J.AP-51 VII.J.AP-52 VII.J.AP-96 VII.J.AP-97 VII.J.AP-98
D	118						
M	119	BWR/PWR	Nickel alloy, PVC, glass piping, piping components exposed to air with borated water leakage, air – indoor uncontrolled, condensation, waste water, raw water (potable)	None	None	No	VII.J.AP-260 VII.J.AP-268 VII.J.AP-269 VII.J.AP-277
M	120	BWR/PWR	Stainless steel piping, piping components exposed to air with borated water leakage, air – dry, gas	None	None	No	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, gas	None	None	No	VII.J.AP-2 VII.J.AP-6

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	122	BWR/PWR	Titanium heat exchanger components, piping, piping components exposed to air – indoor uncontrolled, air – outdoor	None	None	No	VII.J.AP-151 VII.J.AP-160
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	Flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.J.AP-152a VII.J.AP-152b VII.J.AP-161a VII.J.AP-161b
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 SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A2.A-96 VII.A2.A-97 VII.A3.A-56 VII.E1.A-103

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	125	BWR/PWR	Stainless steel, steel (with stainless steel cladding), nickel alloy spent fuel storage racks (BWR), spent fuel storage racks (PWR), piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A2.AP-79 VII.A3.AP-79 VII.E1.AP-79 VII.A2.A-98 VII.A2.A-99
M	126	BWR/PWR	Metallic piping, piping components exposed to treated water, treated borated water, raw water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VII.C1.A-409 VII.E1.A-407 VII.E3.A-408
M	127	BWR/PWR	Metallic piping, piping components, tanks exposed to closed-cycle cooling water, raw water, raw water (potable), treated water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M20, "Open-Cycle Cooling Water System," AMP XI.M27, "Fire Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.3.2.2.7)	VII.C1.A-400 VII.C3.A-400 VII.E5.A-400 VII.G.A-400
M	128	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete, air, condensation, raw water	Loss of material due to general, pitting, crevice corrosion, MIC (soil, raw water environments only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VII.C3.A-401 VII.E5.A-401 VII.H1.A-401
D	129						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	130	BWR/PWR	Metallic sprinklers exposed to air, condensation, raw water, treated water	Loss of material due to general (where applicable), pitting, crevice corrosion, MIC (raw water, treated water only and all metals except for aluminum); 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, condensation	Flow blockage due to fouling	AMP XI.M27, "Fire Water System"	No	VII.G.A-404
M	132	BWR/PWR	Insulated steel, copper alloy (>15% Zn or >8% Al), piping, piping components, tanks, tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to general (steel only), pitting, crevice corrosion; cracking due to SCC (copper alloy (>15% Zn or >8% Al) only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" or AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VII.I.A-405a VII.I.A-405b
M	133	BWR/PWR	HDPE underground piping, piping components	Cracking, blistering, change in color due to water absorption	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.A-406

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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	134	BWR/PWR	Steel, stainless steel, copper alloy piping, piping components, and heat exchanger components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-727
M	135	BWR/PWR	Steel, stainless steel pump casings exposed to waste water environment	Loss of material due to general (steel only), pitting, crevice corrosion, MIC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.E5.A-410 VII.E5.A-411
M	136	BWR/PWR	Steel fire water storage tanks exposed to air, condensation, soil, concrete, raw water, treated water	Loss of material due to general, pitting, crevice corrosion, MIC (raw water, treated water, soil only)	AMP XI.M27, "Fire Water System"	No	VII.G.A-412
M	137	BWR/PWR	Steel, stainless steel, aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to treated water, raw water, waste water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, stainless steel only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VII.C3.A-413 VII.E5.A-413 VII.H1.A-413

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
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, fuel oil, lubricating oil, waste water	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage; loss of material or cracking for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.C1.A-416 VII.C2.A-416 VII.C3.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, fuel oil, lubricating oil, waste water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.C1.A-414 VII.C2.A-414 VII.C3.A-414 VII.E4.A-414 VII.E5.A-414 VII.F1.A-414 VII.F2.A-414 VII.F3.A-414 VII.F4.A-414 VII.G.A-414 VII.H1.A-414 VII.H2.A-414
M	140	BWR/PWR	Gray cast iron, ductile iron 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.E2.A-415 VII.E3.A-415 VII.E4.A-415 VII.E5.A-415 VII.G.A-415 VII.H1.A-415 VII.H2.A-415

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	141						
N	142	BWR/PWR	Stainless steel, steel, nickel alloy, copper alloy closure bolting exposed to fuel oil, lubricating oil, treated water, treated borated water, raw water, waste water	Loss of material due to general (steel; copper alloy in raw water, waste water only), pitting, crevice corrosion, MIC (raw water and waste water environments only)	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-423
D	143						
N	144	BWR/PWR	Stainless steel, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.A-425
N	145	BWR/PWR	Stainless steel closure bolting exposed to air, soil, concrete, underground, waste water	Cracking due to SCC	AMP XI.M18, "Bolting Integrity"	No	VII.I.A-426
N	146	BWR/PWR	Stainless steel underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.I.A-714a VII.I.A-714b VII.I.A-714c

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	147	BWR/PWR	Nickel alloy, nickel alloy cladding piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VII.C2.A-471
D	148						
N	149	BWR/PWR	Fiberglass piping, piping components, ducting, 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, piping components, ducting, ducting components exposed to air	Loss of material or cracking due to exposure to ultraviolet light, ozone, radiation, temperature, or moisture	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-720
N	151	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-716
D	153						
D	154						
N	155	BWR/PWR	Stainless steel piping, piping components, and tanks exposed to waste water >60°C (>140°F)	Cracking due to SCC	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.A-721
D	156						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	157	BWR/PWR	Steel piping, piping components, heat exchanger components exposed to air-outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M27, "Fire Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E1.A-722 VII.E2.A-722 VII.E3.A-722 VII.E4.A-722 VII.E5.A-722 VII.F1.A-722 VII.F2.A-722 VII.F3.A-722 VII.F4.A-722 VII.G.A-722 VII.H1.A-722 VII.H2.A-722
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; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-454
N	159	BWR/PWR	Fiberglass piping, piping components, ducting, ducting components exposed to air	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.D.A-495 VII.E5.A-495 VII.F1.A-495 VII.F2.A-495 VII.F3.A-495 VII.F4.A-495 VII.G.A-495 VII.H1.A-495 VII.H2.A-495

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	160	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components, heat exchanger components exposed to closed-cycle cooling water, raw water, waste water	Cracking due to SCC	AMP XI.M20, "Open-Cycle Cooling Water System," AMP XI.M21A, "Closed Treated Water Systems," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-473b VII.C2.A-473a VII.E5.A-473c
N	161	BWR/PWR	Copper alloy heat exchanger tubes exposed to condensation	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous 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.H2.A-565
D	162						
D	164						
D	165						
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 controlled, air – indoor uncontrolled	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 (steel only), pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.F1.A-566 VII.F2.A-566 VII.F3.A-566 VII.F4.A-566
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

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	171						
N	172	BWR/PWR	PVC piping, piping components exposed to air-outdoor	Reduction in impact strength due to photolysis	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.C1.A-458 VII.E5.A-458 VII.G.A-458
D	173						
D	174						
N	175	BWR/PWR	Fiberglass piping, piping components, tanks exposed to 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 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.I.A-462
N	178	BWR/PWR	Fiberglass piping and piping components exposed to concrete	None	None	No	VII.J.A-710

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	179	BWR/PWR	Masonry walls: structural fire barriers exposed to air	Cracking due to restraint shrinkage, creep, aggressive environment; loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.M26, "Fire Protection," and AMP XI.S5, "Masonry Walls"	No	VII.G.A-626
D	180						
N	181	BWR/PWR	Titanium piping, piping components exposed to condensation	None	None	No	VII.J.A-703
N	182	BWR/PWR	Non-metallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.I.A-704
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, condensation, soil, concrete, raw water	Cracking due to SCC	AMP XI.M27, "Fire Water System"	No	VII.G.A-623
N	186	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.C3.A-482a VII.C3.A-482b VII.C3.A-482c VII.E5.A-482a VII.E5.A-482b VII.E5.A-482c VII.H1.A-482a VII.H1.A-482b VII.H1.A-482c
D	187						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	189	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation, raw water, waste water	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.A2.A-451a VII.A2.A-451b VII.A2.A-451c VII.A2.A-451d VII.A3.A-451a VII.A3.A-451b VII.A3.A-451c VII.A3.A-451d VII.A4.A-451a VII.A4.A-451b VII.A4.A-451c VII.A4.A-451d VII.C1.A-451a VII.C1.A-451b VII.C1.A-451c VII.C1.A-451d VII.C2.A-451a VII.C2.A-451b VII.C2.A-451c VII.C2.A-451d VII.C3.A-451a VII.C3.A-451b VII.C3.A-451c VII.C3.A-451d VII.D.A-451a VII.D.A-451b VII.D.A-451c VII.D.A-451d VII.E1.A-451a VII.E1.A-451b VII.E1.A-451c VII.E1.A-451d VII.E2.A-451a VII.E2.A-451b VII.E2.A-451c VII.E2.A-451d VII.E3.A-451a VII.E3.A-451b VII.E3.A-451c

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report							
New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VII.E3.A-451d VII.E4.A-451a VII.E4.A-451b VII.E4.A-451c VII.E4.A-451d VII.E5.A-451a VII.E5.A-451b VII.E5.A-451c VII.E5.A-451d VII.F1.A-451a VII.F1.A-451b VII.F1.A-451c VII.F1.A-451d VII.F2.A-451a VII.F2.A-451b VII.F2.A-451c VII.F2.A-451d VII.F3.A-451a VII.F3.A-451b VII.F3.A-451c VII.F3.A-451d VII.F4.A-451a VII.F4.A-451b VII.F4.A-451c VII.F4.A-451d VII.G.A-451a VII.G.A-451b VII.G.A-451c VII.G.A-451d VII.H1.A-451a VII.H1.A-451b VII.H1.A-451c VII.H1.A-451d VII.H2.A-451a VII.H2.A-451b VII.H2.A-451c VII.H2.A-451d
D	190						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	191						
N	192	BWR/PWR	Aluminum underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.I.A-706a VII.I.A-706b VII.I.A-706c
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.A3.A-439 VII.A4.A-439 VII.C1.A-532 VII.C2.A-439 VII.C3.A-532 VII.E1.A-439 VII.E2.A-439 VII.E3.A-439 VII.E4.A-532 VII.E5.A-785 VII.G.A-439 VII.G.A-532 VII.H2.A-439 VII.H2.A-532
N	194	BWR/PWR	PVC piping, piping components, and tanks exposed to soil	Loss of material due to wear	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.A-537

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	195	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to raw water, treated water, raw water (potable)	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement (reinforced concrete piping, piping components due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow blockage due to fouling (raw water only)	AMP XI.M27, "Fire Water System"	No	VII.G.A-647
N	196	BWR/PWR	HDPE piping, piping components exposed to raw water, treated water, raw water (potable)	Cracking, blistering, change in color due to water absorption; flow blockage due to fouling (raw water only)	AMP XI.M27, "Fire Water System"	No	VII.G.A-648
N	197	BWR/PWR	Metallic fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached) intended function exposed to any external environment except soil, concrete	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VII.G.A-649

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	198	BWR/PWR	Metallic fire water system piping, piping components, heat exchanger, heat exchanger components (any material) with only a leakage boundary (spatial) or structural integrity (attached) intended function	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC (all metallic materials except aluminum; in liquid environments only)	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.G.A-650
N	199	BWR/PWR	Cranes: steel structural bolting exposed to air	Loss of preload due to self-loosening; loss of material due to general corrosion; cracking	AMP XI.M23, "Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems"	No	VII.B.A-730
D	200						
N	202	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.3.2.2.9)	VII.J.AP-19
N	203	BWR	Stainless steel; steel with stainless steel cladding, nickel alloy piping, piping components, heat exchanger components, tanks exposed to treated water, sodium pentaborate solution	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.A4.AP-110 VII.A4.AP-111 VII.E2.AP-141 VII.E3.AP-110 VII.E4.AP-110
D	204						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	205	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.I.A-734a VII.I.A-734b VII.I.A-734c VII.I.A-734d
D	206						
N	207	BWR/PWR	Stainless steel, copper alloy, titanium heat exchanger tubes exposed to raw water (for components not covered by NRC GL 89-13)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-736
N	208	BWR/PWR	Concrete, concrete cylinder piping, reinforced concrete, asbestos cement, cementitious piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Cracking due to chemical reaction, weathering, settlement, or corrosion of reinforcement (reinforced concrete only); loss of material due to delamination, exfoliation, spalling, popout, scaling, or cavitation; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-737
D	209						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	210	BWR/PWR	HDPE piping, piping components exposed to raw water (for components not covered by NRC GL 89-13)	Cracking, blistering, change in color due to water absorption; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-739
D	211						
D	212						
D	213						
N	214	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VII.C1.A-743 VII.C2.A-743 VII.C3.A-743 VII.D.A-743 VII.E4.A-743 VII.E5.A-743 VII.G.A-743 VII.H1.A-743 VII.H2.A-743
N	215	BWR/PWR	Aluminum fire water storage tanks exposed to air, condensation, soil, concrete, raw water, treated water	Loss of material due to pitting, crevice corrosion	AMP XI.M27, "Fire Water System"	No	VII.G.A-744
N	216	BWR/PWR	Stainless steel fire water storage tanks exposed to air, condensation, soil, concrete, raw water	Cracking due to SCC	AMP XI.M27, "Fire Water System"	No	VII.G.A-745
D	217						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	218	BWR/PWR	Stainless steel fire water storage tanks exposed to air, condensation, soil, concrete, raw water, treated water	Loss of material due to pitting, crevice corrosion, MIC (water and soil environment only)	AMP XI.M27, "Fire Water System"	No	VII.G.A-747
N	219	BWR/PWR	Stainless steel piping, piping components exposed to steam	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.F1.A-748 VII.F2.A-748 VII.F3.A-748 VII.F4.A-748
D	220						
D	221						
N	222	BWR/PWR	Stainless steel, nickel alloy tanks exposed to air, condensation (internal/external)	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-751b VII.I.A-751c VII.I.A-751d VII.I.A-751e
N	223	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-752a VII.I.A-752b VII.I.A-752c
D	224						
D	225						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	226	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VII.I.A-755
N	227	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C3.A-756a VII.C3.A-756b VII.C3.A-756c VII.E5.A-756a VII.E5.A-756b VII.E5.A-756c VII.H1.A-756a VII.H1.A-756b VII.H1.A-756c
N	228	BWR/PWR	Stainless steel, nickel alloy tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.C3.A-757a VII.C3.A-757b VII.C3.A-757c VII.E5.A-757a VII.E5.A-757b VII.E5.A-757c VII.H1.A-757a VII.H1.A-757b VII.H1.A-757c
N	229	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VII.C3.A-758 VII.E5.A-758 VII.H1.A-758

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	230	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	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, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.3)	VII.C3.A-760a VII.C3.A-760b VII.C3.A-760c VII.E5.A-760a VII.E5.A-760b VII.E5.A-760c VII.H1.A-760a VII.H1.A-760b VII.H1.A-760c
N	232	BWR/PWR	Insulated stainless steel, nickel alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-761a VII.I.A-761b VII.I.A-761c VII.I.A-761d

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	233	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.I.A-762a VII.I.A-762b VII.I.A-762c VII.I.A-762d
N	234	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.J.A-763a VII.J.A-763b VII.J.A-763c VII.J.A-763d
N	235	BWR/PWR	Steel, copper alloy, copper alloy (>15% Zn or >8% Al) piping, piping components exposed to air-dry (internal)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M24, "Compressed Air Monitoring"	No	VII.D.A-764
N	236	BWR/PWR	Titanium 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.A3.A-765 VII.A4.A-765 VII.C1.A-765 VII.C3.A-765 VII.E1.A-765 VII.E3.A-765 VII.G.A-765 VII.H2.A-765

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	237	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	VII.J.A-766
N	238	BWR/PWR	Titanium 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.A-767 VII.E3.A-767 VII.E4.A-767 VII.F1.A-767 VII.F2.A-767 VII.F3.A-767 VII.F4.A-767
N	239	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to closed-cycle cooling water	None	None	No	VII.J.A-768
N	240	BWR/PWR	Aluminum heat exchanger components exposed to waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.E5.A-769a VII.E5.A-769b VII.E5.A-769c VII.E5.A-769d

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	241	BWR/PWR	Stainless steel, nickel alloy heat exchanger components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.F1.A-770a VII.F1.A-770b VII.F1.A-770c VII.F1.A-770d VII.F2.A-770a VII.F2.A-770b VII.F2.A-770c VII.F2.A-770d VII.F3.A-770a VII.F3.A-770b VII.F3.A-770c VII.F3.A-770d VII.F4.A-770a VII.F4.A-770b VII.F4.A-770c VII.F4.A-770d
N	242	BWR/PWR	Aluminum heat exchanger components exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.F1.A-771a VII.F1.A-771b VII.F1.A-771c VII.F1.A-771d VII.F2.A-771a VII.F2.A-771b VII.F2.A-771c VII.F2.A-771d VII.F3.A-771a VII.F3.A-771b VII.F3.A-771c VII.F3.A-771d VII.F4.A-771a VII.F4.A-771b VII.F4.A-771c VII.F4.A-771d
D	243						

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	244	BWR	Stainless steel, nickel alloy piping, piping components exposed to treated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.E3.A-773 VII.E4.A-773
N	245	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.I.A-774a VII.I.A-774b VII.I.A-774c VII.I.A-774d
N	246	BWR/PWR	Stainless steel, nickel alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.4)	VII.I.A-775a VII.I.A-775b VII.I.A-775c
N	247	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.10)	VII.C1.A-776a VII.C1.A-776b VII.C1.A-776c VII.C1.A-776d VII.C3.A-776a VII.C3.A-776b VII.C3.A-776c VII.C3.A-776d VII.E5.A-776a VII.E5.A-776b VII.E5.A-776c VII.E5.A-776d

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	248	BWR/PWR	Aluminum piping, piping components, tanks exposed to air with borated water leakage	None	None	No	VII.J.A-777
N	249	BWR/PWR	Steel heat exchanger tubes internal to components exposed to air-outdoor, air-indoor uncontrolled, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-778 VII.F1.A-778 VII.F2.A-778 VII.F3.A-778 VII.F4.A-778
N	250	BWR/PWR	Steel reactor coolant pump oil collection system tanks, piping, piping components exposed to lubricating oil (waste oil)	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M32, "One-Time Inspection"	No	VII.G.AP-116 VII.G.AP-117
D	251						
N	252	BWR/PWR	Aluminum piping, piping components exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VII.I.AP-173
N	253	BWR/PWR	PVC piping, piping components exposed to raw water, waste water	Loss of material due to wear; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," AMP XI.M27, "Fire Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.C1.A-787a VII.C1.A-787c VII.E5.A-787d VII.G.A-787b

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	254	BWR/PWR	Aluminum heat exchanger components exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.3.2.2.8)	VII.F1.A-788a VII.F1.A-788b VII.F1.A-788c VII.F1.A-788d VII.F2.A-788a VII.F2.A-788b VII.F2.A-788c VII.F2.A-788d VII.F3.A-788a VII.F3.A-788b VII.F3.A-788c VII.F3.A-788d VII.F4.A-788a VII.F4.A-788b VII.F4.A-788c VII.F4.A-788d
N	255	BWR/PWR	Any material fire damper assemblies exposed to air	Loss of material due to general, pitting, crevice corrosion; cracking due to SCC; hardening, loss of strength, shrinkage due to elastomer degradation	AMP XI.M26, "Fire Protection"	No	VII.G.A-789

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	256	BWR/PWR	Titanium heat exchanger components other than tubes exposed to raw water	Loss of material due to pitting, crevice corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.A3.A-790a VII.A3.A-790b VII.A4.A-790a VII.A4.A-790b VII.C1.A-790a VII.C1.A-790b VII.C2.A-790a VII.C2.A-790b VII.C3.A-790a VII.C3.A-790b VII.E1.A-790a VII.E1.A-790b VII.E3.A-790a VII.E3.A-790b VII.E4.A-790a VII.E4.A-790b VII.F1.A-790a VII.F1.A-790b VII.F2.A-790a VII.F2.A-790b VII.F3.A-790a VII.F3.A-790b VII.F4.A-790a VII.F4.A-790b VII.G.A-790a VII.G.A-790b VII.H2.A-790a VII.H2.A-790b

<b>Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	257	BWR/PWR	Steel, stainless 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	VII.C1.A-791 VII.C2.A-791 VII.C3.A-791 VII.E1.A-791 VII.E4.A-791 VII.F1.A-791 VII.F2.A-791 VII.F3.A-791 VII.F4.A-791 VII.G.A-791 VII.H2.A-791
N	258	BWR/PWR	Metallic, elastomer, fiberglass, HDPE piping, piping components exposed to waste water	Flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.E5.A-780
N	259	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VII.A3.A-781 VII.A4.A-781 VII.C1.A-781a VII.C1.A-781b VII.C2.A-781 VII.C3.A-781 VII.E1.A-781 VII.E2.A-781 VII.E3.A-781 VII.E4.A-781 VII.F1.A-781 VII.F2.A-781 VII.F3.A-781 VII.F4.A-781 VII.H1.A-781 VII.H2.A-781

**Table 3.3-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Auxiliary Systems**

<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
AMP XI.M2	Water Chemistry
AMP XI.M7	BWR Stress Corrosion Cracking
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M22	Boraflex Monitoring
AMP XI.M23	Inspection of Overhead Heavy and Light Loads (Related to Refueling) Handling Systems
AMP XI.M24	Compressed Air Monitoring
AMP XI.M25	BWR Reactor Water Cleanup System
AMP XI.M26	Fire Protection
AMP XI.M27	Fire Water System
AMP XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M30	Fuel Oil Chemistry
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M40	Monitoring of Neutron-Absorbing Materials Other than Boraflex
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
AMP XI.S6	Structures Monitoring
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A	Aging Management Review—Generic (Branch Technical Position RLSB-1)

1 **3.4 Aging Management of Steam and Power Conversion System**

2 **Review Responsibilities**

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

5 **Secondary**—None

6 **3.4.1 Areas of Review**

7 This section addresses the aging management review (AMR) and the associated aging  
8 management programs (AMPs) of the steam and power conversion system. For a recent vintage  
9 plant, the information related to the steam and power conversion system is contained in  
10 Chapter 10, “Steam and Power Conversion System,” of the plant’s Final Safety Analysis Report  
11 (FSAR), consistent with the “Standard Review Plan for the Review of Safety Analysis Reports for  
12 Nuclear Power Plants” (NUREG–0800). The steam and power conversion systems contained in  
13 this review plan section are generally consistent with those contained in NUREG–0800 except for  
14 the condenser circulating water and the condensate storage systems. For older plants, the  
15 location of applicable information is plant-specific because an older plant’s FSAR may have  
16 predated NUREG–0800.

17 Typical steam and power conversion systems that are subject to an AMR for subsequent license  
18 renewal (SLR) are steam turbine, main steam, extraction steam, feedwater, condensate, steam  
19 generator blowdown, and auxiliary feedwater (AFW). This review plan section also includes  
20 structures and components (SCs) in nonsafety-related systems that are not connected to  
21 safety-related systems, structures, and components (SSCs) but have a spatial relationship such  
22 that their failure could adversely impact the performance of a safety-related SSC-intended  
23 function. Examples of such nonsafety-related systems may be extraction steam, plant heating  
24 steam/auxiliary boilers and hot water heating systems.

25 The aging management for the steam generator is reviewed following the guidance in Section 3.1  
26 of this SRP-SLR. The aging management for portions of the boiling water reactor (BWR) main  
27 steam and main feedwater systems, extending from the reactor vessel to the outermost  
28 containment isolation valve, is reviewed separately following the guidance in Section 3.1 of  
29 this SRP-SLR.

30 The responsible review organization is to review the following subsequent license renewal  
31 application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

32 **AMRs**

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

1 **AMPs**

- 2 • Consistent with the GALL-SLR Report AMPs  
3 • Plant-specific AMPs;

4 **FSAR Supplement**

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

7 **3.4.2 Acceptance Criteria**

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

11 **3.4.2.1 *Aging Management Review Results Consistent With the Generic Aging Lessons***  
12 ***Learned for Subsequent License Renewal Report***

13 The AMR and the AMPs applicable to the steam and power conversion system are described and  
14 evaluated in Chapter VIII of the GALL-SLR Report.

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

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

23 **3.4.2.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by***  
24 ***the Generic Aging Lessons Learned for Subsequent License Renewal Report***

25 The basic acceptance criteria, defined in Subsection 3.4.2.1, need to be applied first for all of the  
26 AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item  
27 to which the SLRA AMR item is compared identifies that "further evaluation is recommended,"  
28 then additional criteria apply as identified by the GALL-SLR Report for each of the following aging  
29 effect/aging mechanism combinations. Refer to Table 3.4-1, comparing the "Further Evaluation  
30 Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the  
31 following subsections.

32 **3.4.2.2.1 *Cumulative Fatigue Damage***

33 Evaluations involving time-dependent fatigue or cyclical loading parameters may be time-limited  
34 aging analyses (TLAAs), as defined in 10 CFR 54.3. TLAAs are required to be evaluated in  
35 accordance with 10 CFR 54.21(c)(1). This TLAA is addressed separately in Section 4.3, "Metal  
36 Fatigue," or Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR  
37 Report. For plant-specific cumulative usage factor calculations that are based on stress-based

1 input methods, the methods are to be appropriately defined and discussed in the  
2 applicable TLAAs.

3 **3.4.2.2.2 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys**

4 Cracking due to stress corrosion cracking (SCC) could occur in indoor or outdoor SS piping,  
5 piping components, and tanks exposed to any air, condensation, or underground environment  
6 when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity of insulated components,  
7 or (d) in the vicinity of potentially transportable halogens. Cracking can occur in environments  
8 containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

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

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

22 The GALL-SLR Report recommends further evaluation of SS piping, piping components, and  
23 tanks exposed to an air, condensation, or underground environment to determine whether an  
24 AMP is needed to manage the aging effect of SCC. The GALL-SLR Report AMP XI.M32,  
25 "One-Time Inspection," describes an acceptable program to demonstrate that SCC is not  
26 occurring. If SCC is occurring, the following AMPs describe acceptable programs to manage loss  
27 of material due to SCC: (a) GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric  
28 Metallic Storage Tanks," for tanks; (b) GALL-SLR Report AMP XI.M36, "External Surfaces  
29 Monitoring of Mechanical Components," for external surfaces of piping and piping components;  
30 (c) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground  
31 piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, "Inspection of  
32 Internal Surfaces in Miscellaneous Piping and Ducting Components," for internal surfaces of  
33 components that are not included in other AMPs. The timing of the one-time or periodic  
34 inspections is consistent with that recommended in the AMP selected by the applicant during the  
35 development of the SLRA. For example, one-time inspections would be conducted between the  
36 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the "detection of aging effects" program  
37 element in AMP XI.M32.

38 The applicant may establish that SCC is not an aging effect requiring management for all  
39 components, by demonstrating that a barrier coating isolates the component from aggressive  
40 environments. Acceptable barriers include tightly-adhering coatings that have been demonstrated  
41 to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier  
42 coating is credited for isolating a component from a potentially aggressive environment, then the  
43 barrier coating is evaluated to verify that it is impervious to the plant-specific environment. The  
44 GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping

1 Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the  
2 integrity of a barrier coating.

3 *3.4.2.2.3 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
4 *Nickel Alloys*

5 Loss of material due to pitting and crevice corrosion could occur in indoor or outdoor SS and  
6 nickel alloy piping, piping components, and tanks exposed to any air, condensation, or  
7 underground environment when the component is: (a) uninsulated; (b) insulated; (c) in the vicinity  
8 of insulated components; or (d) in the vicinity of potentially transportable halogens. Loss of  
9 material due to pitting and crevice corrosion can occur on SS and nickel alloys in environments  
10 containing sufficient halides (e.g., chlorides) in the presence of moisture.

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

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

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

29 The GALL-SLR Report recommends further evaluation of SS and nickel alloy piping, piping  
30 components, and tanks exposed to an air, condensation, or underground environment to  
31 determine whether an AMP is needed to manage the aging effect of loss of material due to pitting  
32 and crevice corrosion. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” describes an  
33 acceptable program to demonstrate that loss of material due to pitting and crevice corrosion is not  
34 occurring at a rate that affects the intended function of the components. If loss of material due to  
35 pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function  
36 of an SSC, the following AMPs describe acceptable programs to manage loss of material due to  
37 pitting or crevice corrosion: (a) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric  
38 Metallic Storage Tanks,” for tanks; (b) GALL-SLR Report AMP XI.M36, “External Surfaces  
39 Monitoring of Mechanical Components,” for external surfaces of piping and piping components;  
40 (c) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground  
41 piping, piping components and tanks; and (d) GALL-SLR Report AMP XI.M38, “Inspection of  
42 Internal Surfaces in Miscellaneous Piping and Ducting Components,” for internal surfaces of  
43 components that are not included in other AMPs. The timing of the one-time or periodic  
44 inspections is consistent with that recommended in the AMP selected by the applicant during the  
45 development of the SLRA. For example, one-time inspections would be conducted between the

1 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the “detection of aging effects” program  
2 element in AMP XI.M32.

3 The applicant may establish that loss of material due to pitting and crevice corrosion is not an  
4 aging effect requiring management by demonstrating that a barrier coating isolates the component  
5 from aggressive environments. Acceptable barriers include coatings that have been  
6 demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides.  
7 If a barrier coating is credited for isolating a component from a potentially aggressive environment,  
8 then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment.  
9 GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping  
10 Components, Heat Exchangers, and Tanks,” describes an acceptable program to manage the  
11 integrity of a barrier coating.

#### 12 3.4.2.2.4 *Quality Assurance for Aging Management of Nonsafety-Related Components*

13 Acceptance criteria are described in Branch Technical Position (BTP) IQMB-1 (Appendix A.2, of  
14 this SRP-SLR Report).

#### 15 3.4.2.2.5 *Ongoing Review of Operating Experience*

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

#### 18 3.4.2.2.6 *Loss of Material Due to Recurring Internal Corrosion*

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

29 The GALL-SLR Report recommends that GALL-SLR Report AMP XI.M38, “Inspection of Internal  
30 Surfaces in Miscellaneous Piping and Ducting Components,” be evaluated for inclusion of  
31 augmented requirements to ensure the adequate management of any recurring aging effect(s).  
32 Alternatively, a plant-specific AMP may be proposed. Potential augmented requirements include:  
33 (i) alternative examination methods (e.g., volumetric versus external visual); (ii) augmented  
34 inspections (e.g., a greater number of locations, additional locations based on risk insights based  
35 on susceptibility to aging effect and consequences of failure, a greater frequency of inspections),  
36 and (iii) additional trending parameters and decision points where increased inspections would  
37 be implemented.

38 The applicant states: (a) why the program’s examination methods will be sufficient to detect the  
39 recurring aging effect before affecting the ability of a component to perform its intended function,  
40 (b) the basis for the adequacy of augmented or lack of augmented inspections, (c) what  
41 parameters will be trended as well as the decision points where increased inspections would be  
42 implemented (e.g., the extent of degradation at individual corrosion sites, the rate of degradation

1 change), (d) how inspections of components that are not easily accessed (i.e., buried,  
2 underground) will be conducted, and (e) how leaks in any involved buried or underground  
3 components will be identified.

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

#### 16 3.4.2.2.7 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

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

26 Susceptible Material: If the material is not susceptible to SCC, then cracking is not an aging effect  
27 requiring management. The microstructure of an aluminum alloy, of which alloy composition is  
28 only one factor, is what determines whether the alloy is susceptible to SCC. Therefore,  
29 determining susceptibility based on alloy composition alone is not adequate to conclude whether a  
30 particular material is susceptible to SCC. The temper, condition, and product form of the alloy is  
31 considered when assessing if a material is susceptible to SCC. Aluminum alloys that are  
32 susceptible to SCC include:

- 33 • 2xxx series alloys in the F, W, O<sub>x</sub>, T3<sub>x</sub>, T4<sub>x</sub>, or T6<sub>x</sub> temper
- 34 • 5xxx series alloys with a magnesium content of 3.5 weight percent or greater
- 35 • 6xxx series alloys in the F temper
- 36 • 7xxx series alloys in the F, T5<sub>x</sub>, or T6<sub>x</sub> temper
- 37 • 2xx.x and 7xx.x series alloys
- 38 • 3xx.x series alloys that contain copper
- 39 • 5xx.x series alloys with a magnesium content of greater than 8 weight percent

40 The material is evaluated to verify that it is not susceptible to SCC and that the basis used to  
41 make the determination is technically substantiated. Tempers have been specifically developed  
42 to improve the SCC resistance for some aluminum alloys. Aluminum alloy and temper  
43 combination which are not susceptible to SCC when used in piping, piping component, and tank  
44 applications include 1xxx series, 3xxx series, 6061-T6<sub>x</sub>, and 5454-x. If it is determined that a  
45 material is not susceptible to SCC, the SLRA provides the components/locations where it is used,

1 alloy composition, temper or condition, product form, and for tempers not addressed above, the  
2 basis used to determine the alloy is not susceptible and technical information substantiating  
3 the basis.

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

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

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

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

1 3.4.2.2.8 *Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
2 *Stress Corrosion Cracking*

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

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

27 3.4.2.2.9 *Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

28 Loss of material due to pitting and crevice corrosion could occur in aluminum piping, piping  
29 components, and tanks exposed to an air, condensation, underground, raw water, or waste water  
30 environment for a sufficient duration of time. Environments that can result in pitting and/or crevice  
31 corrosion of aluminum alloys are those that contain halides (e.g., chloride) in the presence of  
32 moisture. The moisture level and halide concentration in atmospheric and uncontrolled air are  
33 greatly dependent on geographical location and site-specific conditions. Moisture level and halide  
34 concentration should generally be considered high enough to facilitate pitting and/or crevice  
35 corrosion of aluminum alloys in atmospheric and uncontrolled air, unless demonstrated otherwise.  
36 The periodic introduction of moisture or halides into an environment from secondary sources  
37 should also be considered. Leakage of fluids from mechanical connections (e.g., insulated bolted  
38 flanges and valve packing); onto a component in indoor controlled air is an example of a  
39 secondary source that should be considered. Halide concentrations should generally be  
40 considered high enough to facilitate loss of material of aluminum alloys in untreated aqueous  
41 solutions, unless demonstrated otherwise. Plant-specific OE and the condition of aluminum alloy  
42 components are evaluated to determine if prolonged exposure to the plant-specific air,  
43 condensation, underground, or water environments has resulted in pitting or crevice corrosion.  
44 Loss of material due to pitting and crevice corrosion is not an aging effect requiring management  
45 for aluminum alloys if: (a) plant-specific OE does not reveal a history of loss of material due to  
46 pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not

1 occurring or is occurring so slowly that it will not affect the intended function of the components.  
2 The applicant documents the results of the plant-specific OE review in the SLRA.

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

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

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

35 *3.4.2.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
36 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

38 *3.4.2.4 Aging Management Programs*

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

42 If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
43 Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of

1 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA  
2 AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the  
3 SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR  
4 Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the  
5 difference should be reviewed and properly dispositioned. The reviewer should document the  
6 disposition of all SLRA-defined exceptions and NRC staff-identified differences.

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

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

#### 17 3.4.2.5 *Final Safety Analysis Report Supplement*

18 The summary description of the programs and activities for managing the effects of aging for the  
19 subsequent period of extended operation in the FSAR Supplement should be sufficiently  
20 comprehensive that later changes can be controlled by 10 CFR 50.59. The description should  
21 contain information associated with the bases for determining that aging effects will be managed  
22 during the subsequent period of extended operation. The description should also contain any  
23 future aging management activities, including enhancements and commitments, to be completed  
24 before the subsequent period of extended operation. Table X-01 and Table XI-01 of the  
25 GALL-SLR Report provide examples of the type of information to be included in the FSAR  
26 Supplement. Table 3.4-2 lists the programs that are applicable for this SRP-SLR subsection.

### 27 **3.4.3 Review Procedures**

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

#### 29 3.4.3.1 *Aging Management Review Results Consistent With the Generic Aging Lessons* 30 *Learned for Subsequent License Renewal Report*

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

41 Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the  
42 issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm

1 that the applicant has identified those aging effects for the steam and power conversion system  
2 components that are contained in the GALL-SLR Report as applicable to its plant.

3 **3.4.3.2 Aging Management Review Results for Which Further Evaluation Is Recommended by**  
4 **the Generic Aging Lessons Learned for Subsequent License Renewal Report**

5 The basic review procedures defined in Subsection 3.4.3.1 need to be applied first for all of the  
6 AMRs and AMPs provided in this section. In addition, if the GALL-SLR Report AMR item to which  
7 the SLRA AMR item is compared identifies that “further evaluation is recommended,” then  
8 additional criteria apply as identified by the GALL-SLR Report for each of the following aging  
9 effect/aging mechanism combinations. Refer to Table 3.4-1 for the item references for the  
10 following subsections.

11 **3.4.3.2.1 Cumulative Fatigue Damage**

12 Evaluations involving time-dependent fatigue or cyclical loading parameters may be TLAAAs,  
13 as defined in 10 CFR 54.3. TLAAAs are required to be evaluated in accordance with  
14 10 CFR 54.21(c)(1).

15 The staff reviews the information on a case-by-case basis consistent with the review procedures  
16 in SRP-SLR Section 4.3 or 4.7 (as applicable) to determine whether the applicant has provided  
17 a sufficient basis for dispositioning the TLAAAs in accordance with the acceptance criteria in  
18 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff’s review of those cumulative usage  
19 factor analyses that qualify as TLAAAs and are based on plant-specific, stress-based  
20 calculation methods.

21 **3.4.3.2.2 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys**

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

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

33 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
34 plant-specific environments into subcategories. For example, the OE search could be based on  
35 two environments including outdoor air and indoor air. The results could be that SCC has  
36 occurred in the outdoor air environment but not the indoor air environment. The applicant could  
37 further categorize the indoor air locations as those where leakage could impinge on the SS  
38 component’s surface (e.g., leakage from mechanical connections) and those where there is not a  
39 potential for leakage. When the applicant chooses to conduct its OE search in this manner, the  
40 reviewer also is to confirm that the applicant has adequately addressed the potential for the  
41 periodic introduction of either moisture or halides from secondary sources. Secondary sources of  
42 moisture or halides should be considered for all environments including indoor conditioned air.

1 Typical secondary sources of moisture or halides include: leakage from mechanical connections;  
2 leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of  
3 environments consistent with that described in the detection of aging effects program element of  
4 GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and  
5 Ducting Components," is appropriate.

6 *3.4.3.2.3 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel and*  
7 *Nickel Alloys*

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

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

21 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
22 plant-specific environments into subcategories. For example, the OE search could be based on  
23 two environments including outdoor air and indoor air. The results could be that loss of material  
24 due to pitting and crevice corrosion has occurred in the outdoor air environment but not the indoor  
25 air environment. The applicant could further categorize the indoor air locations as those where  
26 leakage could impinge on the SS or nickel alloy component's surface (e.g., leakage from  
27 mechanical connections) and those where there is not a potential for leakage. When the applicant  
28 chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant  
29 has adequately addressed the potential for the periodic introduction of either moisture or halides  
30 from secondary sources. Secondary sources of moisture or halides should be considered for all  
31 environments including indoor conditioned air. Typical secondary sources of moisture or halides  
32 include: leakage from mechanical connections; leakage into vaults; insulation containing halides;  
33 and outdoor air intrusion. Grouping of environments consistent with that described in the  
34 detection of aging effects program element of GALL-SLR Report AMP XI.M38, "Inspection of  
35 Internal Surfaces in Miscellaneous Piping and Ducting Components," is appropriate.

36 *3.4.3.2.4 Quality Assurance for Aging Management of Nonsafety-Related Components*

37 The applicant's AMPs for SLR should contain the elements of corrective actions, the confirmation  
38 process, and administrative controls. Safety-related components are covered by 10 CFR Part 50,  
39 Appendix B, which is adequate to address these program elements. However, Appendix B does  
40 not apply to nonsafety-related components that are subject to an AMP for SLR. Nevertheless, the  
41 applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to  
42 include these components and address these program elements. If the applicant chooses this  
43 option, the reviewer confirms that the applicant has documented such a commitment in the FSAR  
44 Supplement. An example description is in Appendix A of the GALL-SLR Report. If the applicant

1 chooses alternative means, the branch responsible for QA should be requested to review the  
2 applicant's proposal on a case-by-case basis.

### 3 3.4.3.2.5 *Ongoing Review of Operating Experience*

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

12 In addition, the reviewer confirms that the applicant has provided an appropriate summary  
13 description of these activities in the FSAR Supplement. The GALL-SLR Report provides  
14 examples of the type of information to be included in the FSAR Supplement.

### 15 3.4.3.2.6 *Loss of Material Due to Recurring Internal Corrosion*

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

25 The reviewer should evaluate plant-specific OE examples to determine if the chosen AMP should  
26 be augmented. For example, during a 10-year search of plant-specific OE, two instances of a  
27 360 degree 30 percent wall loss occurred at copper alloy to steel joints. Neither the significance  
28 of the aging effect nor the frequency of occurrence of aging effect threshold has been exceeded.  
29 Nevertheless, the OE should be evaluated to determine if the AMP that is proposed to manage  
30 the aging effect is sufficient (e.g., method of inspection, frequency of inspection, number of  
31 inspections) to provide reasonable assurance that the CLB intended functions of the component  
32 will be met throughout the subsequent period of extended operation.

33 The reviewer determines whether a proposed program is adequate to manage recurring internal  
34 corrosion by evaluating the proposed AMP against the criteria in SRP-SLR Section 3.4.2.2.6.

### 35 3.4.3.2.7 *Cracking Due to Stress Corrosion Cracking in Aluminum Alloys*

36 The GALL-SLR Report recommends the further evaluation of aluminum components (i.e., piping,  
37 piping components, and tanks) exposed to air, condensation, underground, or aqueous solutions  
38 that contain halides to manage cracking due to SCC. The reviewer must first determine if  
39 cracking due to SCC is applicable and requires aging management. Cracking is to be considered  
40 applicable unless it is demonstrated that one of the two acceptance criteria are met by  
41 demonstrating that an aggressive environment is not present or the specific material is not  
42 susceptible, as discussed in Section 3.4.2.2.7. Additionally, guidance is also provided on the

1 review of the third condition necessary for SCC to occur, a sustained tensile stress. Each of three  
2 conditions is evaluated based on the review procedures below.

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

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

27 If a barrier coating is employed to effectively isolate the aluminum alloy from an aggressive  
28 environment, then cracking due to SCC is not an aging effect requiring management. The  
29 reviewer is to verify that the barrier coating is impermeable to the plant-specific aqueous solutions  
30 and air that the coating is intended to protect the alloy from being exposed to. If plant-specific OE  
31 is cited as a technical justification for the effectiveness of a barrier coating the reviewer is to verify  
32 that the applicant has a program to manage loss of coating integrity equivalent to the GALL-SLR  
33 Report AMP XI.M42.

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

41 The information necessary to determine if SCC is applicable based on the sustained service  
42 stress is often not readily available. The SCC threshold stress level is dependent on both the  
43 alloy (e.g., chemical composition, processing history, and microstructure) and service  
44 environment. Furthermore, the magnitude and state of the residual stress sustained by a  
45 component is typically not fully characterized. The reviewer must determine the adequacy of both  
46 the SCC threshold value being used by the applicant and the magnitude of the tensile stress

1 being experienced by the component. The evaluation of the SCC threshold value includes the  
2 verification that the (a) test method used to establish the threshold value is standardized and  
3 recognized by the industry, (b) data are statistically significant or conservative, and (c) data are for  
4 a relevant alloy, temper, product form, and environment. The evaluation of the tensile stress  
5 being experienced by the component includes the verification that the stress analysis accounts  
6 for: (a) all applied and residual stresses and (b) stress riser that can initiate SCC cracks, such as  
7 corrosion pits and fabrication defects.

8 Documentation that may assist the reviewer in determining if cracking due to SCC is applicable  
9 and requires aging management include: (a) component drawings, (b) applicable codes  
10 or specifications used in the design, fabrication, and installation of the component,  
11 (c) material-specific material certification data and lot release data, (d) maintenance records,  
12 and (e) plant-specific OE.

13 If it is determined that cracking due to SCC is applicable, the reviewer is to evaluate the applicants  
14 proposed AMP to ensure that cracking is adequately managed so that the component's intended  
15 functions will be maintained consistent with the CLB for the subsequent period of extended  
16 operation. The GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic  
17 Storage Tanks," describes an acceptable program to manage cracking due to SCC of aluminum  
18 in tanks. The GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical  
19 Components," describes an acceptable program to manage cracking due to SCC of aluminum  
20 piping and piping components. The GALL-SLR Report AMP XI.M41, "Buried and Underground  
21 Piping and Tanks," describes an acceptable program to manage cracking due to SCC of  
22 aluminum piping and tanks which are buried or underground. The GALL-SLR Report  
23 AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"  
24 describes an acceptable program to manage cracking due to SCC of aluminum components that  
25 are not included in other AMPs.

26 **3.4.3.2.8**      *Loss of Material Due to General, Crevice or Pitting Corrosion and Cracking Due to*  
27 *Stress Corrosion Cracking*

28 The GALL-SLR Report recommends that for steel piping and piping components exposed to  
29 concrete, if the following conditions are met, loss of material is not considered to be an applicable  
30 aging effect for steel: (a) attributes of the concrete are consistent with ACI 318 or ACI 349 (low  
31 water-to-cement ratio, low permeability, and adequate air entrainment) as cited in NUREG-1557;  
32 (b) plant-specific OE indicates no degradation of the concrete that could lead to penetration of  
33 water to the metal surface; and (c) the piping is not potentially exposed to groundwater. For SS  
34 piping and piping components, loss of material and cracking due to SCC are not considered to be  
35 applicable aging effects as long as the piping is not potentially exposed to groundwater. Where  
36 these conditions are not met, loss of material due to general (steel only), crevice or pitting  
37 corrosion and cracking due to SCC (SS only) are identified as applicable aging effects.  
38 GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," describes an  
39 acceptable program to manage these aging effects.

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

1    3.4.3.2.9       *Loss of Material Due to Pitting and Crevice Corrosion in Aluminum Alloys*

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

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

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

19   The grouping of alloys based on relative susceptibility to loss of material may also be appropriate.  
20   The reviewer is to verify that the considerations given to alloy susceptibility and/or grouping have  
21   a substantiated technical basis. The high strength heat treatable aluminum alloys (2xxx and 7xxx  
22   series) may be treated as a separate population when performing inspections and interpreting  
23   results due to their relatively lower corrosion resistance. The relative susceptibility of moderate  
24   and lower strength alloys varies based on composition (primarily weight percent Cu, Mg, and Fe)  
25   and temper designation.

26   The reviewer is to determine whether an adequate program is credited to manage the aging effect  
27   if the OE reveals that loss of material is applicable or the applicant elects to manage loss of  
28   material due to pitting or crevice corrosion. The reviewer is to verify that the SLRA cites the use of  
29   GALL-SLR Report AMP XI.M32, "One-Time Inspection," for all aluminum piping, piping  
30   components, and tanks exposed to air, condensation, or underground environments when  
31   confirming that the aging effect is not applicable based on the OE evaluation. Alternatively, if the  
32   applicant states that it will utilize a strategy of isolating the aluminum components from the  
33   environment, verify that the aluminum components are coated and GALL-SLR Report  
34   AMP XI.M42 has been cited to manage loss of coating integrity.

35   3.4.3.3       *Aging Management Review Results Not Consistent With or Not Addressed in the*  
36                    *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

1    3.4.3.4    *Aging Management Programs*

2    The reviewer confirms that the applicant has identified the appropriate AMPs as described and  
3    evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its  
4    SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this  
5    enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR  
6    Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program  
7    elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the  
8    exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not  
9    identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the  
10   SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference  
11   satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting  
12   enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report  
13   pertinent to the steam and power conversion system are summarized in Table 3.4-1 of this  
14   SRP-SLR. The “GALL-SLR Item” column identifies the AMR item numbers in the GALL-SLR  
15   Report, Chapter VIII, presenting detailed information summarized by this row.

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

19   3.4.3.5    *Final Safety Analysis Report Supplement*

20   The reviewer confirms that the applicant has provided in the FSAR Supplement information for  
21   aging management of the steam and power conversion systems. Table 3.4-2 lists the AMPs that  
22   are applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has  
23   provided information for Subsection 3.4.3.3, “Aging Management Review Results Not Consistent  
24   With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License  
25   Renewal Report.”

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

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

39   **3.4.4    Evaluation Findings**

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

1 On the basis of its review, as discussed above, the NRC staff concludes that the  
2 applicant has demonstrated that the aging effects associated with the steam and  
3 power conversion system components will be adequately managed so that the  
4 intended functions will be maintained consistent with the CLB for the subsequent  
5 period of extended operation, as required by 10 CFR 54.21(a)(3).

6 The NRC staff also reviewed the applicable FSAR Supplement program  
7 summaries and concludes that they adequately describe the AMPs credited for  
8 managing aging of the steam and power conversion system, as required by  
9 10 CFR 54.21(d).

### 10 **3.4.5 Implementation**

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

### 16 **3.4.6 References**

- 17 1. NRC. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports  
18 for Nuclear Power Plants." Agencywide Documents Access and Management System  
19 (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory  
20 Commission. March 2007.
- 21 2. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of  
22 10 CFR Part 54-The License Renewal Rule." Revision 6. ADAMS Accession No.  
23 ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.
- 24 3. NRC. NUREG-1557, "Summary of Technical Information and Agreements from Nuclear  
25 Management and Resources Council Industry Reports Addressing License Renewal."  
26 Washington, DC: U.S. Nuclear Regulatory Commission. October 1996.
- 27 4. ACI. ACI Standard 318-95, "Building Code Requirements for Reinforced Concrete and  
28 Commentary." Farmington Hills, Michigan: American Concrete Institute. 1995.
- 29 5. ACI. ACI Standard 349-85, "Code Requirements for Nuclear Safety-Related Concrete  
30 Structures." Farmington Hills, Michigan: American Concrete Institute. 1985.
- 31 6. ANSI. ANSI Standard H35.1/H35.1M, "Alloy and Temper Designation Systems for  
32 Aluminum." New York, New York: American National Standards Institute, Inc. 2013.
- 33 7. ASM. *Corrosion of Aluminum and Aluminum Alloys*. J. R. Davis, ed. Materials Park,  
34 Ohio: ASM International. 1999.
- 35 8. NRL. *Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum*  
36 *Alloys*. B. F. Brown, ed. Washington, DC: Naval Research Laboratory. 1972.

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	001	BWR/PWR	Steel piping, piping components exposed to any environment	Cumulative fatigue damage due to fatigue	TLAA, SRP-SLR Section 4.3 "Metal Fatigue"	Yes (SRP-SLR Section 3.4.2.2.1)	VIII.B1.S-08 VIII.B2.S-08 VIII.D1.S-11 VIII.D2.S-11 VIII.G.S-11
M	002	BWR/PWR	Stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.A.SP-118a VIII.A.SP-118b VIII.A.SP-118c VIII.A.SP-118d VIII.B1.SP-118a VIII.B1.SP-118b VIII.B1.SP-118c VIII.B1.SP-118d VIII.B2.SP-118a VIII.B2.SP-118b VIII.B2.SP-118c VIII.B2.SP-118d VIII.C.SP-118a VIII.C.SP-118b VIII.C.SP-118c VIII.C.SP-118d VIII.D1.SP-118a VIII.D1.SP-118b VIII.D1.SP-118c VIII.D1.SP-118d VIII.D2.SP-118a VIII.D2.SP-118b VIII.D2.SP-118c VIII.D2.SP-118d VIII.E.SP-118a VIII.E.SP-118b VIII.E.SP-118c VIII.E.SP-118d VIII.F.SP-118a VIII.F.SP-118b VIII.F.SP-118c VIII.F.SP-118d

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, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
							VIII.G.SP-118a VIII.G.SP-118b VIII.G.SP-118c VIII.G.SP-118d
M	003	BWR/PWR	Stainless steel, nickel alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.A.SP-127b VIII.A.SP-127c VIII.A.SP-127d VIII.A.SP-127e VIII.B1.SP-127b VIII.B1.SP-127c VIII.B1.SP-127d VIII.B1.SP-127e VIII.B2.SP-127b VIII.B2.SP-127c VIII.B2.SP-127d VIII.B2.SP-127e VIII.C.SP-127b VIII.C.SP-127c VIII.C.SP-127d VIII.C.SP-127e VIII.D1.SP-127b VIII.D1.SP-127c VIII.D1.SP-127d VIII.D1.SP-127e VIII.D2.SP-127b VIII.D2.SP-127c VIII.D2.SP-127d VIII.D2.SP-127e VIII.E.SP-127b VIII.E.SP-127c VIII.E.SP-127d VIII.E.SP-127e VIII.F.SP-127b VIII.F.SP-127c VIII.F.SP-127d VIII.F.SP-127e VIII.G.SP-127b

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
							VIII.G.SP-127c VIII.G.SP-127d VIII.G.SP-127e
M	004	PWR	Steel external surfaces exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	VIII.H.S-30
M	005	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Wall thinning due to flow-accelerated corrosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VIII.A.S-15 VIII.B1.S-15 VIII.B2.S-15 VIII.C.S-15 VIII.D1.S-16 VIII.D2.S-16 VIII.E.S-16 VIII.F.S-16 VIII.G.S-16
M	006	BWR/PWR	Metallic closure bolting exposed to any environment, soil, underground	Loss of preload due to thermal effects, gasket creep, self-loosening	AMP XI.M18, "Bolting Integrity"	No	VIII.H.SP-142
M	007	BWR/PWR	High-strength steel closure bolting exposed to air, soil, underground	Cracking due to SCC; cyclic loading	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-03
D	008						
M	009	BWR/PWR	Steel, stainless steel, nickel alloy closure bolting exposed to air-indoor uncontrolled, air-outdoor, condensation	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-02
D	010						

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	011	BWR/PWR	Stainless steel piping, piping components, tanks, heat exchanger components exposed to steam, treated water >60°C (>140°F)	Cracking due to SCC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-98 VIII.B1.SP-88 VIII.B1.SP-98 VIII.B2.SP-98 VIII.C.SP-88 VIII.D1.SP-88 VIII.E.SP-88 VIII.E.SP-97 VIII.F.SP-85 VIII.F.SP-88 VIII.G.SP-88
M	012	BWR/PWR	Steel tanks 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-75 VIII.G.SP-75
D	013						
M	014	BWR/PWR	Steel piping, piping components exposed to steam, treated water	Loss of material due to general, pitting, crevice corrosion, MIC (treated water only)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-71 VIII.B1.SP-71 VIII.B1.SP-74 VIII.B2.SP-160 VIII.B2.SP-73 VIII.C.SP-71 VIII.C.SP-73 VIII.D1.SP-74 VIII.D2.SP-73 VIII.E.SP-73 VIII.F.SP-74 VIII.G.SP-74
M	015	BWR/PWR	Steel heat exchanger components exposed to treated water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-77

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	016	BWR/PWR	Copper alloy, aluminum piping, piping components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC (copper alloy only)	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-101 VIII.D1.SP-90 VIII.D2.SP-90 VIII.E.SP-90 VIII.F.SP-101 VIII.F.SP-90 VIII.G.SP-90
D	017						
M	018	BWR/PWR	Copper alloy, stainless steel heat exchanger tubes exposed to treated water	Reduction of heat transfer due to fouling	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-100 VIII.E.SP-96 VIII.F.SP-96 VIII.F.SP-100 VIII.G.SP-100
M	019	BWR/PWR	Stainless steel, steel heat exchanger components exposed to raw water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.E.SP-117 VIII.E.SP-146 VIII.F.SP-146 VIII.F.SP-117 VIII.G.SP-117 VIII.G.SP-146
M	020	BWR/PWR	Copper alloy, stainless steel piping, piping components exposed to raw water	Loss of material due to general (copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.A.SP-31 VIII.E.SP-31 VIII.E.SP-36 VIII.F.SP-31 VIII.F.SP-36 VIII.G.SP-31 VIII.G.SP-36
D	021						
M	022	BWR/PWR	Stainless steel, copper alloy, steel heat exchanger tubes exposed to raw water	Reduction of heat transfer due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.E.S-28 VIII.E.SP-56 VIII.F.S-28 VIII.G.S-27 VIII.G.S-28 VIII.G.SP-56

<b>Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	023	BWR/PWR	Stainless steel piping, piping components exposed to closed-cycle cooling water >60°C (>140°F)	Cracking due to SCC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.SP-54 VIII.F.SP-54 VIII.G.SP-54
D	024						
M	025	BWR/PWR	Steel heat exchanger components exposed to closed-cycle cooling water	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.A.S-23 VIII.E.S-23 VIII.F.S-23 VIII.G.S-23
M	026	BWR/PWR	Stainless steel heat exchanger components, piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.S-25 VIII.E.SP-39 VIII.F.S-25 VIII.F.SP-39 VIII.G.S-25 VIII.G.SP-39
M	027	BWR/PWR	Copper alloy piping, piping components exposed to closed-cycle cooling water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.E.SP-8 VIII.F.SP-8 VIII.G.SP-8
M	028	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.A.SP-64 VIII.E.SP-41 VIII.E.SP-57 VIII.E.SP-64 VIII.F.SP-41 VIII.F.SP-64 VIII.G.SP-41 VIII.G.SP-64
D	029						
M	030	BWR/PWR	Steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete, air, condensation	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.SP-115 VIII.G.SP-116
D	031						

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	032	BWR/PWR	Gray cast iron, ductile iron piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.E.SP-26 VIII.G.SP-26
M	033	BWR/PWR	Gray cast iron, ductile iron, copper alloy (>15% Zn or >8% Al) piping, piping components exposed to treated water, raw water, closed-cycle cooling water	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.A.SP-27 VIII.A.SP-28 VIII.A.SP-30 VIII.E.SP-27 VIII.E.SP-29 VIII.E.SP-30 VIII.E.SP-55 VIII.F.SP-27 VIII.F.SP-29 VIII.F.SP-30 VIII.F.SP-55 VIII.G.SP-27 VIII.G.SP-28 VIII.G.SP-29 VIII.G.SP-30 VIII.G.SP-55
M	034	BWR/PWR	Steel external surfaces exposed to air – indoor uncontrolled, air – outdoor, condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-29

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	035	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.SP-147b VIII.E.SP-147c VIII.E.SP-147d VIII.E.SP-147e VIII.G.SP-147b VIII.G.SP-147c VIII.G.SP-147d VIII.G.SP-147e
M	036	BWR/PWR	Steel piping, piping components exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.B1.SP-59 VIII.E.SP-59 VIII.G.SP-59
M	037	BWR/PWR	Steel piping, piping components exposed to condensation	Loss of material due to general, pitting, crevice corrosion	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.SP-60 VIII.G.SP-60
M	038	PWR	Steel piping, piping components exposed to raw water	Loss of material due to general, pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System"	No	VIII.G.SP-136
D	039						
M	040	BWR/PWR	Steel piping, piping components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-91 VIII.D1.SP-91 VIII.D2.SP-91 VIII.E.SP-91 VIII.G.SP-91

<b>Table 3.4-1. Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	041	PWR	Steel heat exchanger components exposed to lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-76
M	042	PWR	Aluminum piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-114
M	043	BWR/PWR	Copper alloy piping, piping components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-92 VIII.D1.SP-92 VIII.D2.SP-92 VIII.E.SP-92 VIII.G.SP-92
M	044	BWR/PWR	Stainless steel piping, piping components, heat exchanger components exposed to lubricating oil	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-95 VIII.D1.SP-95 VIII.D2.SP-95 VIII.E.SP-95 VIII.G.SP-79 VIII.G.SP-95
M	045	BWR/PWR	Aluminum heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-113 VIII.G.SP-113
	046	PWR	Stainless steel, steel, copper alloy heat exchanger tubes exposed to lubricating oil	Reduction of heat transfer due to fouling	AMP XI.M39, "Lubricating Oil Analysis," and AMP XI.M32, "One-Time Inspection"	No	VIII.G.SP-102 VIII.G.SP-103 VIII.G.SP-99
M	047	BWR/PWR	Stainless steel piping, piping components, tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-145
M	048	BWR/PWR	Nickel alloy piping, piping components, tanks, closure bolting exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-143
D	049						

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	050	BWR/PWR	Steel piping, piping components, tanks, closure bolting exposed to soil, concrete, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.SP-141 VIII.H.SP-161
D	050a						
M	051	BWR/PWR	Steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-154
M	052	BWR/PWR	Aluminum piping, piping components exposed to gas	None	None	No	VIII.I.SP-23
M	053	BWR/PWR	Copper alloy (>8% Al) piping, piping components exposed to air with borated water leakage	None	None	No	VIII.I.SP-104
M	054	BWR/PWR	Copper alloy piping, piping components exposed to air, condensation, gas	None	None	No	VIII.I.SP-6
M	055	BWR/PWR	Glass piping elements exposed to lubricating oil, air, condensation, raw water, treated water, air with borated water leakage, gas, closed-cycle cooling water	None	None	No	VIII.I.SP-10 VIII.I.SP-33 VIII.I.SP-34 VIII.I.SP-35 VIII.I.SP-67 VIII.I.SP-68 VIII.I.SP-69 VIII.I.SP-70
M	056	BWR/PWR	Nickel alloy piping, piping components, and piping elements exposed to air with borated water leakage	None	None	No	VIII.I.SP-148

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	057	BWR/PWR	PVC piping, piping components exposed to air – indoor uncontrolled, condensation	None	None	No	VIII.I.SP-152 VIII.I.SP-153
M	058	BWR/PWR	Stainless steel piping, piping components exposed to gas	None	None	No	VIII.I.SP-15
M	059	BWR/PWR	Steel piping, piping components exposed to air – indoor controlled, gas	None	None	No	VIII.I.SP-1 VIII.I.SP-4
M	060	BWR/PWR	Metallic piping, piping components exposed to steam, treated water	Wall thinning due to erosion	AMP XI.M17, "Flow-Accelerated Corrosion"	No	VIII.A.S-408 VIII.B1.S-408 VIII.B2.S-408 VIII.C.S-408 VIII.D1.S-408 VIII.D2.S-408 VIII.G.S-408
M	061	BWR/PWR	Metallic piping, piping components, tanks exposed to raw water, waste water	Loss of material due to recurring internal corrosion	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Yes (SRP-SLR Section 3.4.2.2.6)	VIII.A.S-400a VIII.A.S-400b VIII.D1.S-400b VIII.D2.S-400b VIII.E.S-400a VIII.E.S-400b VIII.F.S-400a VIII.F.S-400b VIII.G.S-400a VIII.G.S-400b
M	062	BWR/PWR	Steel, stainless steel or aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to treated water	Loss of material due to general (steel only), pitting, crevice corrosion, MIC (steel, stainless steel only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-405 VIII.G.S-405

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	063	BWR/PWR	Insulated steel, copper alloy (>15% Zn or >8% Al), piping, piping components, tanks, tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to general (steel only), pitting, crevice corrosion; cracking due to SCC (copper alloy (>15% Zn or >8% Al) only)	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" or AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.H.S-402a VIII.H.S-402b
M	064	BWR/PWR	Non-metallic thermal insulation exposed to air, condensation	Reduced thermal insulation resistance due to moisture intrusion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-403
D	065						
M	066	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, lubricating oil	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage; loss of material or cracking for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VIII.E.S-401 VIII.F.S-401 VIII.G.S-401
M	067	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, lubricating oil	Loss of material due to general, pitting, crevice corrosion, MIC	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VIII.E.S-414 VIII.F.S-414 VIII.G.S-414

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	068	BWR/PWR	Gray cast iron, ductile iron piping, 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.E.S-415 VIII.F.S-415 VIII.G.S-415
D	069						
N	070	BWR/PWR	Stainless steel, steel, nickel alloy, copper alloy closure bolting exposed to lubricating oil, treated water, treated borated water, raw water, waste water	Loss of material due to general (steel; copper alloy in raw water, waste water only), pitting, crevice corrosion, MIC (raw water, waste water environments only)	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-418
D	071						
N	072	BWR/PWR	Stainless steel, steel, aluminum piping, piping components, tanks exposed to soil, concrete	Cracking due to SCC (steel in carbonate/bicarbonate environment only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.S-420
N	073	BWR/PWR	Stainless steel closure bolting exposed to air, soil, concrete, underground, raw water, waste water	Cracking due to SCC	AMP XI.M18, "Bolting Integrity"	No	VIII.H.S-421
N	074	BWR/PWR	Stainless steel underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-425a VIII.H.S-425b VIII.H.S-425c

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	075	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-426
N	077	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-428
N	078	BWR/PWR	Elastomer piping, piping components, seals exposed to air, condensation	Hardening or loss of strength due to elastomer degradation	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.D1.S-429 VIII.D2.S-429 VIII.E.S-429 VIII.G.S-429
D	080						
N	081	BWR/PWR	Steel components exposed to treated water, raw water	Long-term loss of material due to general corrosion	AMP XI.M32, "One-Time Inspection"	No	VIII.A.S-432 VIII.D1.S-432 VIII.D2.S-432 VIII.E.S-432 VIII.F.S-432 VIII.G.S-432
N	082	BWR/PWR	Stainless steel piping, piping components exposed to concrete	None	None	Yes (SRP-SLR Section 3.4.2.2.8)	VIII.I.SP-13
N	083	BWR/PWR	Stainless steel, nickel alloy tanks exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.E.SP-162 VIII.G.SP-162
N	084	BWR/PWR	Stainless steel, nickel alloy piping, piping components exposed to steam	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.A.SP-155 VIII.B1.SP-155 VIII.B2.SP-155 VIII.B1.SP-157

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	085	BWR/PWR	Stainless steel, nickel alloy piping, piping components, PWR heat exchanger components exposed to treated water	Loss of material due to pitting, crevice corrosion, MIC	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VIII.B1.SP-87 VIII.C.SP-87 VIII.D1.SP-87 VIII.D2.SP-87 VIII.E.SP-80  VIII.E.SP-87 VIII.F.SP-80 VIII.F.SP-87 VIII.G.SP-87
N	086	BWR/PWR	Stainless steel, steel, aluminum, copper alloy, titanium heat exchanger tubes internal to components exposed to air, condensation	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-433 VIII.G.S-433
D	088						
N	089	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, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.A.S-436 VIII.E.S-436 VIII.F.S-436 VIII.G.S-436
N	090	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger tubes exposed to raw water (for components not covered by NRC GL 89-13)	Reduction of heat transfer due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-437 VIII.F.S-437 VIII.G.S-437
N	091	BWR/PWR	Steel, stainless steel, copper alloy heat exchanger components exposed to raw water (for components not covered by NRC GL 89-13)	Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion, MIC; flow blockage due to fouling	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.E.S-438 VIII.F.S-438 VIII.G.S-438

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	092	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to soil	Loss of material due to selective leaching	AMP XI.M33, "Selective Leaching"	No	VIII.D1.S-439 VIII.D2.S-439 VIII.E.S-439 VIII.F.S-439 VIII.G.S-439
D	093						
N	094	BWR/PWR	Aluminum underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.H.S-442a VIII.H.S-442b VIII.H.S-442c
N	095	BWR/PWR	Stainless steel, nickel alloy underground piping, piping components, tanks	Loss of material due to pitting, crevice corrosion	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-443a VIII.H.S-443b VIII.H.S-443c
N	096	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-444 VIII.G.S-444

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	097	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.S-445a VIII.E.S-445b VIII.E.S-445c VIII.G.S-445a VIII.G.S-445b VIII.G.S-445c
N	098	BWR/PWR	Stainless steel, nickel alloy tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.E.S-446a VIII.E.S-446b VIII.E.S-446c VIII.G.S-446a VIII.G.S-446b VIII.G.S-446c
N	099	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Loss of material due to pitting, crevice corrosion, MIC (soil only)	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-447 VIII.G.S-447

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	100	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.E.S-448a VIII.E.S-448b VIII.E.S-448c VIII.G.S-448a VIII.G.S-448b VIII.G.S-448c
N	101	BWR/PWR	Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"	No	VIII.E.S-449 VIII.G.S-449
N	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, condensation, soil, concrete, raw water, waste water	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.E.S-450a VIII.E.S-450b VIII.E.S-450c VIII.G.S-450a VIII.G.S-450b VIII.G.S-450c

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	103	BWR/PWR	Insulated stainless steel, nickel alloy piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.3)	VIII.H.S-451a VIII.H.S-451b VIII.H.S-451c VIII.H.S-451d
N	104	BWR/PWR	Insulated stainless steel piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.2)	VIII.H.S-452a VIII.H.S-452b VIII.H.S-452c VIII.H.S-452d

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	105	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-453a VIII.H.S-453b VIII.H.S-453c VIII.H.S-453d
N	106	BWR/PWR	Copper alloy (>15% Zn or >8% Al) piping, piping components exposed to air, condensation	Cracking due to SCC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-454
N	107	BWR/PWR	Copper alloy (>15% Zn or >8% Al) tanks exposed to air, condensation	Cracking due to SCC	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-455
D	108						

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	109	BWR/PWR	Aluminum piping, piping components, tanks exposed to air, condensation, raw water, waste water	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.D1.S-457b VIII.D1.S-457d VIII.D1.S-457e VIII.D2.S-457b VIII.D2.S-457d VIII.D2.S-457e VIII.E.S-457b VIII.E.S-457d VIII.E.S-457e VIII.F.S-457b VIII.F.S-457d VIII.F.S-457e VIII.G.S-457b VIII.G.S-457d VIII.G.S-457e VIII.H.S-457c
D	110						
D	111						
N	112	BWR/PWR	Aluminum underground piping, piping components, tanks	Cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.M41, "Buried and Underground Piping and Tanks," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.7)	VIII.H.S-460a VIII.H.S-460b VIII.H.S-460c
D	113						
N	114	BWR/PWR	Titanium 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.S-462 VIII.F.S-462 VIII.G.S-462

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	115	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to treated water	None	None	No	VIII.I.S-463
N	116	BWR/PWR	Titanium heat exchanger tubes exposed to closed-cycle cooling water	Reduction of heat transfer due to fouling	AMP XI.M21A, "Closed Treated Water Systems"	No	VIII.A.S-464 VIII.E.S-464 VIII.F.S-464 VIII.G.S-464
N	117	BWR/PWR	Aluminum piping, piping components, tanks exposed to soil, concrete	Loss of material due to pitting, crevice corrosion	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.S-466
D	118						
N	119	BWR/PWR	Insulated aluminum piping, piping components, tanks exposed to air, condensation	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.H.S-468a VIII.H.S-468b VIII.H.S-468c VIII.H.S-468d

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	120	BWR/PWR	Aluminum piping, piping components, tanks exposed to raw water, waste water	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks," AMP XI.M32, "One-Time Inspection," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," or AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.S-469a VIII.E.S-469b VIII.E.S-469c VIII.E.S-469d VIII.E.S-469e
D	121						
N	122	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No	VIII.H.S-471
N	123	BWR/PWR	Elastomer piping, piping components, seals exposed to air	Loss of material due to wear	AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.D1.S-472 VIII.D2.S-472 VIII.E.S-472 VIII.G.S-472
N	124	BWR/PWR	PVC piping, piping components, tanks exposed to concrete	None	None	No	VIII.I.S-473
N	125	BWR/PWR	PVC piping, piping components, tanks exposed to soil	Loss of material due to wear	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.S-474

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	126	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) heat exchanger components other than tubes, piping, piping components exposed to closed-cycle cooling water	None	None	No	VIII.I.S-465
N	127	BWR/PWR	Aluminum piping, piping components, tanks exposed to air with borated water leakage	None	None	No	VIII.I.S-475
N	128	BWR/PWR	Copper alloy piping, piping components exposed to concrete	None	None	No	VIII.I.S-476
N	129	BWR/PWR	Copper alloy piping, piping components exposed to soil, underground	Loss of material due to general, pitting, crevice corrosion, MIC (soil only)	AMP XI.M41, "Buried and Underground Piping and Tanks"	No	VIII.H.S-477
N	130	BWR/PWR	Titanium heat exchanger components other than tubes exposed to raw water	Loss of material due to pitting, crevice corrosion; flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.A.S-478a VIII.A.S-478b VIII.D1.S-478a VIII.D1.S-478b VIII.D2.S-478a VIII.D2.S-478b VIII.E.S-478a VIII.E.S-478b VIII.F.S-478a VIII.F.S-478b VIII.G.S-478a VIII.G.S-478b
N	131	PWR	Copper alloy (>15% Zn) piping, piping components exposed to air with borated water leakage	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	VIII.H.S-479

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	132	PWR	Stainless steel piping, piping components, tanks exposed to air with borated water leakage	None	None	No	VIII.I.S-480
N	133	BWR/PWR	Aluminum piping, piping components exposed to raw water	Flow blockage due to fouling	AMP XI.M20, "Open-Cycle Cooling Water System," or AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	No	VIII.D1.S-481 VIII.D2.S-481 VIII.E.S-481 VIII.F.S-481 VIII.G.S-481

**Table 3.4-2. AMPs and Additional Guidance Appendices Recommended for Aging Management of Steam and Power Conversion System**

<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP XI.M2	Water Chemistry
AMP XI.M10	Boric Acid Corrosion
AMP XI.M17	Flow-Accelerated Corrosion
AMP XI.M18	Bolting Integrity
AMP XI.M20	Open-Cycle Cooling Water System
AMP XI.M21A	Closed Treated Water Systems
AMP XI.M29	Outdoor and Large Atmospheric Metallic Storage Tanks
AMP XI.M32	One-Time Inspection
AMP XI.M33	Selective Leaching
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
AMP XI.M39	Lubricating Oil Analysis
AMP XI.M41	Buried and Underground Piping and Tanks
AMP XI.M42	Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks
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)

1

1 **3.5 Aging Management of Containments, Structures, and Component Supports**

2 **Review Responsibilities**

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

5 **Secondary**—None

6 **3.5.1 Areas of Review**

7 This section addresses the aging management review (AMR) and the associated aging  
8 management programs (AMPs) for containments, structures and components (SC) supports. For  
9 a recent vintage plant, the information related to containments, supports is contained in Chapter 3,  
10 “Design of Structures, Components, Equipment, and Systems,” of the plant’s final safety analysis  
11 report (FSAR), consistent with the “Standard Review Plan for the Review of Safety Analysis  
12 Reports for Nuclear Power Plants” (NUREG–0800). For older vintage plants, the location of  
13 applicable information is plant-specific because an older plant’s FSAR may have predated  
14 NUREG–0800. The scope of this section is containment structures, and safety-related and other  
15 SC supports.

16 The pressurized water reactor (PWR) containment structures consist of concrete (reinforced or  
17 prestressed) and steel containments. The boiling water reactor (BWR) containment  
18 structures consist of Mark I, Mark II, and Mark III steel and concrete (reinforced or  
19 prestressed) containments.

20 The safety-related structures (other than containments) are organized into nine groups: Group 1:  
21 BWR reactor building, PWR shield building, control room/building; Group 2: BWR reactor building  
22 with steel superstructure; Group 3: auxiliary building, diesel generator building, radwaste building,  
23 turbine building, switchgear room, yard structures (auxiliary feedwater (AFW) pump house,  
24 utility/piping tunnels, security lighting poles, manholes, duct banks), station blackout (SBO)  
25 structures (transmission towers, startup transformer circuit breaker foundation, electrical  
26 enclosure); Group 4: containment internal structures, excluding refueling canal; Group 5: fuel  
27 storage facility, refueling canal; Group 6: water-control structures (e.g., intake structure, cooling  
28 tower, and spray pond); Group 7: concrete tanks and missile barriers; Group 8: steel tank  
29 foundations and missile barriers; and Group 9: BWR unit vent stack.

30 The component supports are organized into seven groups: Group B1.1: supports for American  
31 Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1 piping  
32 and components; Group B1.2: supports for ASME Class 2 and 3 piping and components;  
33 Group B1.3: supports for ASME Class MC components; Group B2: supports for cable tray,  
34 conduit, heating, ventilation, and air conditioning (HVAC) ducts, TubeTrack®, instrument tubing,  
35 non-ASME piping and components; Group B3: anchorage of racks, panels, cabinets, and  
36 enclosures for electrical equipment and instrumentation; Group B4: supports for miscellaneous  
37 equipment (e.g., emergency diesel generator (EDG), HVAC components); and Group B5:  
38 supports for miscellaneous structures (e.g., platforms, pipe whip restraints, jet impingement  
39 shields, masonry walls).

40 The responsible review organization is to review the following subsequent license renewal  
41 application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 1.2, for review:

1 **AMRs**

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

6 **AMPs**

- 7 • Consistent with GALL-SLR Report AMPs
- 8 • Plant-specific AMPs

9 **FSAR Supplement**

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

12 **3.5.2 Acceptance Criteria**

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

16 *3.5.2.1 Aging Management Review Results Consistent With the Generic Aging Lessons  
17 Learned for Subsequent License Renewal Report*

18 The AMRs and the AMPs applicable to structures and component supports are described and  
19 evaluated in Chapters II and III of the GALL-SLR Report.

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

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

28 *3.5.2.2 Aging Management Review Results for Which Further Evaluation Is Recommended by  
29 the Generic Aging Lessons Learned for Subsequent License Renewal Report*

30 The basic acceptance criteria defined in Section 3.5.2.1 need to be applied first for all of the  
31 AMRs and AMPs as part of this section. In addition, if the GALL-SLR Report AMR item to which  
32 the SLRA AMR item is compared identifies that "further evaluation is recommended," then  
33 additional criteria apply for each of the following aging effect/aging mechanism combinations.  
34 Refer to Table 3.5-1, comparing the "Further Evaluation Recommended" column and the  
35 "GALL-SLR Item" column, for the AMR items that reference the following subsections.

1 3.5.2.2.1 *Pressurized Water Reactor and Boiling Water Reactor Containments*

2 3.5.2.2.1.1 *Cracking and Distortion Due to Increased Stress Levels from Settlement;*  
3 *Reduction of Foundation Strength, and Cracking Due to Differential Settlement and*  
4 *Erosion of Porous Concrete Subfoundations*

5 Cracking and distortion due to increased stress levels from settlement could occur in PWR and  
6 BWR concrete and steel containments. The existing program relies on ASME Code Section XI,  
7 Subsection IWL to manage these aging effects. Also, reduction of foundation strength and  
8 cracking, due to differential settlement and erosion of porous concrete subfoundations could occur  
9 in all types of PWR and BWR containments. The existing program relies on the structures  
10 monitoring program to manage these aging effects. However, some plants may rely on a  
11 dewatering system to lower the site groundwater level. If the plant's current licensing basis (CLB)  
12 credits a dewatering system to control settlement, further evaluation is recommended to verify the  
13 continued functionality of the dewatering system during the subsequent period of  
14 extended operation.

15 3.5.2.2.1.2 *Reduction of Strength and Modulus Due to Elevated Temperature*

16 Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR  
17 and BWR concrete and steel containments. The implementation of 10 CFR 50.55a and ASME  
18 Code Section XI, Subsection IWL would not be able to identify the reduction of strength and  
19 modulus of concrete due to elevated temperature. Subsection CC-3440 of ASME Code  
20 Section III, Division 2, specifies the concrete temperature limits for normal operation or any other  
21 long-term period. Further evaluation is recommended of a plant-specific AMP if any portion of the  
22 concrete containment components exceeds specified temperature limits [i.e., general area  
23 temperature greater than 66 degrees Celsius (°C) (150 degrees Fahrenheit (°F) and local area  
24 temperature greater than 93 °C (200 °F)]. Higher temperatures may be allowed if tests and/or  
25 calculations are provided to evaluate the reduction in strength and modulus of elasticity and these  
26 reductions are applied to the design calculations. Acceptance criteria are described in Branch  
27 Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR Report).

28 3.5.2.2.1.3 *Loss of Material Due to General, Pitting and Crevice Corrosion*

29 1. Loss of material due to general, pitting, and crevice corrosion could occur in steel  
30 elements of accessible and inaccessible areas for all types of PWR and BWR  
31 containments. The existing program relies on ASME Code Section XI, Subsection IWE,  
32 and 10 CFR Part 50, Appendix J AMPs, to detect and manage this aging effect. Further  
33 evaluation is recommended of plant-specific programs or other applicable AMPs and/or  
34 time-limited aging analyses (TLAAs) identified to manage this aging effect. For  
35 components that are part of the pressure boundary system but not subject to local  
36 leakage rate testing, justification of their exclusion from 10 CFR Part 50 Appendix J  
37 testing and the selection of AMPs and/or TLAAs to manage this aging effect are  
38 identified in the basis document. Acceptance criteria are described in BTP RLSB-1  
39 (Appendix A.1 of this SRP-SLR Report).

40 2. Loss of material due to general, pitting, and crevice corrosion could occur in steel torus  
41 shell of Mark I containments. The existing program relies on ASME Code Section XI,  
42 Subsection IWE, and 10 CFR Part 50, Appendix J, to manage this aging effect. If  
43 corrosion is significant, recoating of the torus is recommended. Acceptance criteria are  
44 described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

1 3. Loss of material due to general, pitting, and crevice corrosion could occur in steel torus  
2 ring girders and downcomers of Mark I containments, downcomers of Mark II  
3 containments, and interior surface of suppression chamber shell of Mark III  
4 containments. The existing program relies on ASME Code Section XI, Subsection IWE  
5 to manage this aging effect. Further evaluation is recommended of plant-specific  
6 programs to manage this aging effect if corrosion is significant. Acceptance criteria are  
7 described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

8 *3.5.2.2.1.4 Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature*

9 Loss of prestress forces due to relaxation, shrinkage, creep, and elevated temperature for PWR  
10 prestressed concrete containments and BWR Mark II prestressed concrete containments is a  
11 TLAA as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with  
12 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.5, "Concrete  
13 Containment Unbonded Tendon Pre-stress Analysis," and/or Section 4.7 "Other Plant-Specific  
14 Time-Limited Aging Analyses," of this SRP-SLR Report.

15 *3.5.2.2.1.5 Cumulative Fatigue Damage*

16 Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of metal  
17 liner, metal plates, suppression pool steel shells (including welded joints) and penetrations  
18 (including personnel airlock, equipment hatch, control rod drive (CRD) hatch, penetration sleeves,  
19 dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and  
20 BWR vent header, vent line bellows, and downcomers may be TLAAs as defined in 10 CFR 54.3.  
21 TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of  
22 this TLAA is addressed in Section 4.6, "Containment Liner Plates, Metal Containments, and  
23 Penetrations Fatigue Analysis," and for cases of plant-specific components, in Section 4.7 "Other  
24 Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR Report. For plant-specific  
25 cumulative usage factor calculations, the method used is appropriately defined and discussed in  
26 the applicable TLAAs.

27 *3.5.2.2.1.6 Cracking Due to Stress Corrosion Cracking*

28 Stress corrosion cracking (SCC) of stainless steel (SS) penetration sleeves, penetration bellows,  
29 vent line bellows, suppression chamber shell (interior surface), and dissimilar metal welds could  
30 occur in PWR and/or BWR containments. The existing program relies on ASME Code Section XI,  
31 Subsection IWE and 10 CFR Part 50, Appendix J, to manage this aging effect. Further evaluation,  
32 including consideration of SCC susceptibility and applicable operating experience (OE) related to  
33 detection, is recommended of additional appropriate examinations/evaluations implemented to  
34 detect this aging effect for these SS components and dissimilar metal welds.

35 *3.5.2.2.1.7 Loss of Material (Scaling, Spalling) and Cracking Due to Freeze-Thaw*

36 Loss of material (scaling, spalling) and cracking due to freeze-thaw could occur in inaccessible  
37 areas of PWR and BWR concrete containments. Further evaluation is recommended of this aging  
38 effect for plants located in moderate to severe weathering conditions.

39 *3.5.2.2.1.8 Cracking Due to Expansion From Reaction With Aggregates*

40 Cracking due to expansion from reaction with aggregates could occur in inaccessible areas of  
41 concrete elements of PWR and BWR concrete and steel containments. The GALL-SLR Report

1 recommends further evaluation to determine if a plant-specific aging management program is  
2 required to manage this aging effect. Acceptance criteria are described in BTP RLSB-1  
3 (Appendix A.1 of this SRP-SLR Report).

4 *3.5.2.2.1.9 Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide*  
5 *and Carbonation*

6 Increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could  
7 occur in inaccessible areas of concrete elements of PWR and BWR concrete and steel  
8 containments. Further evaluation is recommended if leaching is observed in accessible areas that  
9 impact intended functions. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of  
10 this SRP-SLR Report).

11 *3.5.2.2.2 Safety-Related and Other Structures and Component Supports*

12 *3.5.2.2.2.1 Aging Management of Inaccessible Areas*

13 1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in  
14 below-grade inaccessible concrete areas of Groups 1–3, 5 and 7–9 structures. Further  
15 evaluation is recommended of this aging effect for inaccessible areas of these Groups of  
16 structures for plants located in moderate to severe weathering conditions.

17 2. Cracking due to expansion and reaction with aggregates could occur in inaccessible  
18 concrete areas for Groups 1–5 and 7–9 structures. Further evaluation is recommended  
19 of inaccessible areas of these Groups of structures to determine if a plant-specific AMP  
20 is required to manage this aging effect.

21 3. Cracking and distortion due to increased stress levels from settlement could occur in  
22 below-grade inaccessible concrete areas of structures for all Groups, and reduction in  
23 foundation strength, and cracking due to differential settlement and erosion of porous  
24 concrete subfoundations could occur in below-grade inaccessible concrete areas of  
25 Groups 1–3, 5–9 structures. The existing program relies on structure monitoring  
26 programs to manage these aging effects. Some plants may rely on a dewatering system  
27 to lower the site groundwater level. If the plant's CLB credits a dewatering system,  
28 verification is recommended of the continued functionality of the dewatering system  
29 during the subsequent period of extended operation. No further evaluation is  
30 recommended if this activity is included in the scope of the applicant's structures  
31 monitoring program.

32 4. Increase in porosity and permeability, and loss of strength due to leaching of calcium  
33 hydroxide and carbonation could occur in below-grade inaccessible concrete areas of  
34 Groups 1–5 and 7–9 structures. Further evaluation is recommended if leaching is  
35 observed in accessible areas that impact intended functions.

36 *3.5.2.2.2.2 Reduction of Strength and Modulus Due to Elevated Temperature*

37 Reduction of strength and modulus of concrete due to elevated temperatures could occur in PWR  
38 and BWR Group 1–5 concrete structures. For any concrete elements that exceed specified  
39 temperature limits, further evaluations are recommended. Appendix A of American Concrete  
40 Institute (ACI) 349-85 specifies the concrete temperature limits for normal operation or any other  
41 long-term period. The temperatures shall not exceed 66 °C (150 °F) except for local areas, which

1 are allowed to have increased temperatures not to exceed 93 °C (200°F). Further evaluation is  
2 recommended of a plant-specific program if any portion of the safety-related and other concrete  
3 structures exceeds specified temperature limits [i.e., general area temperature greater than 66 °C  
4 (150°F) and local area temperature greater than 93 °C (200 °F)]. Higher temperatures may be  
5 allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus  
6 of elasticity and these reductions are applied to the design calculations. The acceptance criteria  
7 are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

8 *3.5.2.2.2.3 Aging Management of Inaccessible Areas for Group 6 Structures*

9 Further evaluation is recommended for inaccessible areas of certain Group 6 structure/aging  
10 effect combinations as identified below, whether or not they are covered by inspections in  
11 accordance with the GALL-SLR Report, AMP XI.S7, “Inspection of Water-Control Structures  
12 Associated with Nuclear Power Plants,” or Federal Energy Regulatory Commission  
13 (FERC)/U.S. Army Corp of Engineers dam inspection and maintenance procedures.

- 14 1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in  
15 below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is  
16 recommended of this aging effect for inaccessible areas for plants located in moderate  
17 to severe weathering conditions.
- 18 2. Cracking due to expansion and reaction with aggregates could occur in inaccessible  
19 concrete areas of Group 6 structures. Further evaluation is recommended to determine  
20 if a plant-specific AMP is required to manage this aging effect. Acceptance criteria are  
21 described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).
- 22 3. Increase in porosity and permeability and loss of strength due to leaching of calcium  
23 hydroxide and carbonation could occur in inaccessible areas of concrete elements of  
24 Group 6 structures. Further evaluation is recommended if leaching is observed in  
25 accessible areas that impact intended functions. Acceptance criteria are described in  
26 BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

27 *3.5.2.2.2.4 Cracking Due to Stress Corrosion Cracking, and Loss of Material Due to Pitting*  
28 *and Crevice Corrosion*

29 Cracking due to SSC and loss of material due to pitting and crevice corrosion could occur in:  
30 (a) Group 7 and 8 SS tank liners exposed to standing water; and (b) SS and aluminum alloy  
31 support members; welds; bolted connections; or support anchorage to building structure exposed  
32 to air or condensation (see SRP-SLR Report Sections 3.2.2.2.2, 3.2.2.2.4, 3.2.2.2.8, and  
33 3.2.2.2.10 for background information).

34 For Group 7 and 8 SS tank liners exposed to standing water, further evaluation is recommended  
35 of plant-specific programs to manage these aging effects. The acceptance criteria are described  
36 in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

37 For SS and aluminum alloy support members; welds; bolted connections; support anchorage to  
38 building structure exposed to air or condensation, the plant-specific OE and condition of the SS  
39 and aluminum alloy components are evaluated to determine if the plant-specific air or  
40 condensation environments are aggressive enough to result in loss of material or cracking after  
41 prolonged exposure. The aging effects of loss of material and cracking in SS and aluminum alloy  
42 components is not applicable and does not require management if: (a) the plant-specific OE does

1 not reveal a history of pitting or crevice corrosion or cracking and (b) a one-time inspection  
2 demonstrates that the aging effects are not occurring or that an aging effect is occurring so slowly  
3 that it will not affect the intended function of the components during the subsequent period of  
4 extended operation. The applicant documents the results of the plant-specific OE review in the  
5 SLRA. Visual inspections conducted in accordance with GALL-SLR Report AMP XI.M32,  
6 “One Time Inspection,” are an acceptable method to demonstrate that the aging effects are not  
7 occurring at a rate that affects the intended function of the components. One-time inspections are  
8 conducted between the 50<sup>th</sup> and 60<sup>th</sup> year of operation, as recommended by the “detection of  
9 aging effects” program element in AMP XI.M32. If loss of material or cracking has occurred and is  
10 sufficient to potentially affect the intended function of SS or aluminum alloy support members;  
11 welds; bolted connections; or support anchorage to building structure, either: (a) enhancing the  
12 applicable AMP; (b) conducting a representative sample inspection consistent with GALL-SLR  
13 Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components;” or (c) developing  
14 a plant-specific AMP are acceptable programs to manage loss of material or cracking (as  
15 applicable). Tempers have been specifically developed to improve the SCC resistance for some  
16 aluminum alloys. Aluminum alloy and temper combinations which are not susceptible to SCC  
17 when used in structural support applications include 1xxx series, 3xxx series, 6061-T6x, and  
18 5454-x. For these alloys and tempers, the susceptibility of cracking due to SCC is not applicable.  
19 If these alloys or tempers have been used, the SLRA states the specific alloy or temper used for  
20 the applicable in-scope components.

#### 21 3.5.2.2.2.5 *Cumulative Fatigue Damage*

22 Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of  
23 component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3  
24 component supports are TLAAs as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists.  
25 TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this  
26 TLAA is addressed in Section 4.3, “Metal Fatigue Analysis,” and/or Section 4.7, “Other  
27 Plant-Specific Time-Limited Aging Analyses,” of this SRP-SLR Report. For plant-specific  
28 cumulative usage factor calculations, the method used is appropriately defined and discussed in  
29 the applicable TLAAs.

#### 30 3.5.2.2.2.6 *Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation*

31 Reduction of strength, loss of mechanical properties, and cracking due to irradiation could occur in  
32 PWR and BWR Group 4 concrete structures that are exposed to high levels of neutron and  
33 gamma radiation. These structures include the reactor (primary/biological) shield wall, the  
34 sacrificial shield wall, and the reactor vessel support/pedestal structure. Data related to the  
35 effects and significance of neutron and gamma radiation on concrete mechanical and physical  
36 properties is limited, especially for conditions (dose, temperature, etc.) representative of  
37 light-water reactor (LWR) plants. However, based on literature review of existing research,  
38 radiation fluence limits of  $1 \times 10^{19}$  neutrons/cm<sup>2</sup> neutron radiation and  $1 \times 10^8$  Gy ( $1 \times 10^{10}$  rad)  
39 gamma dose are considered conservative radiation exposure levels beyond which concrete  
40 material properties may begin to degrade markedly (17, 18, 19).

41 Further evaluation is recommended of a plant-specific program to manage aging effects of  
42 irradiation if the estimated (calculated) fluence levels or irradiation dose received by any portion of  
43 the concrete from neutron (fluence cutoff energy  $E > 0.1$  MeV) or gamma radiation exceeds the  
44 respective threshold level during the subsequent period of extended operation or if plant-specific  
45 OE of concrete irradiation degradation exists that may impact intended functions. Higher fluence  
46 or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate

1 the reduction in strength and/or loss of mechanical properties of concrete from those fluence  
2 levels, at or above the operating temperature experienced by the concrete, and the effects are  
3 applied to the design calculations. Supporting calculations/analyses, test data, and other  
4 technical basis are provided to estimate and evaluate fluence levels and the plant-specific  
5 program. The acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this  
6 SRP-SLR Report).

7 3.5.2.2.3 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

9 3.5.2.2.4 *Ongoing Review of Operating Experience*

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

12 3.5.2.3 *Aging Management Review Results Not Consistent With or Not Addressed in the*  
13 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

15 3.5.2.4 *Aging Management Programs*

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

22 If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
23 Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of  
24 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA  
25 AMP with all exceptions would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the  
26 SLRA AMP, the reviewer identifies a difference from the GALL-SLR Report AMP that should have  
27 been identified as an exception to the GALL-SLR Report AMP, this difference should be reviewed  
28 and properly dispositioned. The reviewer should document the disposition of all SLRA-defined  
29 exceptions and NRC staff-identified differences.

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

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

1 3.5.2.5 *Final Safety Analysis Report Supplement*

2 The summary description of the programs and activities for managing the effects of aging for the  
3 subsequent period of extended operation in the FSAR Supplement should be sufficiently  
4 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
5 should contain information associated with the bases for determining that aging effects are  
6 managed during the subsequent period of extended operation. The description should also  
7 contain any future aging management activities, including enhancements and commitments, to be  
8 completed before the subsequent period of extended operation. Table X-01 and Table XI-01 of  
9 the GALL-SLR Report provide examples of the type of information to be included in the FSAR  
10 Supplement. Table 3.5-2 lists the programs that are applicable for this SRP-SLR subsection.

11 **3.5.3 Review Procedures**

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

13 3.5.3.1 *Aging Management Review Results Consistent With the Generic Aging Lessons*  
14 *Learned for Subsequent License Renewal Report*

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

25 Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the  
26 issuance of the GALL-SLR Report. Performance of this review requires the reviewer to confirm  
27 that the applicant has identified those aging effects for the SC supports that are contained in the  
28 GALL-SLR Report as applicable to its plant.

29 3.5.3.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by*  
30 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

31 The basic review procedures defined in Section 3.5.3.1 need to be applied first for all of the AMRs  
32 and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA  
33 AMR item is compared identifies that further evaluation is recommended, then additional criteria  
34 apply for each of the following aging effect/aging mechanism combinations.

35 3.5.3.2.1 *Pressurized Water Reactor and Boiling Water Reactor Containments*

36 3.5.3.2.1.1 *Cracking and Distortion Due to Increased Stress Levels From Settlement;*  
37 *Reduction of Foundation Strength and Cracking Due to Differential Settlement and*  
38 *Erosion of Porous Concrete Subfoundations*

39 Further evaluation is recommended of aging management of (1) cracking and distortion due to  
40 increases in component stress level from settlement for PWR and BWR concrete and steel

1 containments and (2) reduction of foundation strength and cracking due to differential settlement  
2 and erosion of porous concrete subfoundations for all types of PWR and BWR containments if a  
3 dewatering system is relied upon to control settlement. The reviewer reviews and confirms that, if  
4 the applicant credits a dewatering system in its CLB, the applicant has committed to monitor the  
5 functionality of the dewatering system under the applicant's ASME Code Section XI, Subsection  
6 IWL or the structures monitoring program. If not, the reviewer evaluates the plant-specific  
7 program for monitoring the dewatering system during the subsequent period of  
8 extended operation.

#### 9 3.5.3.2.1.2 *Reduction of Strength and Modulus Due to Elevated Temperature*

10 Further evaluation is recommended of programs to manage reduction of strength and modulus of  
11 concrete due to elevated temperature for PWR and BWR concrete and steel containments. The  
12 implementation of ASME Code Section XI, Subsection IWL examinations and 10 CFR 50.55a  
13 would not be able to detect the reduction of concrete strength and modulus due to elevated  
14 temperature and also notes that no mandated aging management exists for managing this  
15 aging effect.

16 A plant-specific evaluation should be performed if any portion of the concrete containment  
17 components exceeds specified temperature limits [i.e., general temperature greater than 66 °C  
18 (150 °F) and local area temperature greater than 93 °C (200 °F)]. Higher temperatures may be  
19 allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus  
20 of elasticity and these reductions are applied to the design calculations. The reviewer reviews  
21 and confirms that the applicant's discussion in the renewal application indicates that the affected  
22 PWR and BWR containment components are not exposed to a temperature that exceeds the  
23 temperature limits. If active cooling is relied upon to maintain acceptable temperatures, then the  
24 reviewer ensures that the aging effects associated with the cooling system are being properly  
25 managed or temperatures are being monitored to identify a problem with the cooling system. If  
26 the limits are exceeded the reviewer reviews the technical basis (i.e., tests and/or calculations)  
27 provided by the applicant to justify the higher temperature. Otherwise, the reviewer reviews the  
28 applicant's proposed programs to ensure that the effects of elevated temperature will be  
29 adequately managed during the subsequent period of extended.

#### 30 3.5.3.2.1.3 *Loss of Material Due to General, Pitting, and Crevice Corrosion*

31 1. The GALL-SLR Report identifies programs to manage loss of material due to general,  
32 pitting, and crevice corrosion in accessible and inaccessible areas of the steel elements  
33 in drywell and torus or the steel liner and integral attachments for all types of PWR and  
34 BWR containments. The AMP consists of ASME Code Section XI, Subsection IWE, and  
35 10 CFR Part 50, Appendix J, leak tests. Subsection IWE exempts from examination  
36 portions of the containments that are inaccessible, such as embedded or inaccessible  
37 portions of steel liners and steel elements in drywell and torus, and integral attachments.

38 To cover the inaccessible areas, 10 CFR 50.55a(b)(2)(ix) requires that the applicant  
39 evaluate the acceptability of inaccessible areas when conditions exist in accessible areas  
40 that could indicate the presence of, or result in, degradation to such inaccessible areas. In  
41 addition, further evaluation of plant-specific programs to manage the aging effects for  
42 inaccessible areas is recommended if the following cannot be satisfied: (1) concrete  
43 meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the  
44 containment concrete in contact with the embedded containment shell or liner; (2) the  
45 moisture barrier, at the junction where the shell or liner becomes embedded, is subject to

1 aging management activities in accordance with ASME Code Section XI, Subsection IWE  
2 requirements; (3) the concrete is monitored to ensure that it is free of penetrating cracks  
3 that provide a path for water seepage to the surface of the containment shell or liner; and  
4 (4) borated water spills and water ponding on the concrete floor are common and when  
5 detected are cleaned up or diverted to a sump in a timely manner. Operating experience  
6 has identified significant corrosion in some plants. If any of the above conditions cannot  
7 be satisfied, then a plant-specific AMP for corrosion is necessary. The reviewer reviews  
8 the applicant's proposed AMP to confirm that, where appropriate, an effective inspection  
9 program has been developed and implemented to ensure that the aging effects in  
10 inaccessible areas are adequately managed.

11 2. The GALL-SLR Report identifies programs to manage loss of material due to general,  
12 pitting, and crevice corrosion in steel torus shell of Mark I containments. The AMP  
13 consists of ASME Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J,  
14 leak tests. In addition, further evaluation is recommended of plant-specific programs to  
15 manage the aging effects if corrosion is significant. Further evaluation of torus shell  
16 corrosion is warranted as a result of industry-wide OE that identified a number of  
17 incidences of torus corrosion. The reviewer reviews the applicant's proposed AMP to  
18 confirm that, where appropriate, an effective inspection program has been developed  
19 and implemented to ensure that the aging effects are adequately managed. A  
20 plant-specific program may include the recoating of the torus, if necessary.

21 3. The GALL-SLR Report identifies programs to manage loss of material due to general,  
22 pitting, and crevice corrosion in steel torus ring girders and downcomers of Mark I  
23 containments, suppression chambers and downcomers of Mark II containments, and  
24 interior surface of suppression chamber shell of Mark III containments. GALL-SLR  
25 Report AMP XI.S1, "ASME Section XI, Subsection IWE," is recommended for aging  
26 management. In addition, further evaluation of plant-specific programs is recommended  
27 to manage the aging effects if plant OE identified significant corrosion of the torus ring  
28 girders, downcomers and suppression chambers.

#### 29 3.5.3.2.1.4 *Loss of Prestress Due to Relaxation, Shrinkage, Creep, and Elevated Temperature*

30 Loss of prestress is a TLAA as defined in 10 CFR 54.3. TLAAAs are required to be evaluated in  
31 accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.5,  
32 "Concrete Containment Unbonded Tendon Prestress Analysis," or Section 4.7, "Other  
33 Plant-Specific Time-Limited Aging Analyses," of this SRP-SLR.

34 The staff reviews the information on a case-by-case basis consistent with the review procedures  
35 in SRP-SLR Sections 4.5 and/or 4.7 (as applicable) to determine whether the applicant has  
36 provided a sufficient basis for dispositioning the TLAAAs in accordance with the acceptance criteria  
37 in 10 CFR 54.21(c)(1)(i), (ii), or (iii).

#### 38 3.5.3.2.1.5 *Cumulative Fatigue Damage*

39 Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement included in  
40 the CLB for the metal liner, metal plates, suppression pool steel shells (including welded joints)  
41 and penetrations (including personnel airlock, equipment hatch, CRD hatch, penetration sleeves,  
42 dissimilar metal welds, and penetration bellows) for all types of PWR and BWR containments and  
43 BWR vent header, vent line bellows, and downcomers are TLAAAs as defined in 10 CFR 54.3.  
44 TLAAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this

1 TLAA is addressed in Section 4.6, “Containment Liner Plate, Metal Containments, and  
2 Penetrations Fatigue Analysis,” and for cases of plant-specific components, in Section 4.7, “Other  
3 Plant-Specific Time-Limited Aging Analyses,” of this SRP-SLR Report.

4 The staff reviews the information on a case-by-case basis consistent with the review procedures  
5 in SRP-SLR Sections 4.6 or 4.7 (as applicable) to determine whether the applicant has provided  
6 a sufficient basis for dispositioning the TLAAAs in accordance with the acceptance criteria in  
7 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff’s review of those cumulative usage factor  
8 analyses that qualify as TLAAAs based on plant-specific calculation methods.

#### 9 3.5.3.2.1.6 *Cracking Due to Stress Corrosion Cracking*

10 Further evaluation is recommended of programs to manage cracking due to SCC in SS  
11 penetration sleeves, penetration bellows, vent line bellows, suppression chamber shell (interior  
12 surface), and dissimilar metal welds in PWR and/or BWR containments. Transgranular stress  
13 corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows  
14 assemblies, SCC may cause aging effects particularly if the material is not shielded from a  
15 corrosive environment. Containment inservice inspection (ISI) IWE and leak rate testing may not  
16 be sufficient to detect cracks, especially for dissimilar metal welds. Additional appropriate  
17 examinations to detect SCC in the listed SS components and dissimilar metal welds, considering  
18 SCC susceptibility and applicable OE (e.g., cracking of two-ply bellows) related to detection, are  
19 recommended to address this issue. The reviewer reviews and evaluates the applicant’s  
20 proposed programs to confirm that adequate inspection methods will be implemented to ensure  
21 that cracks are detected.

#### 22 3.5.3.2.1.7 *Loss of Material (Scaling, Spalling) and Cracking Due to Freeze-Thaw*

23 Further evaluation is recommended of programs to manage loss of material (scaling, spalling) and  
24 cracking due to freeze-thaw for concrete elements of PWR and BWR containments. Containment  
25 ISI Subsection IWL may not be sufficient for plants located in moderate to severe weathering  
26 conditions. Evaluation is needed for plants that are located in moderate to severe weathering  
27 conditions (weathering index >100 day-inch/yr) (NUREG–1557). The weathering index for the  
28 continental United States is shown in American Society for Testing and Materials (ASTM) C33-90,  
29 Figure 1. A plant-specific program is not required if documented evidence confirms that the  
30 existing concrete had air content of 3 percent to 8 percent (including tolerance) and subsequent  
31 inspection of accessible areas did not exhibit degradation related to freeze-thaw. Such  
32 inspections are considered a part of the evaluation. The reviewer reviews and confirms that the  
33 applicant has satisfied the recommendations for inaccessible concrete. Otherwise, the reviewer  
34 reviews the applicant’s proposed AMP to verify that, where appropriate, an effective inspection  
35 program has been developed and implemented to ensure that these aging effects in inaccessible  
36 areas for plants located in moderate to severe weathering conditions are adequately managed.

#### 37 3.5.3.2.1.8 *Cracking Due to Expansion from Reaction With Aggregates*

38 Further evaluation is recommended of programs to manage cracking due to expansion from  
39 reaction with aggregates in inaccessible areas of concrete elements of PWR and BWR concrete  
40 and steel containments. A plant-specific AMP is necessary if (1) reactivity tests or petrographic  
41 examinations of concrete samples identify reaction with aggregates, or (2) accessible concrete  
42 exhibits visual indications of aggregate reactions, such as “map” or “patterned” cracking,  
43 alkali-silica gel, exudations, surface staining, expansion causing structural deformation, relative  
44 movement or displacement, or mismanagement/distortion of attached components. The reviewer

1 confirms that the applicant has not identified one of the above conditions. Otherwise, the reviewer  
2 reviews the applicant's proposed AMP or plant-specific evaluation to verify that, an effective  
3 evaluation or inspection program has been developed and implemented to ensure that this aging  
4 effect in inaccessible areas is adequately managed.

5 *3.5.3.2.1.9 Increase in Porosity and Permeability Due to Leaching of Calcium Hydroxide*  
6 *and Carbonation*

7 Further evaluation is recommended of programs to manage increase in porosity and permeability  
8 due to leaching of calcium hydroxide and carbonation in inaccessible areas of PWR and BWR  
9 concrete and steel containments. A plant-specific AMP is not required, even if reinforced concrete  
10 is exposed to flowing water if (1) there is evidence in the accessible areas that the flowing water  
11 has not caused leaching and carbonation, or (2) evaluation determined that the observed leaching  
12 of calcium hydroxide and carbonation in accessible areas has no impact on the intended function  
13 of the concrete structure. The reviewer confirms that the applicant has satisfied these conditions.  
14 Otherwise, the reviewer reviews the applicant's proposed AMP to verify that, where appropriate,  
15 an effective inspection program has been developed and implemented to ensure that this aging  
16 effect in inaccessible areas is adequately managed.

17 *3.5.3.2.2 Safety-Related and Other Structures, and Component Supports*

18 *3.5.3.2.2.1 Aging Management of Inaccessible Areas*

19 1. Further evaluation is recommended of programs to manage loss of material (spalling,  
20 scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of  
21 Groups 1–3, 5, and 7–9 structures. Structure monitoring programs may not be sufficient  
22 for plants located in moderate to severe weathering conditions. Further evaluation is  
23 needed for plants that are located in moderate to severe weathering conditions  
24 (weathering index >100 day-inch/yr) (NUREG–1557). The weathering index for the  
25 continental United States is shown in ASTM C33-90, Figure 1. A plant-specific program  
26 is not required if documented evidence confirms that the existing concrete had air  
27 content of 3 percent to 8 percent and subsequent inspection did not exhibit degradation  
28 related to freeze-thaw. Such inspections should be considered a part of the evaluation.  
29 The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the  
30 reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an  
31 effective inspection program has been developed and implemented to ensure that this  
32 aging effect in inaccessible areas for plants located in moderate to severe weathering  
33 conditions is adequately managed.

34 2. Further evaluation is recommended to determine if a plant-specific program is required  
35 to manage cracking due to expansion from reaction with aggregates in inaccessible  
36 concrete areas of Groups 1–5 and 7–9 structures. A plant-specific evaluation or  
37 program is required if (1) reactivity tests or petrographic examinations of concrete  
38 samples identify reaction with aggregates, or (2) accessible concrete exhibits visual  
39 indications of aggregate reactions, such as “map” or “patterned” cracking, alkali-silica gel  
40 exudations, surface staining, expansion causing structural deformation, relative  
41 movement or displacement, or misalignment/distortion of attached components. The  
42 reviewer confirms that the applicant has not identified any of the above conditions.  
43 Otherwise, the reviewer reviews the applicant's proposed AMP or plant-specific  
44 evaluation to verify that, an effective evaluation or inspection program has been  
45 developed and implemented to ensure that the aging effect is adequately managed.

1 3. Further evaluation is recommended of aging management of (a) cracking and distortion  
2 due to increased stress levels from settlement for inaccessible concrete areas of  
3 structures for all Groups and (b) reduction of foundation strength, and cracking due to  
4 differential settlement and erosion of porous concrete subfoundations for inaccessible  
5 concrete areas of Groups 1–3, and 5–9 structures if a dewatering system is relied upon  
6 to manage the aging effect. The reviewer confirms that, if the applicant’s plant credits a  
7 dewatering system in its CLB, the applicant has committed to monitor the functionality of  
8 the dewatering system under the applicant’s structures monitoring program. If not, the  
9 reviewer reviews and evaluates the plant-specific program for monitoring the dewatering  
10 system during the subsequent period of extended operation.

11 4. Further evaluation is recommended of programs to manage increase in porosity and  
12 permeability due to leaching of calcium hydroxide and carbonation in below-grade  
13 inaccessible concrete areas of Groups 1–5, and 7–9 structures. A plant-specific AMP is  
14 not required for the reinforced concrete exposed to flowing water if (1) there is evidence  
15 in the accessible areas that the flowing water has not caused leaching of calcium  
16 hydroxide and carbonation or (2) evaluation determined that the observed leaching of  
17 calcium hydroxide and carbonation in accessible areas has no impact on the intended  
18 function of the concrete structure. The reviewer confirms that the applicant has satisfied  
19 these conditions. Otherwise, the reviewer reviews the applicant’s proposed AMP to  
20 verify that, where appropriate, an effective inspection program has been developed  
21 and implemented to ensure that this aging effect in inaccessible areas is  
22 adequately managed.

#### 23 3.5.3.2.2.2 *Reduction of Strength and Modulus Due to Elevated Temperature*

24 Further evaluation is recommended of programs to manage reduction of strength and modulus  
25 of concrete structures due to elevated temperature for PWR and BWR safety-related and  
26 other structures.

27 A plant-specific evaluation should be performed if any portion of the concrete Groups 1–5  
28 structures exceeds specified temperature limits [i.e., general temperature greater than 66 °C  
29 (150 °F) and local area temperature greater than 93 °C (200 °F)]. Higher temperatures may be  
30 allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus  
31 of elasticity and these reductions are applied to the design calculations. The reviewer reviews  
32 and confirms that the applicant’s discussion in the renewal application indicates that the affected  
33 Groups 1–5 structures are not exposed to temperature that exceeds the temperature limits. If  
34 active cooling is relied upon to maintain acceptable temperatures, then the reviewer ensures that  
35 the aging effects associated with the cooling system are being properly managed or temperatures  
36 are being monitored to identify a problem with the cooling system. If the limits are exceeded the  
37 reviewer reviews the technical basis (i.e., tests and/or calculations) provided by the applicant to  
38 justify the higher temperature. Otherwise the reviewer reviews the applicant’s proposed programs  
39 on a case-by-case basis to ensure that the effects of elevated temperature will be adequately  
40 managed during the subsequent period of extended operation.

#### 41 3.5.3.2.2.3 *Aging Management of Inaccessible Areas for Group 6 Structures*

42 Further evaluation is recommended for inaccessible areas of certain Group 6 structure/aging  
43 effect combinations as identified below, whether or not they are covered by inspections in  
44 accordance with GALL-SLR Report AMP XI.S7, or FERC/US Army Corp of Engineers dam  
45 inspection and maintenance procedures.

- 1 1. Loss of material (spalling, scaling) and cracking due to freeze-thaw could occur in  
2 below-grade inaccessible concrete areas of Group 6 structures. Further evaluation is  
3 needed for plants that are located in moderate to severe weathering conditions  
4 (weathering index >100 day-inch/yr) (NUREG-1557, Ref. 15). The weathering index for  
5 the continental U.S. is shown in ASTM C33-90, Figure 1. A plant-specific program is not  
6 required if documented evidence confirms that the existing concrete had air content of  
7 3 percent to 8 percent and subsequent inspection of accessible areas did not exhibit  
8 degradation related to freeze-thaw. Such inspections should be considered a part of the  
9 evaluation. The reviewer reviews and confirms that the applicant has satisfied these  
10 conditions. Otherwise, the reviewer reviews the applicant's proposed AMP to determine  
11 that, where appropriate, an effective inspection program has been developed and  
12 implemented to ensure that this aging effect in inaccessible areas for plants located in  
13 moderate to severe weathering conditions will be adequately managed.
- 14 2. Cracking due to expansion from reaction with aggregates could occur in inaccessible  
15 concrete areas of Group 6 structures. Further evaluation is recommended to determine  
16 if a plant-specific program is required to manage the aging effect. A plant-specific  
17 evaluation or program is required if (1) reactivity tests or petrographic examinations of  
18 concrete samples identify reaction with aggregates, or (2) accessible concrete exhibits  
19 visual indications of aggregate reactions, such as "map" or "patterned" cracking,  
20 alkali-silica gel exudations, surface staining, expansion causing structural deformation,  
21 relative movement or displacement, or misalignment/distortion of attached components.  
22 The reviewer confirms that the applicant has not identified any of the above conditions.  
23 Otherwise, the reviewer reviews the applicant's proposed AMP or plant-specific  
24 evaluation to verify that, an effective evaluation or inspection program has been  
25 developed and implemented to ensure that the aging effect will be adequately managed.
- 26 3. Increase in porosity and permeability due to leaching of calcium hydroxide and  
27 carbonation could occur in below-grade inaccessible concrete areas of Group 6  
28 structures. Further evaluation is recommended to determine if a plant-specific program  
29 is required to manage the aging effect. A plant-specific program is not required for the  
30 reinforced structures exposed to flowing water if (1) there is evidence in the accessible  
31 areas that the flowing water has not caused leaching and carbonation, or (2) evaluation  
32 determined that the observed leaching of calcium hydroxide and carbonation in  
33 accessible areas has no impact on the intended function of the concrete structure. The  
34 reviewer confirms that the applicant has satisfied these conditions. Otherwise, the  
35 reviewer reviews the applicant's proposed AMP to verify that, where appropriate, an  
36 effective inspection program has been developed and implemented to ensure that this  
37 aging effect in inaccessible areas will be adequately managed.

38 3.5.3.2.2.4 *Cracking Due to Stress Corrosion Cracking and Loss of Material Due to Pitting and*  
39 *Crevice Corrosion*

40 Further evaluation is recommended of plant-specific programs to manage cracking due to SCC  
41 and loss of material due to pitting and crevice corrosion for SS tank liners exposed to standing  
42 water. The reviewer reviews the applicant's proposed AMP on a case-by-case basis to  
43 ensure that the intended functions will be maintained during the subsequent period of  
44 extended operation.

45 The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting  
46 and crevice corrosion and cracking due to SCC in SS and aluminum alloy support members;

1 welds; bolted connections; or support anchorage to building structure exposed to any air,  
2 condensation, or underground environment where the presence of sufficient halides  
3 (e.g., chlorides) and moisture is possible; or in the vicinity of potentially transportable halogens.  
4 The possibility of these aging effects also extends to indoor components located in close proximity  
5 to sources of outdoor air (e.g., components near intake vents).

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

13 An applicant may refine its OE search, and subsequent one-time inspections, by binning  
14 plant-specific environments into subcategories. For example, the OE search could be based on  
15 two environments including outdoor air and indoor air. The results could be that loss of material  
16 or cracking has occurred in the outdoor air environment but not the indoor air environment. The  
17 applicant could further categorize the indoor air locations as those where leakage could impinge  
18 on a component's surface (e.g., leakage from mechanical connections) and those where there is  
19 not a potential for leakage. When the applicant chooses to conduct its OE search in this manner,  
20 the reviewer is to also confirm that the applicant has adequately addressed the potential for the  
21 periodic introduction of either moisture or halides from secondary sources. Secondary sources of  
22 moisture or halides should be considered for all environments including indoor conditioned air.  
23 Typical secondary sources of moisture or halides include: leakage from mechanical connections;  
24 leakage into vaults; insulation containing halides; and outdoor air intrusion. Grouping of  
25 environments consistent with that described in the detection of aging effects program element of  
26 GALL-SLR Report AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and  
27 Ducting Components," is appropriate.

#### 28 3.5.3.2.2.5 *Cumulative Fatigue Damage*

29 Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of support  
30 members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are  
31 TLAAAs as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAAs are required to be  
32 evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in  
33 Section 4.3, "Metal Fatigue Analysis," and/or Section 4.7, "Other Plant-Specific Time-Limited  
34 Aging Analyses," of this SRP-SLR Report.

35 The staff reviews the information on a case-by-case basis consistent with the review procedures  
36 in SRP-SLR Sections 4.3 and/or 4.7 (as applicable) to determine whether the applicant has  
37 provided a sufficient basis for dispositioning the TLAAAs in accordance with the acceptance criteria  
38 in 10 CFR 54.21(c)(1)(i), (ii), or (iii). This includes staff's review of those cumulative usage factor  
39 analyses that qualify as TLAAAs based on plant-specific calculation methods.

#### 40 3.5.3.2.2.6 *Reduction of Strength and Mechanical Properties of Concrete Due to Irradiation*

41 Further evaluation is recommended of a plant-specific program to manage reduction of strength,  
42 loss of mechanical properties, and cracking of concrete due to irradiation in PWR and BWR  
43 Group 4 concrete structures, exposed to high levels of neutron and gamma radiation. These  
44 structures include the reactor (primary/biological) shield wall, the sacrificial shield wall, and the

1 reactor vessel support/pedestal structure. The irradiation mechanism consists of radiation  
2 interactions with the material and heating due to absorption of radiation energy at the operating  
3 temperature experienced by the concrete. The intensity of radiation is typically characterized by  
4 the measure of its field or fluence. Both neutron and gamma radiation produce internal heating  
5 from absorption of radiation energy and, at high fluence levels, changes in microstructure and  
6 certain mechanical properties of concrete (e.g., compressive strength, tensile strength, modulus of  
7 elasticity) from radiation interactions with the material. Limited data are available in the  
8 open literature related to the effects and significance of radiation fluences (neutron and  
9 gamma radiation) on intended functions of concrete structures, especially for conditions  
10 (dose, temperature, etc.) representative of existing LWR plants. However, based on literature  
11 review of existing research, fluence limits of  $1 \times 10^{19}$  neutrons/cm<sup>2</sup> neutron radiation and  
12  $1 \times 10^8$  Gy ( $1 \times 10^{10}$  rad) gamma dose are considered conservative radiation exposure levels  
13 beyond which concrete material properties may begin to degrade markedly.

14 Plant-specific calculations/analyses should be performed to identify the neutron (fluence cutoff  
15 energy  $E > 0.1$  MeV) and gamma fields that develop in any portion of the concrete structures of  
16 interest at 80 years of operation and compare them to the above threshold limits. The impact of  
17 any plant-specific OE of concrete irradiation effects on intended functions are evaluated. The  
18 reviewer reviews these analyses, OE and supporting technical basis (e.g., calculations, test data,  
19 plant-specific evaluations) on a case-by-case basis. Higher fluence or dose levels may be  
20 allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in  
21 strength and/or change in mechanical properties of concrete, if any, from those fluence levels and  
22 the effects are applied to the design calculations. The reviewer confirms that the applicant's  
23 discussion in the SLRA indicates that the affected PWR and BWR concrete components are not  
24 exposed to neutron and gamma radiation fluence levels that exceed the threshold limits, or are  
25 otherwise evaluated, for example, the concrete is primarily for shielding and non-structural. The  
26 reviewer also confirms that the impact of any plant-specific OE of concrete irradiation degradation  
27 on intended functions is addressed. If the limits are exceeded, the technical basis (i.e., tests  
28 and/or calculations or evaluations) provided by the applicant to justify higher fluence or dose limits  
29 is reviewed. Otherwise, the applicant's proposed plant-specific program and the supporting  
30 technical basis is reviewed to ensure that the effects of irradiation on the concrete components  
31 will be adequately managed during the subsequent period of extended operation.

#### 32 3.5.3.2.3 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

#### 43 3.5.3.2.4 *Ongoing Review of Operating Experience*

44 The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant  
45 has appropriate programs or processes for the ongoing review of both plant-specific and industry  
46 OE concerning age-related degradation and aging management. Such reviews are used to

1 ensure that the AMPs are effective to manage the aging effects for which they are created. The  
2 AMPs are either enhanced or new AMPs are developed, as appropriate, when it is determined  
3 through the evaluation of OE that the effects of aging may not be adequately managed.  
4 Additional information is in Appendix A.4, "Operating Experience for Aging Management  
5 Programs." In addition, the reviewer confirms that the applicant has provided an appropriate  
6 summary description of these activities in the FSAR Supplement.

7 *3.5.3.3 Aging Management Review Results Not Consistent With or Not Addressed in the*  
8 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

14 *3.5.3.4 Aging Management Programs*

15 The reviewer confirms that the applicant has identified the appropriate AMPs as described and  
16 evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its  
17 SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this  
18 enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR  
19 Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program  
20 elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the  
21 exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not  
22 identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP, with which the  
23 SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference  
24 satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting  
25 enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report  
26 pertinent to the containments, structures, and component supports are summarized in Table 3.5-1  
27 of this SRP-SLR. The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-  
28 SLR Report, Chapters II and III, presenting detailed information summarized by this row.

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

32 *3.5.3.5 Final Safety Analysis Report Supplement*

33 The reviewer confirms that the applicant has provided in its FSAR Supplement information for  
34 aging management of the containments, structures, and component supports. Table 3.5-2 lists  
35 the AMPs that are applicable for this SRP-SLR subsection. The reviewer also confirms that the  
36 applicant has provided information for Subsection 3.5.3.3, "Aging Management Review Results  
37 Not Consistent With or Not Addressed in the Generic Aging Lessons Learned for Subsequent  
38 License Renewal Report."

39 The NRC staff expects to impose a license condition on any renewed license to require the  
40 applicant to update its FSAR to include this FSAR Supplement at the next update required  
41 pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is  
42 complete, the applicant may make changes to the programs described in its FSAR Supplement  
43 without prior NRC approval, provided that the applicant evaluates each such change pursuant to

1 the criteria set forth in 10 CFR 50.59. If the applicant updates the FSAR to include the final FSAR  
2 Supplement before the license is renewed, no condition will be necessary.

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

### 9 **3.5.4 Evaluation Findings**

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

13 On the basis of its review, as discussed above, the NRC staff concludes that the  
14 applicant has demonstrated that the aging effects associated with the  
15 containments, structures, and component supports components will be  
16 adequately managed so that the intended functions will be maintained consistent  
17 with the CLB for the subsequent period of extended operation, as required by  
18 10 CFR 54.21(a)(3).

19 The NRC staff also reviewed the applicable FSAR Supplement program  
20 summaries and concludes that they adequately describe the AMPs credited  
21 for managing aging of the containments, structures, and component supports, as  
22 required by 10 CFR 54.21(d).

### 23 **3.5.5 Implementation**

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

### 29 **3.5.6 References**

- 30 1. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and  
31 Fuel Reprocessing Plants." Washington, DC: U.S. Nuclear Regulatory Commission.  
32 2016.
- 33 2. 10 CFR 50.55a, "Codes and Standards." Washington, DC: U.S. Nuclear Regulatory  
34 Commission. 2016.
- 35 3. 10 CFR 50.59, "Changes, Tests, and Experiments." Washington, DC: U.S. Nuclear  
36 Regulatory Commission. 2016.
- 37 4. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for  
38 Water-Cooled Power Reactors." Washington, DC: U.S. Nuclear Regulatory Commission.  
39 2016.

- 1 5. 10 CFR 50.71, "Maintenance of Record, Making of Reports." Washington, DC:  
2 U.S. Nuclear Regulatory Commission. 2016.
- 3 6. 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear  
4 Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.
- 5 7. 10 CFR 54.4, "Scope." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.
- 6 8. NRC. Regulatory Guide 1.127, "Inspection of Water-Control Structures Associated with  
7 Nuclear Power Plants." Revision 1. Agencywide Documents Access and Management  
8 System (ADAMS) Accession No. ML003739392. Washington, DC: U.S. Nuclear  
9 Regulatory Commission. March 1978.
- 10 9. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of  
11 10 CFR Part 54--The License Renewal Rule." Revision 6. ADAMS Accession  
12 No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.
- 13 10. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant  
14 Components," Subsection IWL, "Requirements for Class CC Concrete Components of  
15 Light-Water Cooled Power Plants." New York, New York: The American Society of  
16 Mechanical Engineers. 2008.
- 17 11. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant  
18 Components," Subsection IWE, "Requirements for Class MC and Metallic Liners of Class  
19 CC Components of Light-Water Cooled Power Plants." New York, New York: The  
20 American Society of Mechanical Engineers. 2008.
- 21 12. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant  
22 Components," Subsection IWF, "Requirements for Class 1, 2, 3, and MC Component  
23 Supports of Light-Water Cooled Power Plants." New York, New York: The American  
24 Society of Mechanical Engineers. 2008.
- 25 13. NEI. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of  
26 Maintenance at Nuclear Power Plants." Revision 2. ADAMS Accession  
27 No. ML11116A198. Washington, DC: Nuclear Energy Institute. April 1996.
- 28 14. NRC. Regulatory Guide 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear  
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<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	001	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
E	002	BWR/PWR	Concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.1)	II.A1.C-07 II.A2.C-07 II.B1.2.C-07 II.B2.2.C-07 II.B3.1.C-07 II.B3.2.C-07
M	003	BWR/PWR	Concrete: dome; wall; basemat; ring girders; buttresses, concrete: containment; wall; basemat, concrete: basemat, concrete fill-in annulus	Reduction of strength and modulus of elasticity due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program	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
E	004	BWR	Steel elements (inaccessible areas): drywell shell; drywell head	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.B3.1.CP-113
E	005	BWR/PWR	Steel elements (inaccessible areas): liner; liner anchors; integral attachments, steel elements (inaccessible areas): suppression chamber; drywell; drywell head; embedded shell; region shielded by diaphragm floor (as applicable)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.A1.CP-98 II.A2.CP-98 II.B1.2.CP-63 II.B2.1.CP-63 II.B2.2.CP-63 II.B3.2.CP-98

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	006	BWR	Steel elements: torus shell	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.3.2)	II.B1.1.CP-48
E	007	BWR	Steel elements: torus ring girders; downcomers; Steel elements: suppression chamber shell (interior surface)	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE"	Yes (SRP-SLR Section 3.5.2.2.1.3.3)	II.B1.1.CP-109 II.B3.1.CP-158
M	008	BWR/PWR	Prestressing system: tendons	Loss of prestress due to relaxation; shrinkage; creep; elevated temperature	TLAA, SRP-SLR Section 4.5, "Concrete Containment Tendon Prestress," and/or SRP-SLR Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses"	Yes (SRP-SLR Section 3.5.2.2.1.4)	II.A1.C-11 II.B2.2.C-11
M	009	BWR/PWR	Metal liner, metal plate, 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 cyclic loading (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
E	010	BWR/PWR	Penetration sleeves; penetration bellows	Cracking due to SCC	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.A3.CP-38 II.B4.CP-38

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	011	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.7)	II.A1.CP-147 II.A2.CP-70 II.B3.2.CP-135
M	012	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, 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	013						
M	014	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.9)	II.A1.CP-102 II.A2.CP-53 II.B1.2.CP-110 II.B2.2.CP-110 II.B3.1.CP-53 II.B3.2.CP-122
D	015						
M	016	BWR/PWR	Concrete (accessible areas): basemat, concrete: containment; wall	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-87 II.A2.CP-72 II.B1.2.CP-106 II.B2.2.CP-106 II.B3.1.CP-72
D	017						
M	018	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-31 II.A2.CP-51 II.B3.2.CP-52
M	019	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment; concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-33 II.A2.CP-58 II.B1.2.CP-59 II.B2.2.CP-59 II.B3.1.CP-66 II.B3.2.CP-60

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	020	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S2, "ASME Section XI, Subsection IWL"	No	II.A1.CP-32 II.A2.CP-155 II.B1.2.CP-54 II.B2.2.CP-54 II.B3.1.CP-156 II.B3.2.CP-55
E	021	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-68 II.A2.CP-74 II.B1.2.CP-79 II.B2.2.CP-79 II.B3.1.CP-74 II.B3.2.CP-88
D	022						
M	023	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
E	024	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, concrete (accessible areas): dome; wall; basemat	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-100 II.A2.CP-71 II.B3.1.CP-71 II.B3.2.CP-73 II.B3.2.CP-84
D	025						
	026	BWR/PWR	Moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.A3.CP-40 II.B4.CP-40

<b>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</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	027	BWR/PWR	Metal liner, metal plate, airlock, equipment hatch, CRD hatch; 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
	028	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.C-16 II.B4.C-16
M	029	BWR/PWR	Personnel airlock, equipment hatch, CRD hatch: locks, hinges, and closure mechanisms	Loss of leak tightness due to mechanical wear	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.CP-39 II.B4.CP-39
	030	BWR/PWR	Pressure-retaining bolting	Loss of preload due to self-loosening	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.A3.CP-150 II.B4.CP-150
	031	BWR/PWR	Pressure-retaining bolting, steel elements: downcomer pipes	Loss of material due to general, pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.A3.CP-148 II.B1.2.CP-117 II.B2.1.CP-117 II.B2.2.CP-117 II.B4.CP-148
	032	BWR/PWR	Prestressing system: tendons; anchorage components	Loss of material due to corrosion	AMP XI.S2, "ASME Section XI, Subsection IWL"	No	II.A1.C-10 II.B2.2.C-10

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	033	BWR/PWR	Seals and gaskets	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S4, "10 CFR Part 50, Appendix J "	No	II.A3.CP-41 II.B4.CP-41
	034	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, "Protective Coating Monitoring and Maintenance"	No	II.A3.CP-152 II.B4.CP-152
M	035	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"	Yes (SRP-SLR Section 3.5.2.2.1.3.1)	II.A1.CP-35 II.A2.CP-35 II.A3.CP-36 II.B1.1.CP-43 II.B1.2.CP-46 II.B2.1.CP-46 II.B2.2.CP-46 II.B3.1.CP-43 II.B3.2.CP-35 II.B4.CP-36
M	036	BWR	Steel elements: drywell head; downcomers	Loss of material due to mechanical wear, including fretting	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.B1.1.C-23 II.B1.2.C-23 II.B2.1.C-23 II.B2.2.C-23
	037	BWR	Steel elements: suppression chamber (torus) liner (interior surface)	Loss of material due to general (steel only), pitting, crevice corrosion	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	No	II.B1.2.C-49 II.B2.2.C-49
M	038	BWR	Steel elements: suppression chamber shell (interior surface)	Cracking due to SCC	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.B3.1.C-24 II.B3.2.C-24

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	039	BWR	Steel elements: vent line bellows	Cracking due to SCC	AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J"	Yes (SRP-SLR Section 3.5.2.2.1.6)	II.B1.1.CP-50
	040	BWR	Unbraced downcomers, steel elements: vent header; downcomers	Cracking due to cyclic loading (CLB fatigue analysis does not exist)	AMP XI.S1, "ASME Section XI, Subsection IWE"	No	II.B2.1.CP-142 II.B2.2.CP-64
E	041	BWR	Steel elements: drywell support skirt, steel elements (inaccessible areas): support skirt	None	None	No	II.B1.1.CP-44 II.B1.2.CP-114 II.B2.1.CP-114 II.B2.2.CP-114
M	042	BWR/PWR	Groups 1-3, 5, 7- 9: concrete (inaccessible areas): foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.1.1)	III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108
M	043	BWR/PWR	All Groups except Group 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	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
E	044	BWR/PWR	All Groups: concrete: all	Cracking and distortion due to increased stress levels from settlement	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-30 III.A2.TP-30 III.A3.TP-30 III.A4.TP-304 III.A5.TP-30 III.A6.TP-30 III.A7.TP-30 III.A8.TP-30 III.A9.TP-30

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
D	045						
E	046	BWR/PWR	Groups 1-3, 5-9: concrete: foundation; subfoundation	Reduction of foundation strength and cracking due to differential settlement and erosion of porous concrete subfoundation	AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.3)	III.A1.TP-31 III.A2.TP-31 III.A3.TP-31 III.A5.TP-31 III.A6.TP-31 III.A7.TP-31 III.A8.TP-31 III.A9.TP-31
M	047	BWR/PWR	Groups 1-5, 7-9: concrete (inaccessible areas): exterior 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	048	BWR/PWR	Groups 1-5: concrete: all	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.2)	III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114 III.A5.TP-114
M	049	BWR/PWR	Groups 6: concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Loss of material (spalling, scaling) and cracking due to freeze-thaw	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.3.1)	III.A6.TP-110
M	050	BWR/PWR	Groups 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.3.2)	III.A6.TP-220
M	051	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
E	052	BWR/PWR	Groups 7, 8 - steel components: tank liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.A7.T-23 III.A8.T-23

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	053	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to cyclic loading (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.3 "Metal Fatigue," and/or Section 4.7 "Other Plant-Specific Time-Limited Aging Analyses"	Yes (SRP-SLR Section 3.5.2.2.2.5)	III.B1.1.T-26 III.B1.2.T-26 III.B1.3.T-26
	054	BWR/PWR	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-25 III.A2.TP-25 III.A3.TP-25 III.A4.TP-25 III.A5.TP-25 III.A7.TP-25 III.A8.TP-25 III.A9.TP-25
	055	BWR/PWR	Building concrete at locations of expansion and 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 III.B5.TP-42
E	056	BWR/PWR	Concrete: exterior above- and below- grade; foundation; interior slab	Loss of material due to abrasion; cavitation	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.T-20
M	057	BWR/PWR	Constant and variable load spring hangers; guides; stops	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.T-28 III.B1.2.T-28 III.B1.3.T-28

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	058	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, surface runoff, seepage	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-22
E	059	BWR/PWR	Group 6: concrete (accessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-38
E	060	BWR/PWR	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-36

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	061	BWR/PWR	Group 6: concrete (accessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-37
E	062	BWR/PWR	Group 6: Wooden Piles; sheeting	Loss of material; change in material properties due to weathering, chemical degradation, and insect infestation repeated wetting and drying, fungal decay	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-223
	063	BWR/PWR	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-24 III.A2.TP-24 III.A3.TP-24 III.A5.TP-24 III.A7.TP-24 III.A8.TP-24 III.A9.TP-24
	064	BWR/PWR	Groups 1-3, 5, 7-9: concrete (accessible areas): exterior above- and below-grade; foundation	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-23 III.A2.TP-23 III.A3.TP-23 III.A5.TP-23 III.A7.TP-23 III.A8.TP-23 III.A9.TP-23

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	065	BWR/PWR	Groups 1-3, 5, 7-9: concrete (inaccessible areas): below-grade exterior; foundation, Groups 1-3, 5, 7-9: concrete (accessible areas): below-grade exterior; foundation, Groups 6: concrete (inaccessible areas): all	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-212 III.A1.TP-27 III.A2.TP-212 III.A2.TP-27 III.A3.TP-212 III.A3.TP-27 III.A5.TP-212 III.A5.TP-27 III.A6.TP-104 III.A7.TP-212 III.A7.TP-27 III.A8.TP-212 III.A8.TP-27 III.A9.TP-212 III.A9.TP-27
	066	BWR/PWR	Groups 1-5, 7, 9: concrete (accessible areas): 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
	067	BWR/PWR	Groups 1-5, 7, 9: Concrete: interior; above-grade exterior, Groups 1-3, 5, 7-9 - concrete (inaccessible areas): below-grade exterior; foundation, Group 6: concrete (inaccessible areas): all	Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-28 III.A1.TP-29 III.A2.TP-28 III.A2.TP-29 III.A3.TP-28 III.A3.TP-29 III.A4.TP-28 III.A5.TP-28 III.A5.TP-29 III.A6.TP-107 III.A7.TP-28 III.A7.TP-29 III.A8.TP-29 III.A9.TP-28 III.A9.TP-29

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	068	BWR/PWR	High-strength steel structural bolting	Cracking due to SCC	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-41
D	069						
	070	BWR/PWR	Masonry walls: all	Cracking due to restraint shrinkage, creep, aggressive environment	AMP XI.S5, "Masonry Walls"	No	III.A1.T-12 III.A2.T-12 III.A3.T-12 III.A5.T-12 III.A6.T-12
M	071	BWR/PWR	Masonry walls: all	Loss of material (spalling, scaling) and cracking due to freeze-thaw	AMP XI.S5, "Masonry Walls"	No	III.A1.TP-34 III.A2.TP-34 III.A3.TP-34 III.A5.TP-34 III.A6.TP-34
M	072	BWR/PWR	Seals; gasket; moisture barriers (caulking, flashing, and other sealants)	Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects	AMP XI.S6, "Structures Monitoring"	No	III.A6.TP-7
	073	BWR/PWR	Service Level I coatings	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, or physical damage	AMP XI.S8, "Protective Coating Monitoring and Maintenance"	No	III.A4.TP-301
M	074	BWR/PWR	Sliding support bearings; sliding support surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-46 III.B2.TP-47 III.B4.TP-46 III.B4.TP-47
M	075	BWR/PWR	Sliding surfaces	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-45 III.B1.2.TP-45 III.B1.3.TP-45
M	076	BWR/PWR	Sliding surfaces: radial beam seats in BWR drywell	Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear	AMP XI.S6, "Structures Monitoring"	No	III.A4.TP-35

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	077	BWR/PWR	Steel components: all structural steel	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-302 III.A2.TP-302 III.A3.TP-302 III.A4.TP-302 III.A5.TP-302 III.A7.TP-302 III.A8.TP-302
M	078	BWR/PWR	Stainless steel fuel pool liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	AMP XI.M2, "Water Chemistry," and monitoring of the spent fuel pool water level and leakage from the leak chase channels.	No	III.A5.T-14
	079	BWR/PWR	Steel components: piles	Loss of material due to corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A3.TP-219
	080	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-248 III.A2.TP-248 III.A3.TP-248 III.A4.TP-248 III.A5.TP-248 III.A6.TP-248 III.A7.TP-248 III.A8.TP-248 III.A9.TP-248 III.B2.TP-248 III.B3.TP-248 III.B4.TP-248 III.B5.TP-248
	081	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-226 III.B1.2.TP-226 III.B1.3.TP-226

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	082	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-274 III.A2.TP-274 III.A3.TP-274 III.A4.TP-274 III.A5.TP-274 III.A7.TP-274 III.A8.TP-274 III.A9.TP-274 III.B2.TP-274 III.B3.TP-274 III.B4.TP-274 III.B5.TP-274
E	083	BWR/PWR	Structural bolting	Loss of material due to general, pitting, crevice corrosion	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC/US Army Corp of Engineers dam inspections and maintenance programs.	No	III.A6.TP-221
D	084						
M	085	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.M2, "Water Chemistry," and AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-232 III.B1.2.TP-232 III.B1.3.TP-232
	086	BWR/PWR	Structural bolting	Loss of material due to pitting, crevice corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-235 III.B1.2.TP-235 III.B1.3.TP-235
	087	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.TP-229 III.B1.2.TP-229 III.B1.3.TP-229

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	088	BWR/PWR	Structural bolting	Loss of preload due to self-loosening	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-261 III.A2.TP-261 III.A3.TP-261 III.A4.TP-261 III.A5.TP-261 III.A6.TP-261 III.A7.TP-261 III.A8.TP-261 III.A9.TP-261 III.B2.TP-261 III.B3.TP-261 III.B4.TP-261 III.B5.TP-261
	089	PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to boric acid corrosion	AMP XI.M10, "Boric Acid Corrosion"	No	III.B1.1.T-25 III.B1.1.TP-3 III.B1.2.T-25 III.B1.3.TP-3 III.B1.2.TP-3 III.B2.T-25 III.B2.TP-3 III.B3.T-25 III.B3.TP-3 III.B4.T-25 III.B4.TP-3 III.B5.T-25 III.B5.TP-3
E	090	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
	091	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S3, "ASME Section XI, Subsection IWF"	No	III.B1.1.T-24 III.B1.2.T-24 III.B1.3.T-24

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
	092	BWR/PWR	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general, pitting corrosion	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-43 III.B3.TP-43 III.B4.TP-43 III.B5.TP-43
M	093	BWR/PWR	Galvanized steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting, crevice corrosion	AMP XI.S6, "Structures Monitoring"	No	III.B2.TP-6 III.B4.TP-6
M	094	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
E	095	BWR/PWR	Galvanized steel support members; welds; bolted connections; support anchorage to building structure	None	None	No	III.B1.1.TP-8 III.B1.2.TP-8 III.B1.3.TP-8 III.B2.TP-8 III.B3.TP-8 III.B4.TP-8 III.B5.TP-8
N	096	BWR/PWR	Groups 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S7, "Inspection of Water-Control Structures Associated with Nuclear Power Plants"	No	III.A6.T-34
N	097	BWR/PWR	Group 4: Concrete (reactor cavity area proximate to the reactor vessel); reactor (primary/biological) shield wall; sacrificial shield wall; reactor vessel support/pedestal structure	Reduction of strength; loss of mechanical properties due to irradiation (i.e., radiation interactions with material and radiation-induced heating)	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.6)	III.A4.T-35

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	098	BWR/PWR	Stainless steel, aluminum alloy support members; welds; bolted connections; support anchorage to building structure	None	None	No	III.B1.1.TP-4 III.B1.2.TP-4 III.B1.3.TP-4 III.B2.TP-4 III.B3.TP-4 III.B4.TP-4 III.B5.TP-4
N	099	BWR/PWR	Aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion, cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.S3, "ASME Section XI, Subsection IWF," or AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.B1.1.T-36a III.B1.1.T-36b III.B1.1.T-36c III.B1.2.T-36a III.B1.2.T-36b III.B1.2.T-36c III.B1.3.T-36a III.B1.3.T-36b III.B1.3.T-36c
N	100	BWR/PWR	Aluminum, stainless steel support members; welds; bolted connections; support anchorage to building structure	Loss of material due to pitting and crevice corrosion, cracking due to SCC	AMP XI.M32, "One-Time Inspection," AMP XI.S6, "Structures Monitoring," or AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.5.2.2.2.4)	III.B2.T-37a III.B2.T-37b III.B2.T-37c III.B3.T-37a III.B3.T-37b III.B3.T-37c III.B4.T-37a III.B4.T-37b III.B4.T-37c III.B5.T-37a III.B5.T-37b III.B5.T-37c

<b>Table 3.5-2. AMPs and Additional Guidance Appendices Recommended for Containments, Structures, and Component Supports</b>	
<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP XI.M2	Water Chemistry
AMP XI.M10	Boric Acid Corrosion
AMP XI.M32	One-Time Inspection
AMP XI.M36	External Surfaces Monitoring of Mechanical Components
AMP XI.S1	ASME Section XI, Subsection IWE
AMP XI.S2	ASME Section XI, Subsection IWL
AMP XI.S3	ASME Section XI, Subsection IWF
AMP XI.S4	10 CFR Part 50, Appendix J
AMP XI.S5	Masonry Walls
AMP XI.S6	Structures Monitoring
AMP XI.S7	Inspection of Water-Control Structures Associated with Nuclear Power Plants
AMP XI.S8	Protective Coating Monitoring and Maintenance
GALL-SLR Report Appendix A	Quality Assurance for Aging Management Programs
GALL-SLR Report Appendix B	Operating Experience for Aging Management Programs
SRP-SLR Appendix A.1	Aging Management Review—Generic (Branch Technical Position RLSB-1)

1 **3.6 Aging Management of Electrical and Instrumentation and Controls**

2 **Review Responsibilities**

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

5 **Secondary**—None

6 **3.6.1 Areas of Review**

7 This section addresses the aging management review (AMR) and the associated aging  
8 management programs (AMPs) of the electrical and instrumentation and control (I&C). For a  
9 recent vintage plant, the information related to the electrical and I&C is contained in Chapter 7,  
10 “Instrumentation and Controls,” and Chapter 8, “Electric Power,” of the plant’s Final Safety  
11 Analysis Report (FSAR), consistent with the “Standard Review Plan for the Review of Safety  
12 Analysis Reports for Nuclear Power Plants” (NUREG–0800) (Ref. 1). For older plants, the  
13 location of applicable information is plant-specific because an older plant’s FSAR may have  
14 predated NUREG–0800. Typical electrical and I&C components that are subject to an AMR for  
15 subsequent license renewal (SLR) are electrical cables and connections, metal enclosed buses,  
16 cable bus, fuse holders, high-voltage insulators, transmission conductors and connections, and  
17 switchyard bus and connections.

18 The responsible review organization is to review the following subsequent license renewal  
19 application (SLRA) AMR and AMP items assigned to it, per SRP-SLR Section 1.2:

20 **AMRs**

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

25 **AMPs**

- 26 • Consistent with GALL-SLR Report AMPs
- 27 • Plant-specific AMPs

28 **FSAR Supplement**

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

31 **3.6.2 Acceptance Criteria**

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

1 3.6.2.1 *Aging Management Review Results Consistent With the Generic Aging Lessons*  
2 *Learned for Subsequent License Renewal Report*

3 The AMRs and the AMPs applicable to the electrical and I&C components are described and  
4 evaluated in Chapter VI of the GALL-SLR Report.

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

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

13 3.6.2.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by*  
14 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

15 The basic acceptance criteria defined in Section 3.6.2.1 need to be applied first for all of the  
16 AMRs and AMPs reviewed as part of this section. In addition, if the GALL-SLR Report AMR item  
17 to which the SLRA AMR item is compared identifies that "further evaluation is recommended,"  
18 then additional criteria apply as identified by the GALL-SLR Report for each of the following aging  
19 effect/aging mechanism combinations. Refer to Table 3.6-1, comparing the "Further Evaluation  
20 Recommended" and the "GALL-SLR Item" column, for the AMR items that reference the  
21 following subsections.

22 3.6.2.2.1 *Electrical Equipment Subject to Environmental Qualification*

23 Environmental qualification is a time-limited aging analysis (TLAA) as defined in 10 CFR 54.3.  
24 TLAA's are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of  
25 this TLAA is addressed separately in Section 4.4, "Environmental Qualification (EQ) of Electrical  
26 Equipment," of this SRP-SLR.

27 3.6.2.2.2 *Reduced Insulation Resistance Due to Age Degradation of Cable Bus*  
28 *Arrangements Caused by Intrusion of Moisture, Dust, Industrial Pollution, Rain,*  
29 *Ice, Photolysis, Ohmic Heating and Loss of Strength of Support Structures and*  
30 *Louvers of Cable Bus Arrangements Due to General Corrosion and Exposure to*  
31 *Air Outdoor*

32 Reduced insulation resistance due to age degradation of cable bus caused by intrusion of  
33 moisture, dust, industrial pollution, rain, ice, photolysis (for ultraviolet sensitive material only),  
34 ohmic heating and loss of strength of support structures, covers or louvers of cable bus  
35 arrangements due to general corrosion or exposure to air outdoor could occur in cable bus  
36 assemblies. Cable bus is a variation of metal enclosed bus (MEB) which is similar in construction  
37 to an MEB, but instead of segregated or nonsegregated electrical buses, cable bus is comprised  
38 of a fully enclosed metal enclosure that utilizes three-phase insulated power cables installed on  
39 insulated support blocks. Cable bus may omit the top cover or use a louvered top cover and  
40 enclosure. Both the cable bus and enclosures are not sealed against intrusion of dust, industrial  
41 pollution, moisture, rain, and ice and therefore may introduce debris into the internal cable  
42 bus assembly.

1 Consequently, cable bus construction and arrangements are such that it may not readily fall under  
2 a specific GALL-SLR Report AMP (e.g., GALL-SLR Report AMP XI.E1 and AMP XI.E4).  
3 GALL SLR Report AMP XI.E1 calls for a visual inspection of accessible insulated cables and  
4 connections subject to an adverse localized environment which may not be applicable to cable  
5 bus due to inaccessibility or applicability of the aging mechanisms and effects. GALL-SLR Report  
6 AMP XI.E4 includes tests and inspections of the internal and external portions of the MEB. The  
7 MEB internal and external inspections and tests may not be applicable to cable bus aging  
8 mechanisms and effects. Therefore, the GALL-SLR Report recommends cable bus aging  
9 mechanisms and effects be evaluated as a plant-specific further evaluation. The evaluation  
10 includes associated AMPs: AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping  
11 and Ducting Components," and AMP XI.S6, "Structures Monitoring." Acceptance criteria are  
12 described in Branch Technical Position (BTP) RLSB-1 (Appendix A.1 of this SRP-SLR).

13 **3.6.2.2.3** *Loss of Material Due to Wind-Induced Abrasion, Loss of Conductor Strength Due*  
14 *to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of*  
15 *Preload for Transmission Conductors, Switchyard Bus, and Connections*

16 Loss of material due to wind-induced abrasion, loss of conductor strength due to corrosion, and  
17 increased resistance of connection due to oxidation or loss of preload could occur in transmission  
18 conductors and connections, and in switchyard bus and connections. The GALL-SLR Report  
19 recommends further evaluation of a plant-specific AMP to demonstrate that this aging effect is  
20 adequately managed. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this  
21 SRP-SLR).

22 **3.6.2.2.4** *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

24 **3.6.2.2.5** *Ongoing Review of Operating Experience*

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

27 **3.6.2.3** *Aging Management Review Results Not Consistent With or Not Addressed in the*  
28 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

30 **3.6.2.4** *Aging Management Programs*

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

35 If the applicant identifies an exception to any of the program elements of the cited GALL-SLR  
36 Report AMP, the SLRA AMP should include a basis demonstrating how the criteria of  
37 10 CFR 54.21(a)(3) would still be met. The NRC reviewer should then confirm that the SLRA  
38 AMP, with all exceptions, would satisfy the criteria of 10 CFR 54.21(a)(3). If, while reviewing the  
39 SLRA AMP, the reviewer identifies a difference between the SLRA AMP and the GALL-SLR  
40 Report AMP that should have been identified as an exception to the GALL-SLR Report AMP, the

1 difference should be reviewed and properly dispositioned. The reviewer should document the  
2 disposition of all SLRA-defined exceptions and NRC staff-identified differences.

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

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

### 13 3.6.2.5 *Final Safety Analysis Report Supplement*

14 The summary description of the programs and activities for managing the effects of aging for the  
15 subsequent period of extended operation in the FSAR Supplement should be sufficiently  
16 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
17 should contain information associated with the bases for determining that aging effects are  
18 managed during the subsequent period of extended operation. The description should also  
19 contain any future aging management activities, including commitments, license conditions,  
20 enhancements, and exceptions, to be implemented prior to or during the subsequent period of  
21 extended operation. Table X-01 and Table XI-01 of the GALL-SLR Report provide examples of  
22 the type of information to be included in the FSAR Supplement. Table 3.6-2 lists the programs  
23 that are applicable for this SRP-SLR subsection.

### 24 3.6.3 **Review Procedures**

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

#### 26 3.6.3.1 *Aging Management Review Results Consistent With the Generic Aging Lessons* 27 *Learned for Subsequent License Renewal Report*

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

38 Furthermore, the reviewer should confirm that the applicant has addressed OE identified after the  
39 issuance of the GALL-SLR Report. Performance of this review includes confirming that the  
40 applicant has identified those aging effects for the electrical and I&C components that are  
41 contained in the GALL-SLR Report as applicable to its plant.

1 3.6.3.2 *Aging Management Review Results for Which Further Evaluation Is Recommended by*  
2 *the Generic Aging Lessons Learned for Subsequent License Renewal Report*

3 The basic review procedures defined in Section 3.6.3.1 need to be applied first for all of the AMRs  
4 and AMPs provided in this section. In addition, if the GALL-SLR AMR item to which the SLRA  
5 AMR item is compared identifies that “further evaluation is recommended,” then additional criteria  
6 apply as identified by the GALL-SLR Report for each of the following aging effect/aging  
7 mechanism combinations.

8 3.6.3.2.1 *Electrical Equipment Subject to Environmental Qualification*

9 Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAAs are required to be  
10 evaluated in accordance with 10 CFR 54.21(c)(1). The NRC staff reviews the evaluation of this  
11 TLAA separately following the guidance in Section 4.4 of this SRP-SLR.

12 3.6.3.2.2 *Reduced Insulation Resistance Due to Age Degradation of Cable Bus*  
13 *Arrangements Caused by Intrusion of Moisture, Dust, Industrial Pollution, Rain,*  
14 *Ice, Photolysis, Ohmic Heating and Loss of Strength of Support Structures and*  
15 *Louvers of Cable Bus Arrangements Due to General Corrosion and Exposure to*  
16 *Air Outdoor*

17 The GALL-SLR Report recommends a plant-specific Cable Bus AMP for the management of  
18 reduced insulation resistance due to age degradation of cable bus caused by intrusion of  
19 moisture, dust, industrial pollution, rain, ice, photolysis (for ultraviolet sensitive material only),  
20 ohmic heating and loss of strength of support structures, covers or louvers of cable bus  
21 arrangements due to general corrosion or exposure to air outdoor. The reviewer reviews the  
22 applicant’s proposed program on a case-by-case basis to verify that an adequate program will be  
23 in place for the management of these aging effects.

24 3.6.3.2.3 *Loss of Material Due to Wind-Induced Abrasion, Loss of Conductor Strength Due*  
25 *to Corrosion, and Increased Resistance of Connection Due to Oxidation or Loss of*  
26 *Preload for Transmission Conductors, Switchyard Bus, and Connections*

27 The GALL-SLR Report recommends a plant-specific AMP for the management of loss of material  
28 due to wind-induced abrasion, loss of conductor strength due to corrosion, and increased  
29 resistance of connection due to oxidation or loss of preload in transmission conductors and  
30 connections, and in switchyard bus and connections. The reviewer reviews the applicant’s  
31 proposed program on a case-by-case basis to verify that an adequate program will be in place for  
32 the management of these aging effects.

33 3.6.3.2.4 *Quality Assurance for Aging Management of Nonsafety-Related Components*

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

1 3.6.3.2.5 *Ongoing Review of Operating Experience*

2 The applicant's AMPs should contain the element of OE. The reviewer verifies that the applicant  
3 has appropriate programs or processes for the ongoing review of both plant-specific and industry  
4 OE concerning age-related degradation and aging management. Such reviews are used to verify  
5 that the AMPs are effective to manage the aging effects for which they are created. The AMPs  
6 are either enhanced or new AMPs are developed, as appropriate, when it is determined through  
7 the evaluation of OE that the effects of aging may not be adequately managed. Additional  
8 information is in Appendix A.4, "Operating Experience for Aging Management Programs." In  
9 addition, the reviewer confirms that the applicant has provided an appropriate summary  
10 description of these activities in the FSAR Supplement.

11 3.6.3.3 *Aging Management Review Results Not Consistent With or Not Addressed in the*  
12 *Generic Aging Lessons Learned for Subsequent License Renewal Report*

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

18 3.6.3.4 *Aging Management Programs*

19 The reviewer confirms that the applicant has identified the appropriate AMPs as described and  
20 evaluated in the GALL-SLR Report. If the applicant commits to an enhancement to make its  
21 SLRA AMP consistent with a GALL-SLR Report AMP, then the reviewer is to confirm that this  
22 enhancement, when implemented, will make the SLRA AMP consistent with the GALL-SLR  
23 Report AMP. If the applicant identifies, in the SLRA AMP, an exception to any of the program  
24 elements of the GALL-SLR Report AMP, the reviewer is to confirm that the SLRA AMP with the  
25 exception will satisfy the criteria of 10 CFR 54.21(a)(3). If the reviewer identifies a difference, not  
26 identified by the SLRA, between the SLRA AMP and the GALL-SLR Report AMP with which the  
27 SLRA claims to be consistent, the reviewer should confirm that the SLRA AMP with this difference  
28 satisfies 10 CFR 54.21(a)(3). The reviewer should document the basis for accepting  
29 enhancements, exceptions, or differences. The AMPs evaluated in the GALL-SLR Report  
30 pertinent to the electrical and I&C components are summarized in Table 3.6-1 of this SRP-SLR.  
31 The "GALL-SLR Item" column identifies the AMR item numbers in the GALL-SLR Report,  
32 Chapters VI, presenting detailed information summarized by this row.

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

36 3.6.3.5 *Final Safety Analysis Report Supplement*

37 The reviewer confirms that the applicant has provided in its FSAR Supplement information for  
38 aging management of the Electrical and I&C System. Table 3.6-2 lists the AMPs that are  
39 applicable for this SRP-SLR subsection. The reviewer also confirms that the applicant has  
40 provided information for Subsection 3.6.3.3, "Aging Management Review Results Not Consistent  
41 With or Not Addressed in the Generic Aging Lessons Learned for Subsequent License  
42 Renewal Report."

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

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

#### 14 **3.6.4 Evaluation Findings**

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

18 On the basis of its review the NRC staff concludes that the applicant has demonstrated  
19 that the aging effects associated with the electrical and I&C components will be  
20 adequately managed so that the intended functions will be maintained consistent with  
21 the current licensing basis for the subsequent period of extended operation, as required  
22 by 10 CFR 54.21(a)(3).

23 The NRC staff also reviewed the applicable FSAR Supplement program summary  
24 descriptions and concludes that they adequately describe the AMPs credited for  
25 managing aging of electrical and I&C, as required by 10 CFR 54.21(d).

#### 26 **3.6.5 Implementation**

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

#### 32 **3.6.6 References**

33 1. NRC. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports  
34 for Nuclear Power Plants." Agencywide Documents Access and Management System  
35 (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory  
36 Commission. March 2007.

<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	001	BWR/PWR	<p>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;</p> <p>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).</p>	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).	Yes, TLAA (SRP-SLR Section 3.6.2.2.1)	VI.B.L-05
M	002	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 or corrosion caused by movement of transmission conductors due to significant wind	AMP XI.E7, "High-Voltage Insulators"	No	VI.A.LP-32
M	003	BWR/PWR	High-voltage electrical insulators composed of porcelain; malleable iron; aluminum; galvanized steel; cement exposed to air – outdoor	Reduced electrical insulation resistance due to presence of cracks, foreign debris, salt, dust, cooling tower plume or industrial effluent contamination	AMP XI.E7, "High-Voltage Insulators"	No	VI.A.LP-28

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	004	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of conductor strength due to corrosion	A plant-specific aging management program is to be evaluated for ACSR	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-38
E	005	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 (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-48
E	006	BWR/PWR	Switchyard bus and connections composed of aluminum; copper; bronze; stainless steel; galvanized steel exposed to air – outdoor	Loss of material due to wind-induced abrasion; Increased electrical resistance of connection due to oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-39
E	007	BWR/PWR	Transmission conductors composed of aluminum; steel exposed to air – outdoor	Loss of material due to wind-induced abrasion	A plant-specific aging management program is to be evaluated for ACAR and ACSR	Yes (SRP-SLR Section 3.6.2.2.3)	VI.A.LP-47
E	008	BWR/PWR	Electrical insulation for electrical cables and connections (including terminal blocks, etc.) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermooxidative 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

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	009	BWR/PWR	Electrical insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR) composed of various organic polymers (e.g., EPR, SR, EPDM, XLPE) exposed to an adverse localized environment caused by heat, radiation, or moisture	Reduced electrical insulation resistance due to thermal/thermooxidative degradation of organics, radiolysis, and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	AMP XI.E2, "Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	No	VI.A.LP-34
M	010	BWR/PWR	Electrical conductor insulation for inaccessible power, instrumentation, and control cables (e.g., installed in duct bank, buried conduit or direct buried) composed of various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield exposed to an adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3A, "Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements," AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements," or AMP XI.E3C, "Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-35a VI.A.LP-35b VI.A.LP-35c
D	011						

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	012	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
E	013	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/thermooxidative degradation of organics/thermoplastics , radiation-induced oxidation, moisture/debris intrusion, and ohmic heating	AMP XI.E4, "Metal Enclosed Bus"	No	VI.A.LP-26
	014	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
	015	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

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
M	016	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor uncontrolled	Increased electrical resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due 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	017	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air-indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue from ohmic heating, thermal cycling, electrical transients	AMP XI.E5, "Fuse Holders"  No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue due to ohmic heating, thermal cycling, electrical transients.	No	VI.A.L-07
M	018	BWR/PWR	Fuse holders (not part of active equipment): metallic clamps composed of various metals used for electrical connections exposed to air – indoor controlled or uncontrolled	Increased electrical resistance of connection due to fatigue caused by frequent fuse removal/manipulation or vibration	AMP XI.E5, "Fuse Holders"  No aging management program is required for those applicants who can demonstrate these fuse holders are not subject to fatigue caused by frequent fuse removal/manipulation or vibration.	No	VI.A.LP-31

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
E	019	BWR/PWR	Cable connections (metallic parts) composed of various metals used for electrical contacts exposed to air – indoor controlled or uncontrolled, air – outdoor	Increased electrical resistance of connection due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	AMP XI.E6, "Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	No	VI.A.LP-30
E	020	PWR	Electrical connector contacts for electrical connectors composed of various metals used for electrical contacts exposed to air with borated water leakage	Increased electrical resistance of connection due to corrosion of connector contact surfaces caused by intrusion of borated water	AMP XI.M10, "Boric Acid Corrosion"	No	VI.A.LP-36
M	021	BWR/PWR	Transmission conductors composed of aluminum exposed to air – outdoor	Loss of conductor strength due to corrosion	None - for ACAR and All Aluminum Conductor (AAC)	No	VI.A.LP-46
M	022	BWR/PWR	Fuse holders (not part of active equipment): insulation material composed of electrical insulation material: bakelite; phenolic melamine or ceramic; molded polycarbonate, and other, exposed to air – indoor controlled or uncontrolled	Reduced electrical insulation resistance due to thermal/thermooxidative 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	023	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

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	024	BWR/PWR	Metal enclosed bus: external surface of enclosure assemblies. Steel air – indoor controlled	None	None	No	VI.A.LP-44
D	026						
N	027	BWR/PWR	Cable bus: external surface of enclosure assemblies galvanized steel; aluminum; air – indoor controlled or uncontrolled	None	None	No	VI.A.L-09
D	028						
N	029	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/thermooxidative degradation of organics and photolysis (UV sensitive materials only) of organics, moisture/debris intrusion and ohmic heating	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-11
N	030	BWR/PWR	Cable bus: external surface of enclosure assemblies composed of steel exposed to air – indoor uncontrolled or air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-12
N	031	BWR/PWR	Cable bus external surface of enclosure assemblies composed of galvanized steel; aluminum exposed to air – outdoor	Loss of material due to general, pitting, crevice corrosion	A plant-specific aging management program is to be evaluated	Yes (SRP-SLR Section 3.6.2.2.2)	VI.A.L-13

<b>Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL-SLR Report</b>							
<b>New, Modified, Deleted, Edited Item</b>	<b>ID</b>	<b>Type</b>	<b>Component</b>	<b>Aging Effect/Mechanism</b>	<b>Aging Management Program (AMP)/TLAA</b>	<b>Further Evaluation Recommended</b>	<b>GALL-SLR Item</b>
N	032	BWR/PWR	Cable bus: external surface of enclosure assemblies: composed of steel; air – indoor controlled	None	None	No	VI.A.L-14

<b>Table 3.6-2. AMPs and Additional Guidance Appendices Recommended for Electrical and Instrumentation and Control Systems</b>	
<b>GALL-SLR Report Chapter/AMP</b>	<b>Program Name</b>
AMP X.E1	Environmental Qualification of Electric Equipment
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)

1 **4 TIME-LIMITED AGING ANALYSES**

2 **4.1 Identification of Time-Limited Aging Analyses and Exemptions**

3 **Review Responsibilities**

4 **Primary**—Branch(es) responsible for the time-limited aging analysis (TLAA) issues

5 **Secondary**—Other branches responsible for engineering, as appropriate

6 **4.1.1 Areas of Review**

7 This review plan section addresses the identification of TLAAAs. The technical review of TLAAAs is  
8 addressed in Sections 4.2 through 4.7. As explained in more detail below, the list of TLAAAs are  
9 certain plant-specific safety analyses that are defined, in part, by the current operating term.  
10 Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1), a license renewal  
11 applicant is required to provide a list of TLAAAs, as defined in 10 CFR 54.3. The area relating to  
12 the identification of TLAAAs is reviewed.

13 TLAAAs may have developed since issuance of a plant’s operating license. As indicated in  
14 10 CFR 54.30, the adequacy of the plant’s current licensing basis (CLB), which includes TLAAAs, is  
15 not an area within the scope of the subsequent license renewal review. Any questions regarding  
16 the adequacy of the CLB are addressed under the backfit rule (10 CFR 50.109) and are separate  
17 from the license renewal process.

18 In addition, pursuant to 10 CFR 54.21(c)(2), an applicant must provide a list of plant-specific  
19 exemptions granted under 10 CFR 50.12 that are based on TLAAAs. The U.S. Nuclear Regulatory  
20 Commission (NRC) staff should focus its review to confirm that the applicant did not omit any  
21 TLAAAs, as defined in 10 CFR 54.3.

22 Pursuant to 10 CFR 54.21(d), each application includes a final safety analysis report (FSAR),  
23 updated final safety analysis report, or updated safety analysis report, as appropriate for the CLB  
24 supplement summary description for each TLAA that is identified in accordance with 10 CFR 54.3.

25 **4.1.2 Acceptance Criteria**

26 The acceptance criteria for the areas of review described in Subsection 4.1.1 of this review  
27 plan section delineate acceptable methods for meeting the requirements of the NRC’s regulations  
28 in 10 CFR 54.21(c)(1). For the applicant’s list of exemptions to be acceptable under the  
29 requirement in 10 CFR 54.21(c)(2), the NRC staff should have reasonable assurance that there  
30 has been no omission of TLAAAs from the subsequent license renewal application (SLRA) that  
31 were used as the basis for receiving NRC approval of regulatory exemptions granted in  
32 accordance with 10 CFR 50.12 requirements.

33 TLAAAs are those licensee calculations and analyses that meet all six of the following criteria, as  
34 defined in 10 CFR 54.3(a):

- 35 1. Involve systems, structures, and components within the scope of license renewal, as  
36 delineated in 10 CFR 54.4(a);
- 37 2. Consider the effects of aging;

- 1 3. Involve time-limited assumptions defined by the current operating term, for example,  
2 40 years;
- 3 4. Were determined to be relevant by the licensee in making a safety determination;
- 4 5. Involve conclusions or provide the basis for conclusions related to the capability of the  
5 system, structure, or component to perform its intended function(s), as delineated in  
6 10 CFR 54.4(b); and
- 7 6. Are contained or incorporated by reference in the CLB.

8 The TLAA identification criterion in Criterion 1 is based only on a comparison to the scoping  
9 requirements in 10 CFR 54.4 and therefore does not limit the applicability of TLAA's only to those  
10 components that would be required to be screened in for an aging management program in  
11 accordance with the requirement in 10 CFR 54.21(a)(1). Thus, the possibility exists that, for a  
12 given CLB, a TLAA may need to be identified for a given active component if the analysis in the  
13 CLB is determined to be in conformance with all six of the criteria in 10 CFR 54.3(a) for identifying  
14 an analysis as a TLAA. Fatigue flaw growth analyses of pressurized water reactor coolant pump  
15 flywheels are examples of plant-specific analyses that apply to an active component type and may  
16 need to be identified as a TLAA for a given application.

17 The applicant's FSAR (as updated) identifies TLAA's that were incorporated by reference into the  
18 CLB. In addition, for subsequent license renewal (SLR) applications, there may be situations  
19 where an analysis of record was not required to be identified as a TLAA for the current operating  
20 period (as approved in the renewed operating license for the facility), but will need to be identified  
21 as a TLAA for a proposed subsequent period of extended operation, as required by the regulation  
22 in 10 CFR 54.21(c)(1). Specifically, criterion 3 for TLAA's in 10 CFR 54.3(a) establishes that to be  
23 a TLAA the analysis has to involve time-limited assumptions defined by the current operating  
24 term. In *Federal Register Notice* (FRN) No. 95-11136, Volume 60, Number 88, dated  
25 May 8, 1995 (Ref. 1), the NRC identified that TLAA's are those:

26 analyses with (i) time-related assumptions, (ii) utilized in determining the acceptability of  
27 SSCs, within the scope of license renewal (as defined in 10 CFR 54.4), (iii) which are  
28 based upon a period of plant operation equal to or greater than the current license  
29 term, but less than the cumulative period of plant operation (viz., the existing license  
30 term plus the period of extended operation requested in the renewed application).

31 For example, for an existing analysis that is part of the CLB and is based on a 60-year time  
32 assumption, the analysis would not necessarily have to be identified as a TLAA for the initial  
33 license renewal request because it would not conform to the definition of a TLAA, as clarified in  
34 FRN No. 95-11136; however, if the same analysis was left unchanged in the CLB and was going  
35 to be relied upon for a proposed SLR period, the analysis would conform to the third criterion for  
36 TLAA's in 10 CFR 54.3(a) because the 60-year assumed life would form the updated current  
37 operating term basis for the proposed SLR period.

38 The reviewer reviews the FSAR Supplement for each TLAA identified as being within the scope of  
39 the SLRA, as defined in 10 CFR 54.3.

1 **4.1.3 Review Procedures**

2 For each area of review described in Subsection 4.1.1, the reviewer adheres to the following  
3 review procedures:

4 The reviewer uses the plant FSAR (as updated) and other CLB documents, such as NRC staff  
5 safety evaluation reports (SERs), to perform the review. The reviewer selects analyses that the  
6 applicant did not identify as TLAAs that are likely to meet the six criteria identified in  
7 Subsection 4.1.2. The reviewer verifies that the selected analyses, not identified by the applicant  
8 as TLAAs, do not meet at least one of the following criteria:

9 Sections 4.2 through 4.6 identify typical types of TLAAs for most plants. Information on the  
10 applicant's methodology for identifying TLAAs also may be useful in identifying calculations that  
11 did not meet the six criteria below.

- 12 1. Involve systems, structures, and components within the scope of license renewal, as  
13 delineated in 10 CFR 54.4(a). Chapter 2 of this Standard Review Plan for Review of  
14 Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides  
15 the reviewer guidance on the scoping and screening methodology, and on plant-level  
16 and various system-level scoping results.
- 17 2. Consider the effects of aging. The effects of aging include, but are not limited to, loss of  
18 material, change in dimension, change in material properties, loss of toughness, loss of  
19 prestress, settlement, cracking, and loss of dielectric properties.
- 20 3. Involve time-limited assumptions defined by the current operating term (e.g., 40 years).  
21 The defined operating term should be explicit in the analysis. Simply asserting that a  
22 component is designed for a service life or plant life is not sufficient. The assertion is  
23 supported by calculations or other analyses that explicitly include a time limit.
- 24 4. Were determined to be relevant by the licensee in making a safety determination.  
25 Relevancy is a determination that the applicant makes based on a review of the  
26 information available. A calculation or analysis is relevant if it can be shown to have a  
27 direct bearing on the action taken as a result of the analysis performed. Analyses are  
28 also relevant if they provide the basis for a licensee's safety determination, and, in the  
29 absence of the analyses, the applicant might have reached a different safety conclusion.
- 30 5. Show capability of the system, structure, or component to perform its intended  
31 function(s), as delineated. Involve conclusions or provide the basis for conclusions  
32 related to 10 CFR 54.4(b). Analyses that do not affect the intended functions of systems,  
33 structures, and components are not TLAAs.
- 34 6. Are contained or incorporated by reference in the CLB. The CLB includes the technical  
35 specifications as well as design basis information (as defined in 10 CFR 50.2), or  
36 licensee commitments documented in the plant-specific documents contained or  
37 incorporated by reference in the CLB, including but not limited to the FSAR, NRC SERs,  
38 the fire protection plan/hazards analyses, correspondence to and from the NRC, the  
39 quality assurance plan, and topical reports included as references to the FSAR.  
40 Calculations and analyses that are not contained in the CLB or not incorporated by  
41 reference in the CLB are not TLAAs. If a code of record is in the FSAR for particular

1 groups of structures or components, reference material includes all calculations called for  
2 by that code of record for those structures and components.

3 TLAAAs that need to be addressed are not necessarily those analyses that have been previously  
4 reviewed or approved by the NRC. The following examples illustrate TLAAAs that need to be  
5 addressed that were not previously reviewed and approved by the NRC:

- 6 • The FSAR states that the design complies with a certain national code and standard. A  
7 review of the code and standard reveals that it calls for an analysis or calculation. Some  
8 of these calculations or analyses will be TLAAAs. The actual calculation was performed by  
9 the applicant to meet the code and standard. The specific calculation was not referenced  
10 in the FSAR. The NRC had not reviewed the calculation. In response to a generic letter  
11 (GL), a licensee submitted a letter to the NRC committing to perform a TLAA that would  
12 address the concern in the GL. The NRC had not documented a review of the applicant's  
13 response and had not reviewed the actual analysis.

14 The following examples illustrate analyses that are *not* TLAAAs and need not be addressed under  
15 10 CFR 54.21(c):

- 16 • Population projections (Section 2.1.3 of NUREG-0800) (Ref. 2).
- 17 • Cost-benefit analyses for plant modifications.
- 18 • Analysis with time-limited assumptions defined short of the current operating term of the  
19 plant, for example, an analysis for a component based on a service life that would not  
20 reach the end of the current operating term.

21 The number and type of TLAAAs vary depending on the plant-specific CLB. All six criteria set forth  
22 in 10 CFR 54.3 (and repeated in Subsection 4.1.2) must be satisfied to conclude that a calculation  
23 or analysis is a TLAA. Table 4.1-1 provides examples of how these six criteria may be applied  
24 (Ref. 3). Table 4.1-2 provides a list of generic TLAAAs that are included in the SRP-SLR.  
25 Table 4.7-1 in SRP-SLR Section 4.7 provides examples of potential plant-specific TLAAAs that have  
26 been identified by license renewal applicants. It is not expected that all applicants would identify  
27 all the analyses in these tables as TLAAAs for their plants. Also, an applicant may perform specific  
28 TLAAAs for its plant that are not shown in these tables.

29 Criterion 3 for TLAAAs in 10 CFR 54.3(a) establishes that, as one of the six criteria that are used to  
30 define a given analysis as a TLAA, the analysis has to involve time-limited assumptions defined  
31 by the current operating term (e.g., 40 years). Therefore, for proposed SLRAs, there may be  
32 instances where an existing, time-dependent analysis did not conform to Criterion 3 for TLAAAs in  
33 10 CFR 54.3(a) for the current period of extended operation, but would conform to this criterion for  
34 the subsequent period of extended operation that is requested for NRC approval. Therefore, the  
35 reviewer should perform a review of the CLB to determine whether there are any existing  
36 analyses for the CLB that will need to be identified as analyses that conform to Criterion 3 for  
37 TLAAAs for the proposed subsequent period of extended operation even though the analyses did  
38 not conform to Criterion 3 for TLAAAs for the previous period of extended operation that was  
39 approved in the renewed operating license for that period. For those cases where the addition of  
40 a proposed subsequent period of extended operation would cause a given analysis to conform to  
41 Criterion 3 for TLAAAs in 10 CFR 54.3(a), the reviewer should assess whether the analysis also  
42 conforms to the remaining five criteria for identifying TLAAAs in 10 CFR 54.3(a), and determine

1 whether the analysis needs to be identified as a TLAA for the subsequent period of extended  
2 operation in accordance with the requirement in 10 CFR 54.21(c)(1).

3 As appropriate, NRC staff from other branches of the Office of Nuclear Reactor Regulation review  
4 the application in their assigned areas without examining the identification of TLAAs. However,  
5 they may come across situations in which they may question why the applicant did not identify  
6 certain analyses as TLAAs. The reviewer coordinates the resolution of any such questions with  
7 these other NRC staff to determine whether these analyses should be evaluated as TLAAs.

8 In order to determine whether there is reasonable assurance that the applicant has identified the  
9 TLAAs for its plant, the reviewer should find that the analyses omitted from the applicant's list are  
10 not TLAAs. Should an applicant identify a TLAA that is also a basis for a plant-specific exemption  
11 that was granted pursuant to 10 CFR 50.12 and the exemption is in effect for the current operating  
12 period, the reviewer verifies that the applicant also has identified that exemption pursuant to  
13 10 CFR 54.21(c)(2). Examples of an exemptions that may have been granted in accordance with  
14 10 CFR 50.12 and based on a TLAA are those NRC-granted exemptions that approved American  
15 Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) case N-514 as  
16 an alternative basis for complying with the pressure lift and system enable temperature set point  
17 requirements for pressurized water reactors (PWRs) low temperature overpressure protection  
18 systems in 10 CFR Part 50, Appendix G and the ASME Code Section XI, Appendix G.

#### 19 **4.1.4 Evaluation Findings**

20 The reviewer determines whether the applicant has provided sufficient information to satisfy the  
21 provisions of this section, and whether the NRC staff's evaluation supports conclusions of the  
22 following type, to be included in the SER:

23 On the basis of its review, as discussed above, the NRC staff concludes that the  
24 applicant has provided an acceptable list of TLAAs as defined in 10 CFR 54.3,  
25 and that no 10 CFR 50.12 exemptions have been granted on the basis of a  
26 TLAA, as defined in 10 CFR 54.3.

#### 27 **4.1.5 References**

- 28 1. NRC. "Nuclear Power Plant License Renewal; Revisions." *Federal Register*: Vol. 60.  
29 No. 88, pp. 22,461–22,495. May 8, 1995.
- 30 2. NRC. NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports  
31 Nuclear Power Plants." Agencywide Documents Access and Management System  
32 (ADAMS) Accession No. ML070630046. Washington, DC: U.S. Nuclear Regulatory  
33 Commission. March 2007.
- 34 3. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of  
35 10 CFR Part 54–The License Renewal Rule." Revision 6. ADAMS Accession  
36 No. ML051860406. Washington, DC: Nuclear Energy Institute. June 2005.

<b>Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAAs) and Basis for Disposition</b>	
<p><b>Example of an analysis that meets all six of the criteria in 10 CFR 54.3(a) for defining an analysis as a TLAA:</b> The 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 <i>Code of Federal Regulations</i> (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.</p> <p>The applicant has not included the RCP flywheels as components that need to be within the scope of an aging management review (AMR), as would otherwise be required in accordance with 10 CFR 54.21(a)(1). The analysis is referenced in the updated final safety analysis report (UFSAR) and is based on design basis transients that are assumed and evaluated in the UFSAR based on a 40-year design life. The analysis is relied upon to establish a 10-year augmented inservice inspection interval for performing inspections of RCP flywheels and to demonstrate that fatigue-induced growth of a flaw in the flywheels would not result in a flywheel missile that could threaten the structural integrity of the reactor coolant pressure boundary during the life of the plant.</p>	
<i>Criterion in 10 CFR 54.3(a)</i>	<i>Disposition Basis for Comparing to the Criterion in 10 CFR 54.3(a)</i>
Criterion 1: <i>The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).</i>	Although the RCP flywheels as active components do not need to be subjected to an AMR (as defined in 10 CFR 54.21(a)(1)), the components are within the scope of license renewal application because their failure could impact the intended pressure retaining function of a component that is located in the reactor coolant pressure boundary (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: <i>The analysis must consider the effects of aging.</i>	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: <i>The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).</i>	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: <i>The analysis must be determined to be relevant by the licensee in making a safety determination.</i>	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.

<b>Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAAs) and Basis for Disposition</b>	
Criterion 5: <i>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).</i>	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: <i>The analysis is contained or incorporated by reference in the CLB.</i>	The analysis conforms to Criterion 6 because the analysis is referenced in the UFSAR for the facility.
<b>Example of analyses that do not meet the six of the criteria for TLAAs in 10 CFR 54.3(a):</b>	
Example of an analysis that does not meet Criterion 1 in 10 CFR 54.3(a): <i>The analysis must involve systems, structures, and components within the scope of license renewal, as delineated in 10 CFR 54.4(a).</i>	<p>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.</p> <p>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.</p>
Example of an analysis that does not meet Criterion 2 in 10 CFR 54.3(a): <i>The analysis must consider the effects of aging.</i>	<p>The CLB and design basis includes a stress analysis for a reactor coolant loop elbow that is compared to American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III allowable stress values. The stress analysis is performed in accordance with ASME Code Section III requirements, as invoked by 10 CFR 50.55a requirements.</p> <p>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.</p>

<b>Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAAs) and Basis for Disposition</b>	
<p>Example of an analysis that does not meet Criterion 3 in 10 CFR 54.3(a): <i>The analysis must involve time-limited assumptions defined by the current operating term (for example, 40 years).</i></p>	<p>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.</p> <p>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.</p>
<p>Example of an analysis that does not meet Criterion 4 in 10 CFR 54.3(a): <i>The analysis must be determined to be relevant by the licensee in making a safety determination.</i></p>	<p>The original licensing basis for a (PWR included a high-energy line break (HELB) analysis for a piping location in the main reactor coolant loop that was based on ASME Code Section III cumulative usage factor (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.</p> <p>The original HELB analysis for this piping location is no longer relied upon for the CLB because it was replaced by the NRC-approved LBB analysis for the main coolant loops, which included these piping locations. Therefore, the original HELB analysis for this piping location is not relevant in making a safety determination relative to the inclusion of a pipe whip restraint on the piping component. Under this example, the HELB analysis for this specific piping location does not conform to Criterion 4 in 10 CFR 54.3(a) and does not meet the definition of a TLAA in the 10 CFR Part 54 rule. HELB analyses for piping locations not excluded by LBB would still be relied upon for the CLB and would need to be identified as TLAAs for the SLRA.</p>
<p>Example of an analysis that does not meet Criterion 5 in 10 CFR 54.3(a): <i>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</i></p>	<p>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.</p> <p>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.</p>

<b>Table 4.1-1. Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAAs) and Basis for Disposition</b>	
<i>delineated in 10 CFR 54.4(b).</i>	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): <i>The analysis is contained or incorporated by reference in the CLB.</i>	<p>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, “<i>Dynamic Effects</i>.” 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).</p> <p>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.</p>

<b>Table 4.1-2. Generic Time-Limited Aging Analyses</b>	
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)	

1 **4.2 Reactor Pressure Vessel Neutron Embrittlement Analyses**

2 **Review Responsibilities**

3 **Primary**—Branch(es) responsible for the time-limited aging analysis (TLAA) issues

4 **Secondary**—Branch responsible for reactor systems

5 **4.2.1 Areas of Review**

6 During plant service, neutron irradiation reduces the fracture toughness of ferritic steel in the  
7 reactor pressure vessel (RPV) beltline region of light-water nuclear power reactors, where RPV  
8 beltline region is described in Regulatory Issue Summary (RIS) 2014-11 (Ref. 1). Areas of review  
9 to ensure that the RPV has adequate fracture toughness to prevent brittle failure during normal  
10 and off-normal operating conditions are (a) upper-shelf energy (USE), (b) pressurized thermal  
11 shock (PTS) for pressurized water reactor (PWRs), (c) heat-up and cool-down (pressure-  
12 temperature limits) curves, (d) Boiling Water Reactor Vessel and Internals Project (BWRVIP)-05  
13 analysis for elimination of circumferential weld inspection and analysis of the axial welds, and  
14 (e) other plant-specific TLAAs on RPV neutron embrittlement. The adequacy of the analyses for  
15 these five areas is reviewed for the subsequent period of extended operation.

16 The branch responsible for reactor systems reviews neutron fluence and dosimetry information in  
17 the application.

18 **4.2.2 Acceptance Criteria**

19 The acceptance criteria for the areas of review described in Subsection 4.2.1 of this review plan  
20 section delineate acceptable methods for meeting the requirements of the U.S. Nuclear  
21 Regulatory Commission (NRC) regulation in Title 10 of the *Code of Federal Regulations*  
22 (10 CFR) 54.21(c)(1) (Refs. 2, 3).<sup>1</sup>

23 **4.2.2.1 Time-Limited Aging Analyses**

24 Pursuant to 10 CFR 54.21(c)(1)(i)–(iii), an applicant must demonstrate one of the following:

- 25 (i) The analyses remain valid for the period of extended operation;
- 26 (ii) The analyses have been projected to the end of the period of extended operation; or
- 27 (iii) The effects of aging on the intended function(s) will be adequately managed for the  
28 period of extended operation.

29 For the first three areas of review for the analysis of RPV neutron embrittlement, the specific  
30 acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

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<sup>1</sup>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).

1 4.2.2.1.1 *Neutron Fluence*

2 Neutron fluence is the number of neutrons accumulated per unit area during a certain period  
3 of neutron irradiation. An RPV neutron fluence analysis involves time-limited assumptions  
4 (e.g., 40 years of original design life) and is used to determine the loss of fracture toughness due  
5 to neutron irradiation embrittlement of the RPV. Appendix H to 10 CFR Part 50 (Ref. 4) requires  
6 that an applicant must implement an RPV Surveillance program for an RPV if the peak neutron  
7 fluence at the end of the design life of the RPV exceeds a neutron fluence of  $10^{17}$  n/cm<sup>2</sup> (E > 1  
8 MeV). The RPV neutron fluence analysis is also integral to other neutron embrittlement TLAAs  
9 (e.g., USE and pressure-temperature (P-T) limits analyses) because neutron fluence is a  
10 fundamental parameter which is used to determine the level of neutron irradiation embrittlement of  
11 an RPV. As discussed above, the RPV neutron fluence analysis is important in making a safety  
12 determination for an RPV in terms of loss of fracture toughness due to neutron  
13 irradiation embrittlement.

14 Typically, the RPV neutron fluence analysis is described in the applicant's Final Safety Analysis  
15 Report (FSAR) or other design documents approved by NRC. In its subsequent license renewal  
16 application (SLRA), the applicant identifies (a) the neutron fluence for each beltline material at the  
17 end of extended license term, (b) the NRC staff-approved methodology used to calculate the  
18 neutron fluence or submits the methodology for NRC staff review, (c) whether the methodology is  
19 consistent with the guidance in NRC Regulatory Guide (RG) 1.190 (Ref. 5), and (d) how the  
20 neutron fluence is monitored during the subsequent period of extended operation. An applicant  
21 may take any one of the following three dispositions for the RPV neutron fluence analysis.

22 4.2.2.1.1.1 *10 CFR 54.21(c)(1)(i)*

23 A neutron fluence analysis typically accounts for planned operation by including assumptions  
24 regarding the neutron flux emitted from the core. The flux is integrated over time to yield the  
25 estimated fluence. Frequently, neutron fluence calculations will include projected fluence values  
26 for multiple periods of exposure, (e.g., 40, 60, and 80 calendar years). In order to use a  
27 disposition for fluence pursuant to 10 CFR 54.21(c)(1)(i), the applicant will demonstrate the  
28 existing RPV neutron fluence analysis, including the projected flux for planned operation, in the  
29 current licensing basis (CLB) remains valid during the subsequent period of extended operation.  
30 The fluence calculation will be re-evaluated to confirm its validity.

31 4.2.2.1.1.2 *10 CFR 54.21(c)(1)(ii)*

32 For a disposition in accordance with 10 CFR 54.21(c)(1)(ii), the applicant will provide new or  
33 updated calculations that address the fluence effects during the subsequent period of extended  
34 operation. The new or updated RPV neutron fluence analysis is evaluated to consider the  
35 subsequent period of extended operation in accordance with (1) NRC RG 1.190, or (2) a  
36 methodology that has been approved for use by the NRC.

37 4.2.2.1.1.3 *10 CFR 54.21(c)(1)(iii)*

38 In the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report  
39 Aging Management Programs (AMP) X.M2, "Neutron Fluence Monitoring," the NRC staff has  
40 evaluated an AMP for projecting and monitoring neutron fluence for the subsequent period of  
41 extended operation. The staff has determined that this program is acceptable to project and  
42 monitor neutron fluence for managing loss of fracture toughness due to neutron irradiation  
43 embrittlement of RPVs in accordance with 10 CFR 54.21(c)(1)(iii).

1 4.2.2.1.2 *Upper-Shelf Energy*

2 10 CFR Part 50 Appendix G (Ref. 6) paragraph IV.A.1 requires that the RPV beltline materials  
3 have a Charpy USE of no less than 68 J (50 ft-lb) throughout the life of the RPV, unless otherwise  
4 approved by the NRC. An applicant may take any one of the following three approaches.

5 4.2.2.1.2.1 *10 CFR 54.21(c)(1)(i)*

6 The RPV components evaluated in the existing USE analysis or NRC-approved equivalent  
7 margins analysis (EMA) are reevaluated to demonstrate that the existing analysis remains valid  
8 during the subsequent period of extended operation because the neutron fluence projected to the  
9 end of the subsequent period of extended operation is bounded by the neutron fluence in the  
10 existing USE analysis or NRC-approved EMA.

11 4.2.2.1.2.2 *10 CFR 54.21(c)(1)(ii)*

12 The RPV components evaluated in the existing USE analysis or NRC-approved EMA are  
13 reevaluated to consider the subsequent period of extended operation in accordance with  
14 10 CFR Part 50, Appendix G.

15 10 CFR Part 50, Appendix G, Section IV.A.1, requires applicants to take further corrective actions  
16 where the 68 Joule (J) (50 ft-lb) end-of-life (EOL) USE criterion cannot be met. When this occurs,  
17 a licensee is required to submit a supplemental analysis for NRC approval. The applicant will  
18 need to submit a plant-specific engineering analysis (usually an EMA) for NRC approval as  
19 supplemental information for subsequent license renewal (SLR). Otherwise, failure to meet the  
20 USE requirements of 10 CFR Part 50, Appendix G for the RPV materials as evaluated using the  
21 neutron fluence that are projected for the subsequent period of extended operation mandates  
22 imposition of additional commitments or license conditions on USE for the SLRA.

23 4.2.2.1.2.3 *10 CFR 54.21(c)(1)(iii)*

24 Acceptance criteria for accepting USE TLAA's in accordance with 10 CFR 54.21(c)(1)(iii) have yet  
25 to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects  
26 will be managed such that the intended function(s) will be maintained during the subsequent  
27 period of extended operation.

28 4.2.2.1.3 *Pressurized Thermal Shock (for PWRs)*

29 For PWRs, 10 CFR 50.61 (Ref. 7) requires that the reference temperature for RPV beltline  
30 materials evaluated at the neutron fluence corresponding to the end of the subsequent period of  
31 extended operation, reference temperature pressurized thermal shock ( $RT_{PTS}$ ), be less than the  
32 PTS screening criteria at the expiration date of the operating license, unless otherwise approved  
33 by the NRC. The PTS screening criteria are 132 degrees Celsius ( $^{\circ}C$ ) (270 degrees Fahrenheit  
34 ( $^{\circ}F$ ) for plates, forgings, and axial weld materials, and 149  $^{\circ}C$  (300  $^{\circ}F$ ) for circumferential weld  
35 materials. Alternatively, the licensee may comply with the requirements of 10 CFR 50.61a  
36 (Ref. 8). The regulations require updating of the PTS assessment upon a request for a change in  
37 the expiration date of a facility's operating license, or whenever there is a significant change in  
38 projected values of  $RT_{PTS}$ . Therefore, the  $RT_{PTS}$  value must be calculated for the entire licensed  
39 operating period of the facility, including the subsequent period of extended operation. If the  
40 analyses result in  $RT_{PTS}$  values that exceed the PTS screening criteria at the end of the  
41 subsequent period of extended operation, the applicant is required to implement additional

1 corrective actions as described in 10 CFR 50.61 or 10 CFR 50.61a. The PTS TLAA may be  
2 handled as follows.

3 4.2.2.1.3.1 10 CFR 54.21(c)(1)(i)

4 The existing PTS analysis based on 10 CFR 50.61 remains valid during the subsequent period of  
5 extended operation because the neutron fluence projected to the end of the subsequent period of  
6 extended operation is bound by the neutron fluence assumed in the existing analysis. If the  
7 existing PTS analysis is based on 10 CFR 50.61a, the applicant demonstrates that the current  
8 analysis remains applicable for the subsequent period of extended operation.

9 4.2.2.1.3.2 10 CFR 54.21(c)(1)(ii)

10 The PTS analysis is reevaluated to consider the subsequent period of extended operation in  
11 accordance with 10 CFR 50.61 or 10 CFR 50.61a. If the analyses result in  $RT_{PTS}$  values that  
12 exceed the PTS screening criteria at the end of the subsequent period of extended operation, the  
13 applicant is required to implement additional corrective actions as described in 10 CFR 50.61 or  
14 10 CFR 50.61a. If the existing PTS analysis is based on 10 CFR 50.61a, the applicant updates  
15 the submittal to reflect the subsequent period of extended operation.

16 4.2.2.1.3.3 10 CFR 54.21(c)(1)(iii)

17 The NRC staff position for license renewal (LR) on this option is described in a May 27, 2004  
18 letter from L.A. Reyes to the Commission (Ref. 9), which states that if the applicant does not  
19 extend the TLAA, the applicant provides an assessment of the CLB TLAA for PTS, a discussion of  
20 the flux reduction program implemented in accordance with 10 CFR 50.61(b)(3), if necessary, and  
21 an identification of the viable options that exist for managing the aging effect in the future.

22 4.2.2.1.4 *Pressure-Temperature Limits*

23 10 CFR Part 50, Appendix G, requires that the RPV be maintained within established P-T limits  
24 during normal operating conditions of the plant (including heat-ups and cool-downs of the reactor  
25 and anticipated operational transients), and during pressure tests and system leak tests. These  
26 limits specify the maximum allowable pressure as a function of reactor coolant temperature. As  
27 the RPV becomes embrittled and its fracture toughness is reduced, the allowable pressure (given  
28 the required minimum temperature) is reduced. RIS 2014-11 clarifies issues that must be  
29 addressed in developing P-T limits.

30 P-T limits are TLAAAs for the application if the plant currently has P-T limit curves approved for the  
31 expiration of the current period of operation (e.g., 32 effective full-power year (EFPY) or some  
32 other licensed EFPY value defined for the expiration date of the current license). However, the  
33 P-T limits for the subsequent period of extended operation need not be submitted as part of the  
34 SLRA since the P-T limits need to be updated through the 10 CFR 50.90 (Ref. 10) licensing  
35 process when necessary for P-T limits that are located in the limiting conditions of operations  
36 (LCOs) of the Technical Specifications (TS). For those plants that have approved pressure-  
37 temperature limit reports (PTLRs), the P-T limits for the subsequent period of extended operation  
38 will be updated at the appropriate time through the plant's Administrative Section of the TS and  
39 the plant's PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which  
40 constitute the CLB, will ensure that the P-T limits for the subsequent period of extended operation  
41 will be updated prior to expiration of the P-T limit curves for the current period of operation.

1 P-T limits may be handled as follows.

2 4.2.2.1.4.1 10 CFR 54.21(c)(1)(i)

3 The applicant demonstrates (on a case-by-case basis) that existing P-T limits in the CLB will  
4 remain valid during the subsequent period of extended operation.

5 4.2.2.1.4.2 10 CFR 54.21(c)(1)(ii)

6 The P-T limits are updated for the subsequent period of extended operation in accordance with  
7 10 CFR Part 50, Appendix G and the applicant's appropriate TS change process for updating the  
8 P-T limit curves.

9 For P-T limit curves that are included in and controlled by requirements in the limiting conditions of  
10 operations of the plant TS, the applicant submits the changes to the P-T limits as a license  
11 amendment request (i.e., a TS change request) for the SLRA that is submitted in accordance with  
12 the requirements in 10 CFR 54.22 (Ref. 11) and uses the license amendment submittal as the  
13 basis for accepting the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).

14 For P-T limits that are controlled by Administrative Controls TS requirements and located in an  
15 NRC-approved PTLR, the applicant updates the P-T limits in accordance with the methodology or  
16 methodologies approved in the applicable Administrative Controls TS section for its PTLR process  
17 and submits the updated PTLR(s) containing the updated P-T limits to the NRC (as information) in  
18 accordance the reporting requirements in the applicable Administrative Controls TS section. The  
19 applicant uses the submittal of the updated PTLR as the basis for accepting the TLAA in  
20 accordance with 10 CFR 54.21(c)(1)(ii).

21 4.2.2.1.4.3 10 CFR 54.21(c)(1)(iii)

22 Updated P-T limits for the subsequent period of extended operation must be established and  
23 completed using the applicable TS change process for updating the P-T limit curves prior to the  
24 plant's entry into the subsequent period of extended operation. The 10 CFR 50.90 process for  
25 P-T limits located in the LCOs or the Administrative Controls Process for P-T limits that are  
26 administratively amended through a PTLR process can be considered adequate AMPs or aging  
27 management activities within the scope of 10 CFR 54.21(c)(1)(iii), such that P-T limits will be  
28 maintained through the subsequent period of extended operation.

29 4.2.2.1.5 *Elimination of Boiling Water Reactor Circumferential Weld Inspections*

30 Some boiling water reactors (BWRs) have an approved technical alternative in the CLB, which  
31 eliminates the RPV circumferential shell weld inspections from the American Society of  
32 Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI program for the  
33 current license term. Approved technical alternatives for SLR have yet to be developed. If these  
34 analyses are identified as TLAAAs, they will be evaluated on a case-by-case basis in accordance  
35 with the requirements in 10 CFR 54.21(c)(1).

36 4.2.2.1.6 *Boiling Water Reactor Axial Welds*

37 Those BWRs that have been approved to use the circumferential weld technical alternative  
38 performed acceptable conditional probability of failure analyses of their RPV axial shell welds.  
39 Approved technical alternatives for SLR have yet to be developed. If these analyses are identified

1 as TLAAAs, they will be evaluated on a case-by-case basis in accordance with the requirements  
2 in 10 CFR 54.21(c)(1).

3 **4.2.2.2 Final Safety Analysis Report Supplement**

4 The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
5 evaluation of TLAAAs for the subsequent period of operation in the FSAR Supplement is sufficiently  
6 comprehensive, such that later changes can be controlled by 10 CFR 50.59 (Ref. 12). The  
7 description contains information associated with the TLAAAs regarding the basis for determining  
8 that the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

9 **4.2.3 Review Procedures**

10 For each area of review described in Subsection 4.2.1, the following review procedures should  
11 be followed.

12 **4.2.3.1 Time-Limited Aging Analyses**

13 For the first four areas of review for the analysis of RPV neutron embrittlement, the review  
14 procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii). For each area,  
15 the applicant's three options under Section 54.21(c)(1) are discussed in turn.

16 The applicant may identify activities to be performed to verify the assumption basis of the neutron  
17 fluence calculations that are used to evaluate the RPV neutron embrittlement analyses. An  
18 evaluation of that verification activity is provided by the applicant in the SLRA. The reviewer  
19 assures that the applicant's verification activity is sufficient to confirm the calculation assumptions  
20 for the 80-year period. If the assumption basis is not verified, the applicant must reevaluate the  
21 analysis and take appropriate corrective actions as necessary, consistent with the requirements of  
22 the affected regulation.

23 **4.2.3.1.1 Neutron Fluence**

24 **4.2.3.1.1.1 10 CFR 54.21(c)(1)(i)**

25 The reviewer confirms that the applicant's existing RPV neutron fluence analysis remains valid  
26 during the subsequent period of extended operation. The reviewer also confirms that the  
27 applicant identifies (a) the neutron fluence for each beltline material at the end of the subsequent  
28 period of extended operation, (b) the NRC staff-approved methodology used to determine the  
29 neutron fluence or submits the methodology for NRC staff review, and (c) whether the  
30 methodology is consistent with the guidance in NRC RG 1.190.

31 **4.2.3.1.1.2 10 CFR 54.21(c)(1)(ii)**

32 The reviewer confirms that the applicant adequately reevaluated its RPV neutron fluence analysis  
33 for the subsequent period of extended operation. As part of its review, the review confirms that  
34 the applicant identifies (a) the neutron fluence for each beltline material at the end of the  
35 subsequent period of extended operation, (b) the NRC staff-approved methodology used to  
36 determine the neutron fluence or submits the methodology for NRC staff review, and (c) whether  
37 the methodology is consistent with the guidance in NRC RG 1.190.

1 4.2.3.1.1.3 10 CFR 54.21(c)(1)(iii)

2 GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring" of the GALL-SLR Report provides an  
3 acceptable method to project and monitor RPV neutron fluence through the subsequent period of  
4 extended operation in accordance with 10 CFR 54.21(c)(1)(iii). The NRC staff reviews an  
5 applicant's program for dispositioning the TLAA in accordance with the requirements in  
6 10 CFR 54.21(c)(1)(iii) and the guidance in GALL-SLR Report AMP X.M2. Plant-specific  
7 approaches to projecting and monitoring neutron fluence will be evaluated on a case-by-case  
8 basis to ensure that the aging effects due to neutron irradiation embrittlement will be managed  
9 such that the intended functions(s) will be adequately maintained for the subsequent period of  
10 extended operation.

11 4.2.3.1.2 Upper-Shelf Energy

12 4.2.3.1.2.1 10 CFR 54.21(c)(1)(i)

13 The projected  $\frac{1}{4}T$  neutron fluence at the end of the subsequent period of extended operation is  
14 reviewed for all beltline materials to verify that it is bounded by the neutron fluence assumed in the  
15 existing USE or NRC-approved EMA analysis in the CLB.

16 4.2.3.1.2.2 10 CFR 54.21(c)(1)(ii)

17 The documented results of the revised USE analysis (or revised EMA analysis, as applicable)  
18 based on the projected neutron fluence at the end of the subsequent period of extended operation  
19 are reviewed for compliance with 10 CFR Part 50, Appendix G. The applicant may use NRC  
20 RG 1.99 Rev. 2 (Ref. 13) as the basis for using the  $\frac{1}{4}T$  neutron fluence values for the reactor  
21 vessel beltline components (as projected to the end of the SLR period) to project the USE values  
22 for the reactor vessel beltline components at the end of the subsequent period of extended  
23 operation. The applicant also may use ASME Code Section XI Appendix K (Ref. 14) for the  
24 purpose of performing an equivalent margins analysis to demonstrate that adequate protection  
25 for ductile failure is maintained to the end of the subsequent period of extended operation. The  
26 NRC staff reviews the applicant's methodology for this evaluation. Branch Technical Position  
27 (BTP) 5-3, "Fracture Toughness Requirements," in Standard Review Plan (Ref. 15), Section 5.3.2,  
28 "Pressure Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock," provides  
29 additional NRC positions on estimations of USE values for RPV beltline materials.

30 The NRC staff confirms that the applicant has provided sufficient information for all USE and/or  
31 equivalent margins analysis calculations for the subsequent period of extended operation  
32 as follows:

33 The applicant identifies the neutron fluence at the  $\frac{1}{4}T$  location for each beltline  
34 material at the expiration of the subsequent period of extended operation.

35 To confirm that the USE analysis meets the requirements of Appendix G of 10 CFR Part 50 at the  
36 end of the subsequent period of extended operation, the NRC staff determines whether:

- 37 1. For each beltline material, the applicant provides the unirradiated USE and the projected  
38 USE at the end of the subsequent period of extended operation, and whether the drop in  
39 USE was determined using the limit lines in Figure 2 of NRC RG 1.99, Rev 2, based on  
40 the material copper content, or from surveillance data.

1 2. If an equivalent margins analysis is used to demonstrate compliance with the USE  
2 requirements in Appendix G of 10 CFR Part 50, the applicant provides the analysis or  
3 identifies an NRC-approved topical report that contains the analysis which is applicable  
4 to the subsequent period of extended operation. Information the NRC staff considers to  
5 assess the equivalent margins analysis includes the unirradiated USE (if available) for  
6 the material, its copper content, the neutron fluence ( $1/4T$  and at 1-inch depth), the  
7 projected SLR USE, the operating temperature in the downcomer at full power, the  
8 vessel radius, the vessel wall thickness, the J-applied analysis for Service Level C and  
9 D, the vessel accumulation pressure, and the vessel bounding heat-up/cool-down rate  
10 during normal operation.

11 4.2.3.1.2.3 10 CFR 54.21(c)(1)(iii)

12 The applicant's proposal to demonstrate that the effects of aging on the intended function(s)  
13 will be adequately managed for the subsequent period of extended operation is reviewed on a  
14 case-by-case basis.

15 4.2.3.1.3 *Pressurized Thermal Shock (for Pressurized Water Reactors)*

16 4.2.3.1.3.1 10 CFR 54.21(c)(1)(i)

17 The projected clad-to-base metal interface neutron fluence at the end of the subsequent period of  
18 extended operation is reviewed to verify that it is bounded by the neutron fluence assumed in the  
19 existing PTS analysis.

20 For PTS analysis based on an NRC-approved submittal based on 10 CFR 50.61a, the applicant  
21 demonstrates that the analysis bounds the subsequent period of extended operation.

22 4.2.3.1.3.2 10 CFR 54.21(c)(1)(ii)

23 The documented results of the revised PTS analysis based on the projected neutron fluence at  
24 the end of the subsequent period of extended operation are reviewed for compliance with  
25 10 CFR 50.61 or 10 CFR 50.61a.

26 The NRC staff confirms that the applicant has provided sufficient information for PTS for the  
27 subsequent period of extended operation as follows:

28 The applicant identified the neutron fluence at the clad-to-base metal interface for  
29 each beltline material at the expiration of the subsequent period of extended  
30 operation.

31 There are two methodologies from 10 CFR 50.61 that can be used in the PTS analysis, based on  
32 the projected neutron fluence at the end of the subsequent period of extended operation.  $RT_{NDT}$  is  
33 the reference temperature (NDT means nil-ductility temperature) used as an indexing parameter  
34 to determine the fracture toughness and the amount of embrittlement of a material.  $RT_{PTS}$  is the  
35 reference temperature used in the PTS analysis and is related to  $RT_{NDT}$  at the end of the facility's  
36 operating license.

37 The first methodology does not rely on plant-specific surveillance data to calculate delta  $RT_{NDT}$   
38 ( $\Delta RT_{NDT}$ , the mean value of the adjustment or shift in reference temperature caused by  
39 irradiation). The  $\Delta RT_{NDT}$  is determined by multiplying a chemistry factor from the tables in

1 10 CFR 50.61 by a neutron fluence factor calculated from the neutron flux using Equation 3 in  
2 10 CFR 50.61.

3 For the surveillance data to be defined as credible, the difference in the predicted values and the  
4 measured values for  $\Delta RT_{NDT}$  must be less than 15.6 °C (28 °F) for weld metal components or less  
5 than 9.4 °C (17 °F) for base metal components. When a credible surveillance data set exists,  
6 the chemistry factor can be determined from these data in lieu of a value from the table in  
7 10 CFR 50.61. The standard deviation for the  $\Delta RT_{NDT}$  used in the margin term assessment  
8 (e.g.,  $\sigma_{\Delta}$ ) of the  $RT_{PTS}$  calculations may be reduced from 15.6 °C (28 °F) to 7.8 °C (14 °F) for  
9 welds or from 9.4 °C (17 °F) to 4.7 °C (8.5 °F) for base metal materials. However,  $\sigma_{\Delta}$  need not  
10 exceed one-half of the  $RT_{NDT}$  value used in the  $RT_{PTS}$  calculations.

11 To confirm that the PTS analysis results in  $RT_{PTS}$  values below the screening criteria in  
12 10 CFR 50.61 at the end of the subsequent period of extended operation, the applicant provides  
13 the following:

- 14 1. For each beltline material, provide the unirradiated  $RT_{NDT}$ , the method of calculating the  
15 unirradiated  $RT_{NDT}$  (either generic or plant-specific), the margin, chemistry factor, the  
16 method of calculating the chemistry factor, the mean value for the shift in transition  
17 temperature, and the  $RT_{PTS}$  value.
- 18 2. If there are two or more data for a surveillance material that is from the same heat of  
19 material as the beltline material, provide analyses to determine whether the data are  
20 credible in accordance with NRC RG 1.99, Revision 2, and whether the margin value  
21 used in the analysis is appropriate.
- 22 3. If a surveillance program does not include the vessel beltline controlling material but two  
23 or more data sets are available from other beltline materials, then provide an analysis of  
24 the data in accordance with NRC RG 1.99, Revision 2, Regulatory Position C.2.1, to  
25 show that the results either bound or are comparable to the values that would be  
26 calculated for the same materials using Regulatory Position C.1.1.

27 If the PTS screening criteria in 10 CFR 50.61 are projected to be exceeded during the subsequent  
28 period of extended operation, an analysis based on NRC RG 1.154 (Ref. 16) or 10 CFR 50.61a  
29 may be submitted for review. For applicants with PTS analysis based upon an NRC-approved  
30 submittal using 10 CFR 50.61a, the analysis is revised to reflect the subsequent period of  
31 extended operation.

#### 32 4.2.3.1.3.3 10 CFR 54.21(c)(1)(iii)

33 The NRC staff reviews the applicant's proposal to demonstrate that the effects of aging on the  
34 intended function(s) will be adequately managed for the subsequent period of extended operation  
35 will be reviewed on a case-by-case basis.

36 If corrective actions are necessary, the NRC staff ensures that the SLRA provides an assessment  
37 of the CLB TLAA for PTS, a discussion of the flux reduction program implemented in accordance  
38 with § 50.61(b)(3), if necessary, and an identification of the viable options that exist for managing  
39 the aging effect in the future. As part of this review, the staff ensures that the applicant addressed  
40 the following topics:

- 1 A. The applicant explains its core management plans (e.g., operation with a low leakage core  
2 design and/or integral burnable neutron absorbers) from now through the end of  
3 the subsequent period of extended operation. Based on this core management strategy,  
4 the applicant:
- 5 (1) Identifies the material in the RPV which has limiting  $RT_{PTS}$  value,  
6 (2) Provides the projected neutron fluence value for the limiting material at end of the  
7 subsequent period of extended operation,  
8 (3) Provides the projected  $RT_{PTS}$  value for the limiting material at end of the  
9 subsequent period of extended operation, and  
10 (4) Provides the projected date and neutron fluence values at which the limiting  
11 material will exceed the screening criteria in § 50.61.
- 12 B. The applicant discusses the AMPs or aging management activities that it intends to  
13 implement, which actively “manage” the condition of the facility’s RPV and hence, the risk  
14 associated with PTS. This discussion is expected to address, at least, the facility’s reactor  
15 pressure vessel material surveillance program.
- 16 C. If corrective actions are necessary, the applicant briefly discusses the options that it is  
17 considering with respect to “resolving” the PTS issue through end of the subsequent  
18 period of extended operation. It is anticipated that this discussion includes some or all of  
19 the following:
- 20 (1) Plant modifications (e.g., heating of emergency core cooling system injection  
21 water) which could limit the risk associated with postulated PTS events (see  
22 § 50.61(b)(4) and/or (b)(6)),  
23 (2) More detailed safety analyses which may be performed to show that the PTS risk  
24 for the facility is acceptably low through end of the subsequent period of extended  
25 operation (see § 50.61(b)(4)),  
26 (3) More advanced material property evaluation (e.g., use of Master Curve  
27 technology) to demonstrate greater fracture resistance for the limiting material  
28 (applies to § 50.61(b)(4)),  
29 (4) The potential for RPV thermal annealing in accordance with § 50.66  
30 (see § 50.61(b)(7)), and/or  
31 (5) Use of the alternative PTS Rule (§ 50.61a).

#### 32 4.2.3.1.4 *Pressure-Temperature Limits*

33 The regulation in 10 CFR Part 50, Appendix G requires that the RPV be maintained within  
34 established P-T limits during normal operating conditions of the plant, including heat-ups and  
35 cool-downs of the reactor and anticipated operational transients, and during pressure test and  
36 system leak test conditions. These limits specify the maximum allowable pressure as a function  
37 of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is  
38 reduced, the allowable pressure (given the required minimum temperature) is reduced.

1 The regulation in 10 CFR 50.36 (Ref. 17) requires that P-T limits be controlled by plant TS;  
2 however, the process for performing updates of the P-T limits depends on whether the P-T limit  
3 curves for the facility are maintained in the Limiting Conditions of Operation Section of the TS  
4 (i.e., in the TS LCOs) or in a PTLR that is controlled and updated in accordance with the  
5 Administrative Controls Section of the plant TS (i.e., by an Administrative Controls TS Section).  
6 P-T limits are TLAAAs for the application if the plant currently has P-T limit curves approved for the  
7 expiration of the current period of operation (e.g., 32 EFPY or some other licensed EFPY value  
8 defined for the expiration date of the current license). However, as stated in Standard Review  
9 Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants  
10 (SRP-SLR) Section 4.2.2.1.3, the assessment of P-T limit TLAAAs for incoming SLRAs and basis  
11 for accepting the TLAAAs under the requirements of 10 CFR 54.21(c)(1)(i), (ii) or (iii) depends on  
12 the process that is used for updating the P-T limits.

13 For P-T limits that are located in the TS LCOs and are controlled by the 10 CFR 50.90 license  
14 amendment process, the P-T limits are required to be updated and approved by the NRC prior to  
15 expiration of the current P-T limit curves in the TS LCOs, or when a change to the P-T limits is  
16 needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H. For  
17 those plants that have approved PTLRs, the P-T limits are required to be updated prior to  
18 expiration of the current P-T limit curves in the PTLRs, or when a change to the P-T limits is  
19 needed for compliance with the requirements in Section IV.C of 10 CFR Part 50, Appendix H, or  
20 when required by a specific P-T limits update clause in the Administrative Controls TS Section  
21 that governs implementation of the PTLR process.

22 Specifically, for plants with approved PTLRs, the Administrative Controls TS Section governing  
23 the PTLR process requires that the update of the P-T limits be accomplished using prescribed  
24 methodologies referenced in the TS requirements. NRC generic letter (GL) 96-03 (Ref. 18)  
25 provides the NRC's position on the minimum requirements that need to be included in the  
26 Administrative Controls TS Section that governs implementation of the PTLR process and the  
27 type of information that need to be included in the NRC-approved methodologies that will be used  
28 to update the P-T limits and PTLRs. The GL identifies that 10 CFR 50.90 license amendment  
29 requests are not necessary for updates of the P-T limit curves if the required methodologies are  
30 used to update the P-T limits in the PTLRs. Since GL 96-03 establishes the NRC's position on  
31 what needs be included within the scope of the P-T limit methodologies, applicants with approved  
32 PTLRs should verify that the P-T limit methodologies referenced in the applicable Administrative  
33 Controls TS Section for their PTLR processes are still in conformance with the criteria in  
34 GL 96-03, and that a resulting 10 CFR 54.22 change of the TS is not needed for their SLRAs. If it  
35 is determined that a change to the referenced methodologies is needed for the SLRA, the  
36 applicant should submit the changes to the referenced methodologies as part of a 10 CFR 54.22  
37 implemented license amendment and TS change request for the SLRA.

#### 38 4.2.3.1.4.1 10 CFR 54.21(c)(1)(i)

39 If the P-T limits are located in the TS LCOs or the PTLRs (whichever is applicable to CLB) and the  
40 applicant selects the 10 CFR 54.21(c)(1)(i) option as the basis for accepting the TLAA, the  
41 projected neutron fluences for the  $\frac{1}{4}T$  and  $\frac{3}{4}T$  locations of each of the RPV beltline components  
42 at the end of the subsequent period of extended operation are reviewed to confirm that they are  
43 bounded by the neutron fluences used to develop the existing P-T limit analysis.

1 4.2.3.1.4.2 10 CFR 54.21(c)(1)(ii)

2 The documented results of the revised P-T limit analysis based on the projected reduction in  
3 fracture toughness at the end of the subsequent period of extended operation is reviewed for  
4 compliance with 10 CFR Part 50, Appendix G. If the P-T limits are controlled by the TS LCOs, the  
5 reviewer confirms that the updated P-T limits for the facility are submitted as a 10 CFR 54.22  
6 required license amendment and TS change request for the facility. The reviewer reviews the  
7 submitted P-T limit analysis for compliance with requirements in 10 CFR Part 50, Appendix G. If  
8 the P-T limits are controlled by an applicable Administrative Control TS Section and a PTLR  
9 process, the updated P-T limits are reviewed to confirm that the updated P-T limits have been  
10 submitted in an updated PTLR that has been included with the SLRA. The P-T limits in the  
11 updated PTLR are also reviewed to confirm that the P-T limits have been calculated in  
12 accordance with the methodologies referenced in the applicable Administrative Controls TS  
13 Section for the PTLR process, or if not, that the updated methodology or methodologies used to  
14 generate the updated P-T limits in the PTLR has or have been submitted as part of a  
15 10 CFR 54.22 implemented license amendment and TS change request for the SLRA.

16 The P-T limit evaluations are dependent upon the neutron fluence.

17 4.2.3.1.4.3 10 CFR 54.21(c)(1)(iii)

18 Updated P-T limits for the subsequent period of extended operation must be established and  
19 implemented prior to entry into the subsequent period of extended operation. The 10 CFR 50.90  
20 process for P-T limits located in the TS LCOs or the TS Administrative Controls Process for P-T  
21 limits that are administratively amended through a PTLR process can be considered adequate  
22 AMPs within the scope of 10 CFR 54.21(c)(1)(iii), such that P-T limits will be maintained through  
23 the subsequent period of extended operation.

24 For plants whose P-T limits are controlled by an applicable Administrative Controls TS Section  
25 and an NRC-approved PTLR process, the methodologies referenced in the applicable TS Section  
26 are reviewed to verify that they will comply with the requirements in 10 CFR Part 50, Appendix G  
27 and conform to the recommended position for minimum methodology contents in GL 96-03.  
28 Otherwise, the methodology bases for generating updates of the P-T limits during the subsequent  
29 period of extended operation are reviewed to determine whether a 10 CFR 54.22-implemented  
30 license amendment and TS change of the methodology requirements is necessary for the SLRA.

31 For BWRs whose applicants are accepting their P-T limits in accordance with the criterion in  
32 10 CFR 54.21(c)(1)(iii), the NRC staff confirms that the applicant addresses the following Renewal  
33 Applicant Action Item in the NRC staff's Safety Evaluation Report (SER) for BWRVIP-74 (Ref. 19).

34 Action Item 9: Appendix A of BWRVIP-74-A (Ref. 20) indicates that a set of P-T  
35 curves should be developed for the heat-up and cool-down operating conditions  
36 in the plant at a given EFPY in the subsequent period of extended operation.

37 This means that, for this action item, the applicant has not provided updated curves, but shall  
38 have a procedure for updating P-T limits in accordance with 10 CFR Part 50, Appendix G, that will  
39 cover 80 years.

1    4.2.3.1.5       *Elimination of Boiling Water Reactor Circumferential Weld Inspection*

2    Some BWRs have an approved technical alternative in the CLB, which eliminates the RPV  
3    circumferential shell weld inspections from the ASME Code Section XI program for the current  
4    license term. Approved technical alternatives for SLR have yet to be developed. If these  
5    analyses are identified as TLAAs, they will be evaluated on a case-by-case basis in accordance  
6    with 10 CFR 54.21(c)(1).

7    4.2.3.1.6       *Boiling Water Reactor Axial Welds*

8    Those BWRs that have been approved to use the circumferential weld technical alternative also  
9    performed conditional probability of failure analyses of their RPV axial shell welds. Approved  
10   technical alternatives for SLR have yet to be developed. If these analyses are identified as  
11   TLAAs, they will be evaluated on a case-by-case basis in accordance with 10 CFR 54.21(c)(1).

12   4.2.3.2       *Final Safety Analysis Report Supplement*

13   The reviewer verifies that the applicant has provided information to be included in the FSAR  
14   Supplement that includes a summary description of the evaluation of the RPV neutron  
15   embrittlement TLAA. Table 4.2-1, “Examples of FSAR Supplement for Reactor Vessel Neutron  
16   Embrittlement Analyses” of this review plan section contains examples of acceptable FSAR  
17   Supplement information for this TLAA. The reviewer verifies that the applicant has provided an  
18   FSAR Supplement with information equivalent to that in Table 4.2-1.

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

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

32   **4.2.4   Evaluation Findings**

33   The reviewer determines whether the applicant has provided sufficient information to satisfy the  
34   provisions of this section and whether the NRC staff’s evaluation supports conclusions of the  
35   following type, depending on the applicant’s choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be  
36   included in the SER:

37           On the basis of its review, as discussed above, the NRC staff concludes that  
38           the applicant has provided an acceptable demonstration, pursuant to  
39           10 CFR 54.21(c)(1), that, for the RPV neutron embrittlement TLAA, (choose  
40           which is appropriate) (i) the analyses remain valid for the subsequent period of  
41           extended operation, (ii) the analyses have been projected to the end of the

1 subsequent period of extended operation, or (iii) the effects of aging on the  
2 intended function(s) will be adequately managed for the subsequent period of  
3 extended operation. The NRC staff also concludes that the FSAR Supplement  
4 contains an appropriate summary description of the RPV neutron embrittlement  
5 TLAA evaluation for the subsequent period of extended operation.

#### 6 4.2.5 References

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**Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses**

TLAA	Description of Evaluation	Implementation Schedule*
<p>Neutron Fluence</p> <p>Example for acceptance per § 54.21(c)(1)(iii)</p>	<p>The neutron fluence of each reactor vessel component made from a ferritic steel material has been projected to the end of the period of extended operation using a methodology that conforms to the guidance in RG 1.190 or other fluence methodology approved by the staff. The neutron fluence values for these components are monitored through the end of the subsequent period of extended operation using a program that conforms to the guidance in GALL-SLR Report AMP X.M2, "Neutron Fluence Monitoring," or alternatively, using a plant-specific program that has been approved by the staff."</p>	<p>Calculations of neutron fluence, the methods used, and how the neutron fluence are submitted with the SLRA.</p>
<p>Upper-shelf energy (USE)</p> <p>Example for acceptance per § 54.21(c)(1)(ii)</p>	<p>Example for Plant-Specific USE Analysis Accepted Under § 54.21(c)(1)(ii)</p> <p>10 CFR Part 50 Appendix G Paragraph IV.A.1 requires that the RPV beltline materials must have Charpy upper-shelf energy (USE) of no less than 68 J (50 ft-lb) throughout the life of the reactor pressure vessel (RPV) unless otherwise approved by the NRC. The USE analyses for the ferritic steel components (i.e., RPV shell plates or forgings, nozzle plates or forgings, and associated pressure retaining welds) in the beltline region of the RPV have been updated based on component neutron fluence values that have been projected to the end of the subsequent period of extended operation and the current RPV surveillance test data for the facility. [Applicant to add any additional information it considers necessary for the quality of the FSAR supplement summary description, including information that it may desire to include relative to codes, standards, regulatory guide criteria, or other NRC-approved methods used in performance of the USE calculations.] The updated USE values for the components are projected to exceed 68 J (50 ft-lb) at the end of the subsequent period of extended operation. This provides an acceptable basis for demonstrating that the USE TLAA is acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the analysis has been projected to the end of the subsequent period of extended operation.</p>	<p>The updated USE analysis is complete. That is, the updated USE analysis accepted under 10 CFR 54.21(c)(1)(ii) was completed and quality assurance reviewed by the applicant prior to submittal of the SLRA and was included in the SLRA submitted for NRC approval in accordance with 10 CFR Part 54 reporting requirements.</p> <p>The basis for demonstrating acceptance of the TLAA under 10 CFR 54.21(c)(1)(ii) is included in the SLRA.</p>
<p>Upper-shelf energy (USE)</p> <p>Example for acceptance per § 54.21(c)(1)(ii)</p>	<p>Example for Plant-Specific RPV Component USE Assessment Projected Under §54.21(c)(1)(ii) That Fails to Meet the 50 ft-lb (68 J) USE Requirement at the End of the Subsequent Period of Extended Operation and an EMA is submitted to demonstrate acceptability under 10 CFR 5421(c)(1)(ii)</p> <p>The upper shelf energy analysis for RPV [Insert specific RPV shell, forging or weld component description and ID number along with applicable Heat No. in parentheses], as projected to the end of the subsequent period of extended operation, did not comply with the 50 ft-lb (68 J) for these types of assessment in 10 CFR Part 50, Appendix G. To address the potential non-compliance, a plant-specific</p>	<p>The updated EMA analysis is complete. That is, the updated EMA analysis submitted under 10 CFR 54.21(c)(1)(ii) was completed and QA'd by the applicant prior to submittal of the SLRA and was included in the SLRA that is submitted for NRC approval in accordance with 10 CFR Part 54. Alternatively, the EMA analysis was submitted to and</p>

<b>Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses</b>		
	<p>equivalent margins analysis (EMA) for the component was submitted [Select Either: “with the LRA” or “in a license amendment”] to demonstrate that the safety margins against fracture for component are at least as conservative as those required for the component by the provisions in the ASME Boiler and Pressure Vessel Code, Section XI, for the facility. The EMA was approved [Select Either: “in the safety evaluation report for the SLRA.” or “in an individual safety evaluation for the license amendment action that was submitted in accordance with 10 CFR Part 50, Appendix G, reporting requirements.”] This provides sufficient demonstration that the EMA(s) for the RPV component(s) [is/are] acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the [analysis/analyses] [has/have] been projected to the end of the subsequent period of extended operation.</p>	<p>approved by the NRC in accordance with a 10 CFR 50.90 license amendment submittal. The SLRA provides a basis for this prior license amendment approval that is sufficient to accept the TLAA in accordance with 10 CFR 54.21(c)(1)(ii).</p>
<p>Upper-shelf energy (USE)</p> <p>Example for acceptance per § 54.21(c)(1)(ii)</p>	<p>Example for BWR SLRAs that Submit Updated BWRVIP-74 Equivalent Margins Analyses for Their RPV Components under 10 CFR 54.21(c)(1)(ii)</p> <p>The upper shelf energy (USE) requirements in 10 CFR Part 50, Appendix G for the shell [Select Either: “plate components” or “forging components”], nozzles, and welds located in the beltline region of the reactor pressure vessel (RPV) have been addressed through the performance of an equivalent margins analyses (EMA) for the components, as permitted by the 10 CFR Part 50, Appendix G, rule. The EMAs were calculated using neutron fluence values for the components that were projected to the end of the subsequent period of extended operation. The EMAs were performed in accordance with the generic criteria for performing these types of assessments in Appendix B of EPRI Report No. 1008872 (BWRVIP-74-A) and were submitted for NRC review in accordance with Applicant Action Item No. 10 in the NRC safety evaluation for BWRVIP-74-A dated October 18, 2001 (ADAMS ML012920549). The NRC reviewed the updated EMAs for the components and found them to be acceptable in accordance with NRC’s criteria for accepting these types of EMAs, as given in the NRC safety evaluation for the BWRVIP-74-A. This provides sufficient demonstration that the EMAs for the RPV components are acceptable in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii) and that the analyses have been projected to the end of the subsequent period of extended operation.</p>	<p>The updated EMA analysis is complete. That is, the updated EMA analysis accepted under 10 CFR 54.21(c)(1)(ii) was completed and QA’d by the applicant prior to submittal of the SLRA and included in the SLRA submitted for NRC approval in accordance with 10 CFR Part 54. Alternatively, the EMA analysis was submitted to and approved by the NRC in accordance with a 10 CFR 50.90 license amendment submittal.</p> <p>Submittal of these types of EMAs are subject to the Applicant Action Item 10 in the staff’s SE for BWRVIP-74-A, dated October 18, 2001.</p>
<p>Pressurized thermal shock (for PWRs)</p> <p>Example for acceptance per § 54.21(c)(1)(ii)</p>	<p>For PWRs, 10 CFR 50.61 (or alternatively, 10 CFR 50.61a) requires the reference temperature <math>RT_{PTS}</math> for RPV beltline materials to be less than the pressurized thermal shock (PTS) screening criteria at the expiration date of the operating license unless otherwise approved by the NRC. The reference temperature has been determined to be less than the PTS screening criteria at the end of the subsequent period of extended operation, unless alternate requirements have been</p>	<p>The 10 CFR 50.61 evaluation is complete. The PTS analysis accepted under 10 CFR 54.21(c)(1)(ii) was completed and QA’d by the applicant prior to submittal of the SLRA and to be included in the SLRA submitted for NRC</p>

<b>Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses</b>		
	invoked in accordance with 10 CFR 50.61 or 10 CFR 50.61a and approved by the NRC.	approval in accordance with 10 CFR Part 54, and the applicant is to demonstrate acceptability of the TLAA during the SLRA review using the TLAA acceptance criteria in 10 CFR 54.21(c)(1)(ii).
Pressure-temperature (P-T) limits  Example for acceptance per § 54.21(c)(1)(iii)	10 CFR Part 50 Appendix G requires that heat-ups and cool-downs of the reactor pressure vessel (RPV) be accomplished within established P T limits. These limits specify the maximum allowable pressure as a function of reactor coolant temperature. As the RPV becomes embrittled and its fracture toughness is reduced, the minimum allowable temperature for operating at a given reactor pressure in the pressure range for permissible operations (i.e., pressures up to the maximum allowable safety limit pressure set in technical specifications) allowable pressure is increased. 10 CFR Part 50 Appendix G requires periodic update of P-T limits based on projected embrittlement and data from a material surveillance program. The P-T limits will be updated in accordance with the requirements [Select Either: “the 10 CFR 50.90 license amendment process.” for facilities with P-T limits set and governed by the limiting conditions of operation in the plant technical specifications, or “the plant’s program for implementing its pressure-temperature limits report process, as governed by the administrative controls section of the plant technical specifications.” for plants licensed to implement PTLRs] in order to consider the impacts of increasing neutron fluence levels caused by operations during the subsequent period of extended operation.	<p><u>For P-T limits controlled by TS LCOs:</u> Updates of the P-T limit curves are set relative to the expiration dates of the existing licensed P-T limit curves. Updates of the P-T limit curves are to be submitted for NRC approval in accordance with the applicant’s 10 CFR 50.90 license amendment request process. Updates of the P-T curves must be finalized, QA’d, submitted for NRC approval, approved by the NRC, and implemented prior to the expiration dates of the current licensed P-T limit curves located in the limiting conditions of operations section of the plant technical specifications.</p> <p><u>For P-T limits controlled by TS PTLR requirements:</u> Updates of the P-T limit curves are set relative to the expiration dates of the existing licensed P-T limit curves. The updated P-T limit curves and pressure temperature limits report (PTLR) are required to be updated in accordance with the applicant’s PTLR implementation process, as governed by applicable requirements in the administrative controls section of the plant technical specifications (TS). Updates of the P-T curves must be finalized and implemented prior to</p>

<b>Table 4.2-1. Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses</b>		
		the expiration dates of the licensed curves in the current PTLR. Updated PTLRs are to be submitted to the NRC in accordance with any applicable reporting requirements in the TS administrative controls section governing implementation of the PTLR process (depending in the TS provisions, this may or may not require NRC approval).
Elimination of BWR circumferential weld inspections and analysis of BWR axial welds	Examples of the FSAR Supplements for these TLAAAs are not given - approved technical alternatives for SLR have yet to be developed.	If the TLAA is applicable, a plant-specific implementation schedule to be provided and justified by the applicant.
Other miscellaneous TLAAAs on RV neutron embrittlement	Provide sufficient information on how the calculations for plant-specific TLAAAs were performed, what the limiting TLAA parameter was calculated to be in accordance with the neutron fluence projected for the subsequent period of extended operation, and why the TLAA is acceptable under either 10 CFR 54.21 (c)(1)(i), (ii), or (iii).	If the TLAA is applicable, a plant-specific implementation schedule to be provided and justified by the applicant.
*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.		

1

1 **4.3 Metal Fatigue**

2 **Review Responsibilities**

3 **Primary**—Branch(es) responsible for the time-limited aging analysis (TLAA) issues

4 **Secondary**—None

5 **4.3.1 Area of Review**

6 Fatigue occurs in a metal component when it is subjected to fluctuating loads. If the loading is of  
7 sufficient magnitude or frequency, cracks may initiate and propagate in the component at the  
8 location of maximum loading. To address fatigue concerns, Section III of the American Society of  
9 Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requires a fatigue analysis  
10 for Class 1 components. The analysis must consider all expected cyclic loads based on the  
11 anticipated number of cyclic loadings. In the most rigorous evaluation, the ASME Code provisions  
12 include the calculation of the cumulative usage factor (CUF) for selected locations within a  
13 component, which is a calculated measure of the expended fatigue initiation life at each location in  
14 the component. Under these provisions, the ASME Code limits the CUF to a value of less than or  
15 equal to unity for acceptable fatigue design. A CUF below a value of unity provides assurance  
16 that no crack has initiated at the analyzed location in the component. Other provisions in  
17 Section III of the ASME Code allow less rigorous treatment to address the fatigue design in  
18 components that have smaller or less frequent cyclic loadings, (i.e., fatigue waiver evaluation). In  
19 some cases, continued adequacy of the fatigue life of a component may be demonstrated through  
20 reinspections that continue to demonstrate an absence of fatigue flaws, (i.e., flaw tolerance  
21 evaluation). In other cases, the growth of fatigue flaws is assessed to ensure that flaws detected  
22 in components remain within allowable limits.

23 The acceptability of metal components from a fatigue standpoint is demonstrated by one or  
24 more relevant fatigue parameters, which include, but are not limited to, the CUF values, the  
25 environmentally-adjusted  $CUF_{en}$  values, transient cycle limits, and predicted flaw sizes (for fatigue  
26 flaw tolerance or component flaw evaluations). The limits of the fatigue parameters are  
27 established by the applicable fatigue analyses and may be a design limit, for example from an  
28 ASME Code fatigue evaluation, or an analysis-specific value, for example based on the number of  
29 cyclic load occurrences assumed in fatigue waiver evaluations or the acceptable flaw sizes  
30 postulated in flaw tolerance or component flaw evaluations.

31 As a result of the assumptions used in the underlying evaluations associated with metal  
32 component fatigue parameters (i.e., the magnitude and frequency of the assumed cyclic loadings  
33 for the future operating life of the component), the continued validity of metal fatigue analyses is  
34 reviewed for the subsequent period of extended operation.

35 Areas of review to ensure that the metal component fatigue parameter evaluations are valid for  
36 the subsequent period of extended operation include:

- 37 1. CUF calculations or fatigue waiver evaluations for components designed using the  
38 fatigue requirements of Section III of the ASME Code or other Codes that use a  $I_t$   
39 calculation (e.g., the 1969 edition of American National Standards Institute (ANSI) B31.7  
40 for Class 1 piping, ASME NC-3200 vessels, ASME NE-3200 Class MC components,  
41 ASME NG-3200 core support structures, and metal bellows designed to ASME

- 1 NC 3649.4(e)(3), ND-3649.4(e)(3), or NE-3366.2(e)(3) or the Draft ASME Code for  
2 Pumps and Valves for  $I_t$  analyses).
- 3 2. Fatigue-based maximum allowable stress calculations for components evaluated to  
4 United States of America Standards (USAS) ANSI B31.1 or ASME Code Class 2 and 3  
5 requirements.
- 6 3. CUF calculations for components that require evaluation of environmental effects  
7 ( $CUF_{en}$ ).
- 8 4. Fatigue-based flaw growth, flaw tolerance, or fracture mechanics analyses, including  
9 those used to support reinspection intervals for components.

10 **4.3.2 Acceptance Criteria**

11 Acceptance criteria are provided in the following subsections for the areas of review described in  
12 Subsection 4.3.1 that delineate acceptable methods for meeting the requirements of the  
13 U.S. Nuclear Regulatory Commission (NRC) regulations in Title 10 of the *Code of Federal*  
14 *Regulations* (10 CFR) 54.21(c)(1).

15 *4.3.2.1 Time-Limited Aging Analysis*

16 Pursuant to 10 CFR 54.21(c)(1)(i) through (iii), an applicant must demonstrate one of the following  
17 for each analysis:

- 18 i. The analyses remain valid for the period of extended operation;
- 19 ii. The analyses have been projected to the end of the period of extended operation; or
- 20 iii. The effects of aging on the intended function(s) will be adequately managed for the  
21 period of extended operation.

22 In some instances, the applicant may identify activities to be performed to verify the assumption  
23 bases of the fatigue analyses. Evaluations of those activities are provided by the applicant. The  
24 reviewer assures that the applicant's activities are sufficient to confirm the calculation assumptions  
25 for the subsequent period of extended operation.

26 Specific acceptance criteria for metal component fatigue evaluations are discussed in the  
27 following subsections.

28 *4.3.2.1.1 Components Evaluated for Fatigue Parameters Other than  $CUF_{en}$*

29 For metal components evaluated for fatigue parameters other than  $CUF_{en}$ , the acceptance criteria  
30 depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:

31 *4.3.2.1.1.1 10 CFR 54.21(c)(1)(i)*

32 The existing fatigue parameter calculations remain valid for the subsequent period of extended  
33 operation because the number of accumulated cycles and the assumed severity of each of the  
34 cyclic loadings evaluated in the calculations are not projected to exceed the limits evaluated for  
35 these loadings. The revised projections are verified to be consistent with historical plant operating  
36 characteristics and anticipated future operation.

1 4.3.2.1.1.2 10 CFR 54.21(c)(1)(ii)

2 The fatigue parameter calculations are revised and shown to remain acceptable throughout the  
3 subsequent period of extended operation based on a revised projection of the cumulative number  
4 and assumed severity of each of the cyclic loadings to the end of the subsequent period of  
5 extended operation. The revised projections are verified to be consistent with historical plant  
6 operating characteristics and anticipated future operation. The resulting fatigue parameter values  
7 are verified to remain less than or equal to their respective allowable value for the subsequent  
8 period of extended operation.

9 4.3.2.1.1.3 10 CFR 54.21(c)(1)(iii)

10 The applicant proposes an aging management program (AMP) as the basis for demonstrating that  
11 the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the  
12 fatigue parameter evaluations will be adequately managed during the subsequent period of  
13 extended operation. The AMP in Section X.M1, "Fatigue Monitoring," of the Generic Aging  
14 Lessons Learned for Subsequent License Renewal (GALL-SLR) Report provides one method that  
15 may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).

16 An applicant may also propose another AMP to demonstrate compliance with the requirement in  
17 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP is  
18 described in terms of the 10 program elements defined in the Standard Review Plan for Review of  
19 Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Appendix A.1,  
20 "Branch Technical Position, Aging Management Review—Generic," Sections A.1.2.3.1  
21 through A.1.2.3.10.

22 If an inspection program is proposed as the basis for aging management, the applicant should  
23 ensure that: (a) inspections will be performed for the specific component(s) or structure(s) in the  
24 evaluation and (b) applicant has justified that the inspection methods and frequencies in the  
25 proposed inspection program are applicable to the component(s), such that they may be used to  
26 demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).

27 4.3.2.1.2 Components Evaluated for  $CUF_{en}$

28 For metal components evaluated for  $CUF_{en}$ , the acceptance criteria depend on the applicant's  
29 choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

30 Applicants should also include  $CUF_{en}$  calculations for additional component locations if they are  
31 considered to be more limiting than those previously evaluated. This sample set includes the  
32 locations identified in NUREG/CR-6260 and additional plant-specific component locations in the  
33 reactor coolant pressure boundary if they may be more limiting than those considered in  
34 NUREG/CR-6260. Plant-specific justification can be provided to demonstrate that calculations for  
35 the NUREG/CR-6260 locations do not need to be included. Environmental effects on fatigue for  
36 these critical components can be evaluated using the positions described in Regulatory Guide  
37 (RG) 1.207, Revision 1; NUREG/CR-6909, Revision 0 (with "average temperature" used  
38 consistent with the clarification that was added to NUREG/CR-6909, Revision 1); or other  
39 subsequent NRC-endorsed alternatives.

1 4.3.2.1.2.1 10 CFR 54.21(c)(1)(i)

2 The existing CUF<sub>en</sub> calculations remain valid for the subsequent period of extended operation  
3 because the number of accumulated cycles, the assumed severity of the cyclic loadings, and the  
4 assumed water chemistry conditions evaluated in the calculations are not projected to exceed the  
5 limits evaluated for these loadings. The revised projections for the number of accumulated cycles  
6 are verified to be consistent with historical plant operating characteristics and anticipated  
7 future operation.

8 4.3.2.1.2.2 10 CFR 54.21(c)(1)(ii)

9 The CUF<sub>en</sub> calculations are revised and shown to remain acceptable throughout the subsequent  
10 period of extended operation based on a revised projection of the cumulative number of  
11 occurrences, the assumed severity of cyclic loadings, and the assumed water chemistry  
12 conditions to the end of the subsequent period of extended operation. The revised projections are  
13 verified to be consistent with historical plant operating characteristics and anticipated future  
14 operation. The resulting CUF<sub>en</sub> values are verified to remain less than or equal to unity for the  
15 subsequent period of extended operation.

16 4.3.2.1.2.3 10 CFR 54.21(c)(1)(iii)

17 In Section X.M1 of the GALL-SLR Report, the NRC staff evaluated a program for monitoring and  
18 tracking the number of occurrences and the severity of critical cyclic loadings for selected  
19 components. In Section XI.M2 of the GALL-SLR Report, the NRC staff evaluated a program for  
20 monitoring and tracking water chemistry conditions. The NRC staff determined that these  
21 programs, when used together, are acceptable AMPs to address the effects of reactor water  
22 environment on component fatigue life according to 10 CFR 54.21(c)(1)(iii). The GALL-SLR  
23 Report may be referenced in a subsequent license renewal application and should be treated in  
24 the same manner as an approved topical report. In referencing the GALL-SLR Report, the  
25 applicant should indicate that the material referenced is applicable to the specific plant involved  
26 and should provide the information necessary to adopt the finding of program acceptability as  
27 described and evaluated in the report. The applicant also should verify that the approvals set  
28 forth in the GALL-SLR Report for the generic program apply to the applicant's program.  
29 Alternatively, the components could be replaced and the CUF<sub>en</sub> values for the replacement  
30 components shown to be acceptable for the subsequent period of extended operation.

31 4.3.2.2 *Final Safety Analysis Report Supplement*

32 The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
33 evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently  
34 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
35 should contain sufficient information such as source of the data, references to the methodology  
36 used, and parameters used. The basis for demonstrating acceptance of the TLAA under  
37 10 CFR 54.21(c)(1)(ii) should be included and demonstrated in the SLRA.

38 **4.3.3 Review Procedures**

39 Review procedures for metal component fatigue parameter evaluations for the areas of review  
40 described in Subsection 4.3.1 are discussed in the following subsections.

1 4.3.3.1 *Time-Limited Aging Analysis*

2 The Code of Record should be used for the re-evaluation, or the applicant may update to a later  
3 Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter  
4 case, the reviewer verifies that the requirements in 10 CFR 50.55a are met. The reviewer  
5 assures that the applicant's activities are sufficient to confirm the calculation assumptions for the  
6 subsequent period of extended operation.

7 4.3.3.1.1 *Components Evaluated for Fatigue Parameters Other Than  $CUF_{en}$*

8 For metal components evaluated for fatigue parameters other than  $CUF_{en}$ , the review procedures  
9 depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:

10 4.3.3.1.1.1 *10 CFR 54.21(c)(1)(i)*

11 The operating cyclic load experience and a list of the assumed transients used in the existing  
12 fatigue parameter calculations is reviewed for the current operating term to ensure that the  
13 projected number of transient occurrences during the subsequent period of extended operation  
14 will not exceed the assumed number of transient occurrences in the existing fatigue parameter  
15 calculations. The projected number of occurrences for each transient is verified to be consistent  
16 with historical plant operating characteristics and anticipated future operation. In addition, a  
17 comparison of the operating cyclic load severity to the severity for each transient assumed in the  
18 existing fatigue parameter calculations is made to demonstrate that the cyclic load severity for  
19 each transient used in the fatigue parameter calculations remains bounding. For consistency  
20 purposes, the review also includes an assessment of the TLAA information against relevant  
21 design basis information and current licensing basis (CLB) information.

22 4.3.3.1.1.2 *10 CFR 54.21(c)(1)(ii)*

23 The operating cyclic load experience is reviewed to ensure that the increased number of cyclic  
24 load occurrences and their severity for each transient used for any reanalysis remain within the  
25 number of transient occurrences and severity for each transient projected to the end of the  
26 subsequent period of extended operation. The revised fatigue parameter calculations are  
27 reviewed to ensure that the fatigue parameter remains less than or equal to the allowed value at  
28 the end of the subsequent period of extended operation. The revised fatigue parameter  
29 calculations are shown to remain acceptable based on revised projections of the cumulative  
30 number of occurrences and the assumed severity of each transient to the end of the subsequent  
31 period of extended operation. The revised projections are verified to be consistent with historical  
32 plant operating characteristics and anticipated future operation. For consistency purposes, the  
33 review also includes an assessment of the TLAA information against relevant design basis  
34 information and CLB information.

35 4.3.3.1.1.3 *10 CFR 54.21(c)(1)(iii)*

36 Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant proposes an AMP or aging management  
37 activities as the basis for demonstrating that the effect or effects of aging on the intended  
38 function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be  
39 adequately managed during the subsequent period of extended operation. If Section X.M1,  
40 "Fatigue Monitoring," of the GALL-SLR Report is used as the basis for managing cumulative  
41 fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s),

1 the reviewer reviews the applicant's AMP against the program elements defined in GALL-SLR  
2 Report Section X.M1.

3 An applicant also has the option of proposing another GALL-based AMP, a plant-specific AMP, or  
4 plant-specific activities, or combination of, to demonstrate compliance with the requirement in  
5 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging  
6 management, the reviewer reviews the applicant's AMP against the program element criteria  
7 defined in the applicable AMP section in Chapter XI of the GALL-SLR Report. If the basis for  
8 aging management is a plant-specific AMP or plant-specific aging management activities, the  
9 reviewer reviews the program element criteria for the AMP or activities against the program  
10 element criteria defined in this SRP-SLR, Appendix A.1, "Branch Technical Position, Aging  
11 Management Review—Generic," Sections A.1.2.3.1 through A.1.2.3.10.

12 If a sampling based inspection program (a type of condition monitoring program) is proposed as  
13 the basis for aging management, the reviewer ensures that the AMP actually performs inspections  
14 of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and  
15 that the applicant has appropriately justified that the inspection methods and associated  
16 frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical  
17 loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance  
18 with 10 CFR 54.21(c)(1)(iii).

#### 19 4.3.3.1.2 *Components Evaluated for $CUF_{en}$*

20 For metal components evaluated for  $CUF_{en}$ , the review procedures depend on the applicant's  
21 choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

22 Applicants should include  $CUF_{en}$  calculations for the limiting component locations exposed to the  
23 reactor water environment. This sample set includes the locations identified in NUREG/CR-6260  
24 and additional plant-specific component locations in the reactor coolant pressure boundary if they  
25 may be more limiting than those considered in NUREG/CR-6260. Plant-specific justification can  
26 be provided to demonstrate that calculations for the NUREG/CR-6260 locations do not need to  
27 be included. Environmental effects on fatigue for these critical components may be evaluated  
28 using the guidance in RG 1.207, Revision 1; NUREG/CR-6909, Revision 0 (with "average  
29 temperature" used consistent with the clarification that was added to NUREG/CR-6909,  
30 Revision 1); or other subsequent NRC-endorsed alternatives.

#### 31 4.3.3.1.2.1 *10 CFR 54.21(c)(1)(i)*

32 The operating cyclic load experience and a list of the assumed transients used in the existing  
33 fatigue parameter calculations are reviewed for the current operating term to ensure that the  
34 number of assumed occurrences of each transient would not be exceeded during the subsequent  
35 period of extended operation. A comparison of the operating cyclic load severity to the severity  
36 assumed in the existing fatigue parameter calculations for each transient should be made to  
37 demonstrate that the cyclic load severities used in the fatigue parameter calculations remain  
38 bounding. In addition, a comparison of the water chemistry conditions to those assumed in the  
39 existing environmental multiplier ( $F_{en}$ ) calculations should be made to demonstrate that the water  
40 chemistry conditions used in the  $F_{en}$  calculations remain appropriate. For consistency purposes,  
41 the review also includes an assessment of the TLAA information against relevant design basis  
42 information and CLB information. A plant-specific justification can be provided to demonstrate  
43 that the guidance in Section 4.3.1.2.3 of NUREG-1800, Revision 2, is applicable to the existing

1 CUF<sub>en</sub> calculations. Considering the evaluations above, verify the existing CUF<sub>en</sub> calculations  
2 remain valid for the subsequent period of extended operation.

3 4.3.3.1.2.2 10 CFR 54.21(c)(1)(ii)

4 The operating cyclic load experience and a list of the assumed transients used in the existing  
5 fatigue parameter calculations is reviewed for the current operating term to ensure that the  
6 number of assumed occurrences for each transient are projected to the end of the subsequent  
7 period of extended operation. The reviewer verifies that a comparison of the operating cyclic load  
8 severity to the severity assumed in the existing fatigue parameter calculations for each transient  
9 has been made to demonstrate that the cyclic load severities used in the fatigue parameter  
10 calculations remain bounding. In addition, the reviewer verifies that a comparison of the water  
11 chemistry conditions to those assumed in the F<sub>en</sub> calculations has been made to demonstrate that  
12 the water chemistry conditions used in the F<sub>en</sub> calculations are appropriate. For consistency  
13 purposes, the review also includes an assessment of the TLAA information against relevant  
14 design basis information and CLB information. The review includes verification that the applicant  
15 has updated the CUF<sub>en</sub> calculations for the applicable NUREG/CR-6260 or more limiting  
16 component locations using the methods of analysis in either RG 1.207, Revision 1,  
17 NUREG/CR-6909, Revision 0 (with “average temperature” used consistent with the clarification  
18 that was added to NUREG/CR-6909, Revision 1); or other subsequent NRC-endorsed  
19 alternatives.

20 The Code of Record should be used for the reevaluation, or the applicant may update to a later  
21 Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter  
22 case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.

23 4.3.3.1.2.3 10 CFR 54.21(c)(1)(iii)

24 The applicant may reference Sections X.M1 and XI.M2 of the GALL-SLR Report in its subsequent  
25 license renewal application and use these GALL-SLR chapters to accept the TLAA in accordance  
26 with 10 CFR 54.21(c)(1)(iii), as appropriate. The review should verify that the applicant has stated  
27 that the report is applicable to its plant with respect to its program that monitors and tracks the  
28 number and severity of critical cyclic loadings and water chemistry conditions for metal  
29 components. The reviewer verifies that the applicant has identified the appropriate programs as  
30 described and evaluated in the GALL-SLR Report. The reviewer also ensures that the applicant  
31 has stated that its program contains the same program elements that the NRC staff evaluated and  
32 relied upon in approving the corresponding generic program in the GALL-SLR Report. For  
33 consistency purposes, the review also includes an assessment of the TLAA information against  
34 relevant design basis and CLB information (including applicable cycle-counting requirements and  
35 water chemistry monitoring set forth in the applicable AMPs).

36 An applicant also has the option of proposing another GALL-based AMP, a plant-specific AMP, or  
37 plant-specific activities, or combination of, to demonstrate compliance with the requirement in  
38 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging  
39 management, the reviewer reviews the applicant’s AMP against the program element criteria  
40 defined in the applicable AMP section in Chapter XI of the GALL-SLR Report. If the basis for  
41 aging management is a plant-specific AMP or plant-specific aging management activities, the  
42 reviewer reviews the program element criteria for the AMP or activities against the program  
43 element criteria defined in this SRP-SLR, Appendix A.1, “Branch Technical Position, Aging  
44 Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10.

1 If a sampling based inspection program (a type of condition monitoring program) is proposed as  
2 the basis for aging management, the reviewer ensures that the AMP actually performs inspections  
3 of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and  
4 that the applicant has appropriately justified that the inspection methods and associated  
5 frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical  
6 loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance  
7 with 10 CFR 54.21(c)(1)(iii).

#### 8 4.3.3.2 *Final Safety Analysis Report Supplement*

9 The reviewer verifies that the applicant has provided information to be included in the FSAR  
10 Supplement that includes a summary description of the evaluation of the metal fatigue TLAA.  
11 Table 4.3-1 contains examples of acceptable FSAR Supplement information for fatigue parameter  
12 TLAA's that are dispositioned in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). The reviewer  
13 verifies that the applicant has provided a FSAR Supplement with information equivalent to that in  
14 Table 4.3-1. The table includes examples for environmentally-assisted fatigue parameter TLAA's  
15 and non-environmentally-assisted fatigue parameter TLAA's.

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

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

#### 29 **4.3.4 Evaluation Findings**

30 The reviewer determines whether the applicant has provided sufficient information to satisfy the  
31 provisions of this section and whether the NRC staff's evaluation supports conclusions of the  
32 following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be  
33 included in the NRC staff's Safety Evaluation Report:

34 On the basis of its review, as discussed above, the NRC staff concludes that  
35 the applicant has provided an acceptable demonstration, pursuant to  
36 10 CFR 54.21(c)(1), that, for the [reviewer to insert applicable type of metal  
37 fatigue analysis] TLAA, [choose which is appropriate] (i) the analyses remain  
38 valid for the subsequent period of extended operation, (ii) the analyses have  
39 been projected to the end of the subsequent period of extended operation, or  
40 (iii) the effects of aging on the intended function(s) will be adequately managed  
41 for the subsequent period of extended operation. The NRC staff also concludes  
42 that the FSAR Supplement contains an appropriate summary description of the  
43 [reviewer to insert applicable type of metal fatigue analysis] TLAA, evaluation for  
44 the subsequent period of extended operation.

1 **4.3.5 References**

- 2 1. ANSI/ASME B31.1, "Power Piping." New York, New York: American National  
3 Standards Institute.
- 4 2. ANSI/ASME B31.7-1969, "Nuclear Power Piping." New York, New York: American  
5 National Standards Institute.
- 6 3. NRC. Regulatory Guide 1.207, "Guidelines for Evaluating the Effects of Light-Water  
7 Reactor Coolant Environments in Fatigue Analyses of Metal Components." Revision 1.  
8 Washington, DC: U.S. Nuclear Regulatory Commission. **Pending publication late 2016.**
- 9 4. NRC. NUREG/CR-6909, Revision 1, ANL-12/60, "Effect of LWR Coolant Environments  
10 on the Fatigue Life of Reactor Materials." Agencywide Documents Access and  
11 Management System (ADAMS) Accession No. ML14087A068. Washington, DC:  
12 U.S. Nuclear Regulatory Commission. March 2014.
- 13 5. ASME. ASME Code, Section III, "Rules for Construction of Nuclear Facility Components."  
14 New York, New York: The American Society of Mechanical Engineers.
- 15 6. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant  
16 Components, Nonmandatory, Appendix A, Analysis of Flaws." New York, New York: The  
17 American Society of Mechanical Engineers.
- 18 7. ASME. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant  
19 Components, Appendix C, Evaluation of Flaws in Austenitic Piping." New York, New York:  
20 The American Society of Mechanical Engineers.
- 21 8. NRC. NUREG/CR-5704, "Effects of LWR Coolant Environments on Fatigue Design  
22 Curves of Austenitic Stainless Steels." ADAMS Accession No. 9904280060.  
23 Washington, DC: U.S. Nuclear Regulatory Commission. April 1999.
- 24 9. NRC. NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design  
25 Curves of Carbon and Low-Alloy Steels." ADAMS Accession No. 980326084.  
26 Washington, DC: U.S. Nuclear Regulatory Commission. March 1998.
- 27 10. NRC. NUREG/CR-6260, "Application of NUREG/CR-5999 Interim Fatigue Curves to  
28 Selected Nuclear Power Plant Components." ADAMS Accession No. 9503280383.  
29 Washington, DC: U.S. Nuclear Regulatory Commission. March 1995.

<b>Table 4.3-1. Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation</b>		
<b>10 CFR 54.21(c)(1)(i) Examples</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Components Evaluated for Fatigue Parameters Other than CUF <sub>en</sub>	<p>[Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation]</p> <p>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).</p>	Completed prior to submittal of an SLRA
Components Evaluated for CUF <sub>en</sub>	<p>[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]</p> <p>The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations. [Applicant to provide adequate description of its plant-specific justification demonstrates that the guidance in Section 4.3.1.2.3 of NUREG-1800, Revision 2 applies to the existing CUF<sub>en</sub> calculations.]</p> <p>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).</p>	Completed prior to submittal of an SLRA
<b>10 CFR 54.21(c)(1)(ii) Examples</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Components Evaluated for Fatigue Parameters Other than CUF <sub>en</sub>	<p>[Applicant to identify and provide adequate description of the specific metal fatigue parameter evaluation]</p> <p>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).</p>	Completed prior to submittal of an SLRA
Components Evaluated for CUF <sub>en</sub>	<p>[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]</p>	Completed prior to submittal of an SLRA

<b>Table 4.3-1. Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation</b>		
	<p>The effects of the water environment on component fatigue life have been addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1; NUREG/CR-6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR-6909, Revision 1); or other subsequent NRC-endorsed alternatives.</p> <p>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).</p>	
<b>10 CFR 54.21(c)(1)(iii) Examples</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Components Evaluated for Fatigue Parameters Other than CUF <sub>en</sub>	<p>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]</p> <p>The fatigue monitoring program is being used as the basis for accepting these TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The AMP is for accepting these TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). 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).</p>	<p>(If the applicant will be using the Fatigue Monitoring Program to accept the TLAA. This FSAR supplement would not apply for an applicant that is accepting the fatigue TLAA using an AMP different than the Fatigue Monitoring Program.)</p> <p>In order to justify continued acceptance of the TLAA under 10 CFR 54.21(c)(1)(iii), the existing fatigue monitoring program will continue to be implemented during the subsequent period of extended operation. Any SLR enhancements of the program needed for aging management and acceptance of the TLAA are to be incorporated and implemented into the program at least 6 months prior to entry into the subsequent period of extended operation.</p>

<b>Table 4.3-1. Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation</b>		
<p>Components Evaluated for CUF<sub>en</sub></p>	<p>The effects of the water environment on component fatigue life will be addressed by assessing the impact of the water environment on the limiting component locations, using the positions described in Regulatory Guide 1.207, Revision 1; NUREG/CR-6909, Revision 0 (with “average temperature” used consistent with the clarification that was added to NUREG/CR-6909, Revision 1); or other subsequent NRC-endorsed alternatives. A limiting sample of critical components can be evaluated by applying environmental adjustment factors to the existing CUF analyses or by performing more refined calculations.</p> <p>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).</p>	<p>In order to justify continued acceptance of the TLAA under 10 CFR 54.21(c)(1)(iii), the existing fatigue monitoring program will continue to be implemented during the subsequent period of extended operation. Any SLR enhancements of the program needed for aging management and acceptance of the TLAA are to be incorporated and implemented into the program at least 6 months prior to entry into the subsequent period of extended operation.</p>

## 1 **4.4 Environmental Qualification (EQ) of Electric Equipment**

### 2 **Review Responsibilities**

3 **Primary**—Branch responsible for electrical engineering

4 **Secondary**—None

### 5 **4.4.1 Areas of Review**

6 The U.S. Nuclear Regulatory Commission (NRC) has established environmental qualification  
7 (EQ) requirements in the Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50,  
8 Appendix A, Criterion 4, and 10 CFR 50.49. Section 50.49 specifically requires each nuclear  
9 power plant licensee to establish a program to qualify certain electric equipment (not including  
10 equipment located in mild environments) so that such equipment, up to its end-of-life condition  
11 (qualified life), will meet its performance specifications during and following design basis accidents  
12 under the most severe environmental conditions postulated at the equipment's respective  
13 location. Such conditions include, among others, conditions resulting from a design basis event  
14 such as a loss of coolant accident (LOCA), high-energy line break, and post-LOCA environments.  
15 Electric equipment is qualified to perform its safety function in its respective harsh environment  
16 after the effects of in-service (operational) aging. Per 10 CFR 50.49, the effects of significant  
17 aging mechanisms are addressed as part of EQ. Those components with a qualified life equal to  
18 or greater than the duration of the current plant operating term are covered by time-limited aging  
19 analyses (TLAAs).

20 For equipment located in a harsh environment, the objective of EQ is to demonstrate with  
21 reasonable assurance that electric equipment important to safety, for which a qualified life has  
22 been established, can perform its safety function(s) without experiencing common cause failures  
23 before, during or after applicable design basis events.

24 For equipment located in a mild environment (an environment that at no time would be  
25 significantly more severe than the environment occurring during normal operation, including  
26 anticipated operational occurrences (10 CFR 50.49), the demonstration that the equipment can  
27 meet its functional requirements during normal environmental conditions and anticipated  
28 operational occurrences is in accordance with the plant's design and licensing bases. Equipment  
29 important to safety located in a mild environment is not part of an EQ program according to  
30 10 CFR 50.49(c). Documents that demonstrate that a component is qualified or designed for a  
31 mild environment include design/purchase specifications, seismic qualification reports, an  
32 evaluation or certificate of conformance as applicable.

33 Some nuclear power plants have mechanical equipment that was qualified in accordance with the  
34 provisions of Criterion 4 of Appendix A to 10 CFR Part 50. If a plant has qualified mechanical  
35 equipment, it is typically documented in the plant's master EQ list. If this qualified mechanical  
36 equipment requires a performance of a TLAA, it should be performed in accordance with the  
37 provisions of Standard Review Plan for Review of Subsequent License Renewal (SRP-SLR)  
38 Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." If a TLAA of qualified  
39 mechanical equipment is necessary, usually it will involve assessments of the environmental  
40 effects on consumable components such as seals, gaskets, lubricants, fluids for hydraulic  
41 systems, or diaphragms.

1    4.4.1.1    *Time-Limited Aging Analysis*

2    All operating plants must meet the requirements of 10 CFR 50.49 for certain important-to-safety  
3    electrical components. It defines the scope of components to be included, requires the  
4    preparation and maintenance of a list of in-scope components, and requires the preparation and  
5    maintenance of a qualification file that includes component performance specifications, electrical  
6    characteristics, and environmental conditions. The provisions of 10 CFR 50.49(e) require, in part,  
7    consideration of all significant types of aging degradation that can affect component functional  
8    capability. Additionally, 10 CFR 50.49(e)(5) requires component replacement or refurbishment  
9    prior to the end of designated life, unless additional life is established through reanalysis or  
10   ongoing qualification. Four methods of demonstrating qualification for aging and accident  
11   conditions are established by 10 CFR 50.49(f). Different qualification criteria are permitted by  
12   10 CFR 50.49(k) and based on plant and component vintage. Supplemental EQ regulatory  
13   guidance for compliance with these different qualification criteria is provided in NRC Regulatory  
14   Guide 1.89, Rev. 1, "Environmental Qualification of Certain Electric Equipment Important to Safety  
15   for Nuclear Power Plants" (Ref. 1), and the Division of Operating Reactors (DOR) Guidelines  
16   (Ref. 2), and NUREG–0588 (Ref. 3). The principal nuclear industry qualification standards for  
17   electric equipment are Institute of Electrical and Electronics Engineers (IEEE) STD 323-1971  
18   (Ref. 4) and IEEE STD 323-1974 (Ref. 5). These standards contain explicit EQ considerations  
19   based on TLAAs. Compliance with 10 CFR 50.49 provides reasonable assurance that the  
20   component can perform its intended functions during and following accident conditions after  
21   experiencing the effects of in-service aging for applicable equipment.

22   4.4.1.1.1    *Division of Operating Reactors Guidelines*

23   The qualification of electric equipment that is subject to significant known degradation due to aging  
24   where a qualified life was previously required to be established in accordance with Section 5.2.4 of  
25   the DOR Guidelines is reviewed for the subsequent period of extended operation according to  
26   those requirements. If a qualified life was not previously established, the qualification is reviewed  
27   in accordance with Section 7 of the DOR Guidelines. In addition, 10 CFR 50.49(l) should be  
28   addressed for replacement equipment.

29   4.4.1.1.2    *NUREG–0588, Category II (IEEE STD 323-1971)*

30   The qualification of certain electric equipment important to safety for which qualification was  
31   required in accordance with NUREG–0588, Category II, is reviewed for conformance to those  
32   requirements for the subsequent period of extended operation to assess the validity of the  
33   extended qualification. These requirements include IEEE STD 382-1972 (Ref. 6) for valve  
34   operators and IEEE STD 334-1971 (Ref. 7). In addition, 10 CFR 50.49(l) has to be addressed for  
35   replacement equipment.

36   4.4.1.1.3    *NUREG–0588, Category I (IEEE STD 323-1974)*

37   The qualification of certain electric equipment important to safety for which qualification was  
38   required in accordance with NUREG–0588, Category I, is reviewed for conformance to those  
39   requirements for the subsequent period of extended operation to assess the validity of the  
40   extended qualification.

1 4.4.1.2 *Generic Safety Issue*

2 Regulatory Issue Summary (RIS) 2003-09 was issued on May 2, 2003, (Ref. 8) to inform  
3 addressees of the results of the technical assessment of generic safety issue (GSI)-168,  
4 “Environmental Qualification of Electrical Equipment” (Ref. 9). This RIS requires no action on the  
5 part of the addressees.

6 4.4.1.3 *Final Safety Analysis Report Supplement*

7 The detailed information on the evaluation of TLAAs is contained in the subsequent license  
8 renewal application (SLRA). A summary description of the evaluation of TLAAs for the period of  
9 extended operation is contained in the applicant’s Final Safety Analysis Report (FSAR)  
10 supplement. The FSAR Supplement is an area of review.

11 **4.4.2 Acceptance Criteria**

12 The acceptance criteria for the areas of review described in Subsection 4.4.1 of this review plan  
13 section delineate acceptable methods for meeting the requirements of the NRC’s regulations in  
14 10 CFR 54.21(c)(1).

15 4.4.2.1 *Time-Limited Aging Analysis*

16 For long-term operation, TLAAs are reviewed to determine continued acceptability of the analyzed  
17 component for the subsequent period of extended operation. The time-dependent parameter is  
18 reevaluated, analyzed or assumed to determine a value that applies to the subsequent period of  
19 extended operation. This new value of the time-dependent parameter is then used to reevaluate  
20 the analysis parameter, applicable to the subsequent period of extended operation.

21 Pursuant to 10 CFR 54.21(c)(1)(i)–(iii), the TLAA is acceptable if it meets one of the  
22 following cases:

- 23 (i) The analysis remains valid for the subsequent period of extended operation. The  
24 time dependent parameter(s) for the subsequent period of extended operation does not  
25 exceed the time-dependent parameter value used in the existing EQ analysis.
- 26 (ii) The analysis has been projected to the end of the subsequent period of extended  
27 operation and remains acceptable for the subsequent period of extended operation. The  
28 time-dependent parameter(s) is projected for the subsequent period of extended  
29 operation. The value of the time-dependent analysis parameter(s) remains bounded to  
30 the value used in the existing EQ analysis.
- 31 (iii) The effects of aging on the intended function(s) will be adequately managed for the  
32 subsequent period of extended operation.

33 Specific acceptance criteria for EQ of certain electric equipment important to safety analyzed to  
34 Section 5.2.4 of the DOR Guidelines; NUREG–0588, Category II (Section 4); or NUREG–0588,  
35 Category I, depend on the applicant’s choice, that is, 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are:

1 4.4.2.1.1 10 CFR 54.21(c)(1)(i)

2 The existing qualification is based on previous testing, analysis, or OE, or combinations thereof  
3 that demonstrate that the equipment is qualified for the period of extended operation. For option  
4 (i), the aging evaluation existing at the time of the SLRA for the component remains valid for the  
5 subsequent period of extended operation, and no further evaluation is necessary.

6 4.4.2.1.2 10 CFR 54.21(c)(1)(ii)

7 Qualification of the equipment is extended for the subsequent period of extended operation by  
8 testing, analysis, or OE, or combinations thereof, in accordance with the CLB. For option (ii), a  
9 reanalysis of the aging evaluation is performed in order to project the qualification of the  
10 component through the subsequent period of extended operation. Important reanalysis attributes  
11 of an aging evaluation include analytical methods, data collection and reduction methods,  
12 underlying assumptions, acceptance criteria, and corrective actions if acceptance criteria are not  
13 met. These reanalysis attributes are discussed in Table 4.4-1.

14 4.4.2.1.3 10 CFR 54.21(c)(1)(iii)

15 In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal  
16 (GALL-SLR) Report (Ref. 10), the NRC staff has evaluated the EQ program (10 CFR 50.49) and  
17 determined that it is an acceptable aging management program (AMP) to address EQ according  
18 to 10 CFR 54.21(c)(1)(iii). The GALL-SLR Report may be referenced in an SLRA and should be  
19 treated in the same manner as an approved topical report. However, the GALL-SLR Report  
20 contains one acceptable way and is not the only way to manage aging for subsequent  
21 license renewal.

22 In referencing the GALL-SLR Report, the applicant should indicate that the material referenced is  
23 applicable to the specific plant involved and should provide the information necessary to adopt the  
24 finding of program acceptability as described and evaluated in the report. The applicant should  
25 also verify that the approvals set forth in the GALL-SLR Report for the generic program apply to  
26 the applicant's program.

27 4.4.2.2 *Final Safety Analysis Report Supplement*

28 The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
29 evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently  
30 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
31 should contain sufficient information associated with the TLAAs for the reviewer to determine that  
32 the applicant has made the demonstration required by 10 CFR 54.21(c)(1).

33 **4.4.3 Review Procedures**

34 For each area of review described in Subsection 4.4.1, the following review procedures should  
35 be followed:

36 4.4.3.1 *Time-Limited Aging Analysis*

37 For electric equipment qualified to the requirements of 10 CFR 50.49, the review procedures  
38 depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), which are:

1 4.4.3.1.1 10 CFR 54.21(c)(1)(i)

2 The documented results, test data, analyses, etc. of the previous qualification, which consisted of  
3 an appropriate combination of testing, analysis, and operating experience (OE), are reviewed  
4 to confirm that the original qualified life remains valid for the subsequent period of extended  
5 operation.

6 4.4.3.1.2 10 CFR 54.21(c)(1)(ii)

7 The results of projecting the qualification to the end of the subsequent period of extended  
8 operation are reviewed. The qualification methods include testing, inspection, OE, reanalysis,  
9 ongoing qualification or combinations thereof.

10 The reanalysis of an aging evaluation is normally performed to extend the qualification by  
11 reevaluating original attributes, assumptions and conservatisms for environmental conditions and  
12 other factors to identify excess conservatisms incorporated in the prior evaluation. Reanalysis of  
13 an aging evaluation to extend the qualification of electrical equipment is performed pursuant to  
14 10 CFR 50.49(e) as part of an EQ program. While an electrical equipment life limiting condition  
15 may be due to thermal, radiation, or operational/testing and cyclic aging, the majority of electrical  
16 equipment aging limits are based on thermal conditions. Conservatism may exist in aging  
17 evaluation parameters, such as the assumed service conditions including temperature and  
18 radiation, loading, power, signal conditions, cycles, and application (e.g., de-energized versus  
19 energized), or the use of an unrealistically low activation energy.

20 The reanalysis of an aging evaluation is performed according to the station's quality assurance  
21 program requirements, which requires the verification of assumptions and conclusions including  
22 the maintenance of required margins and uncertainties.

23 For reanalysis, the reviewer verifies that an applicant has completed its reanalysis, addressing  
24 attributes of analytical methods, data collection and reduction methods, underlying assumptions,  
25 acceptance criteria, and corrective actions if acceptance criteria are not met (see Table 4.4-1).  
26 The reviewer also verifies that the reanalysis has been completed in a timely manner prior to the  
27 end of qualified life.

28 4.4.3.1.3 10 CFR 54.21(c)(1)(iii)

29 The applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The review  
30 should verify that the applicant has stated that the report is applicable to its plant with respect to  
31 its EQ program. The reviewer verifies that the applicant has identified the appropriate AMP as  
32 described and evaluated in the GALL-SLR Report. The reviewer also verifies that the applicant  
33 has stated that its EQ program contains, and is consistent with, the same program elements that  
34 the NRC staff evaluated and relied upon in approving the corresponding generic AMP in the  
35 GALL-SLR Report. No further NRC staff evaluation is necessary.

36 If the applicant does not reference the GALL-SLR Report in its renewal application, additional  
37 NRC staff evaluation is necessary to determine whether the applicant's TLAA analysis and EQ  
38 AMP is acceptable for this area of review.

1 4.4.3.2 *Final Safety Analysis Report Supplement*

2 The reviewer verifies that the applicant has provided information to be included in the FSAR  
3 Supplement that includes a summary description of the TLAA evaluation of the applicant's EQ  
4 AMP including time dependent electric equipment. Table 4.4-2 contains examples of acceptable  
5 FSAR Supplement information for this TLAA. The reviewer verifies that the applicant has  
6 provided a FSAR Supplement with information consistent with that in Table 4.4-2 including  
7 plant-specific commitments, license conditions, enhancements or exceptions.

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

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

21 **4.4.4 Evaluation Findings**

22 The reviewer determines whether the applicant has provided information sufficient to satisfy the  
23 provisions of this section and whether the applicant's evaluation supports conclusions of the  
24 applicant's TLAA evaluation. Depending on the applicant's selection, a review of the applicant's  
25 10 CFR 54.21(c)(1)(i), (ii), or (iii) evaluation is to be included in the NRC staff's Safety  
26 Evaluation Report:

27 On the basis of its review, the NRC staff concludes that the applicant has  
28 provided an acceptable demonstration, pursuant to 10 CFR 54.2 (c)(1), that, for  
29 the environmental qualification of Electric Equipment TLAA, [choose which is  
30 appropriate] (i) the analyses remain valid for the subsequent period of extended  
31 operation, (ii) the analyses have been projected to the end of the subsequent  
32 period of extended operation, or (iii) the effects of aging on the intended  
33 function(s) will be adequately managed for the subsequent period of extended  
34 operation. The staff also concludes that the FSAR Supplement contains an  
35 appropriate summary description of electrical equipment TLAA evaluation for the  
36 subsequent period of extended operation.

37 **4.4.5 References**

- 38 1. NRC. Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment  
39 Important to Safety for Nuclear Power Plants." Revision 1. Agencywide Documents  
40 Access and Management System (ADAMS) Accession No. ML14070A119.  
41 Washington, DC: U.S. Nuclear Regulatory Commission. May 20, 1984.

- 1 2. NRC. "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical  
2 Equipment in Operating Reactors." DOR Guidelines. ADAMS Accession No.  
3 ML032541214. Washington, DC: U.S. Nuclear Regulatory Commission.  
4 November 13, 1979.
- 5 3. NRC. NUREG-0588, "Interim Staff Position on Environmental Qualification of  
6 Safety-Related Equipment." ADAMS Accession No. ML031480402. Washington, DC:  
7 U.S. Nuclear Regulatory Commission. July 31, 1981.
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9 Class 1E Equipment for Nuclear Power Generating Stations." ADAMS Accession No.  
10 ML032200240. New York, New York: Institute of Electrical and Electronics Engineers.  
11 September 16, 1971.
- 12 5. IEEE. IEEE Standard 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for  
13 Nuclear Power Generating Stations." ADAMS Accession No. ML03220206. New York,  
14 New York: Institute of Electrical and Electronics Engineers. December 31, 1974.
- 15 6. IEEE. IEEE Standard 382-1972, "Standard for Qualification of Actuators for Power  
16 Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants."  
17 ADAMS Accession No. ML032200228. New York, New York: Institute of Electrical and  
18 Electronics Engineers. April 10, 1973.
- 19 7. IEEE. IEEE Standard 334-1971, "IEEE Standard for Type Tests of Continuous Duty Class  
20 1E Motors for Nuclear Power Generating Stations." New York, New York: Institute of  
21 Electrical and Electronics Engineers.
- 22 8. NRC. Regulatory Issue Summary 2003-09, "Environmental Qualification of Low-Voltage  
23 Instrumentation and Control Cables." ADAMS Accession No. ML031220078.  
24 Washington, DC: U.S. Nuclear Regulatory Commission. May 2, 2003.
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26 Generic Safety Issue-168. ADAMS Accession No. ML022910316. Washington, DC:  
27 U.S. Nuclear Regulatory Commission. August 16, 2002.
- 28 10. NRC. "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR)  
29 Report." Washington, DC: U.S. Nuclear Regulatory Commission.
- 30 11. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and  
31 Fuel Reprocessing Plants." Washington, DC: U.S. Nuclear Regulatory Commission.  
32 2016.
- 33 12. 10 CFR 50.49, "Environmental Qualification of Electrical Equipment Important to Safety for  
34 Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.
- 35 13. NRC. Regulatory Guide 1.211, "Qualification of Safety-Related Cables and Field Splices  
36 for Nuclear Power Plants." ADAMS Accession No. ML082530205. Washington, DC:  
37 U.S. Nuclear Regulatory Commission. April 1, 2009.

- 1 14. NRC. Regulatory Guide 1.100, "Seismic Qualification of Electrical and Active Mechanical  
2 Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear  
3 Power Plants." ADAMS Accession No. ML0913204680. Washington, DC: U.S. Nuclear  
4 Regulatory Commission. September 30, 2009.
- 5 15. NRC. Regulatory Guide 1.218, "Condition-Monitoring Techniques for Electric Cables Used  
6 in Nuclear Power Plants." ADAMS Accession No. ML103510458. Washington, DC:  
7 U.S. Nuclear Regulatory Commission. April 30, 2012.
- 8 16. IEEE. IEEE Standard 1205-2014, "IEEE Guide for Assessing, Monitoring, and Mitigating  
9 Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and  
10 Other Nuclear Facilities." New York, New York: Institute of Electrical and Electronics  
11 Engineers.
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13 Nuclear Power Plants." ADAMS Accession No. ML093080087. Washington, DC:  
14 U.S. Nuclear Regulatory Commission. February 24, 2012.
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16 Inside the Containment of Nuclear Power Plants." ADAMS Accession No. ML003740261.  
17 Washington, DC: U.S. Nuclear Regulatory Commission. January 31, 1974.

<b>Table 4.4-1. Environmental Qualification Reanalysis and Ongoing Qualification Attributes</b>	
<b>Attributes</b>	<b>Description</b>
Analytical methods	<p>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.</p>
Data collection and reduction methods	<p>The identification of excess conservatism in electrical equipment service conditions used in the prior aging evaluation is the chief method used for a reanalysis. For example, temperature data, associated margins, and uncertainties used in an equipment EQ evaluation may be based on anticipated plant design temperatures found to be conservative when compared to actual plant temperature data. When used, plant environmental data may be obtained from monitors used for technical specification compliance; other installed monitors, measurements made by plant operators during rounds, dedicated monitors for EQ equipment or combinations of the above. The environmental data gathering and analysis method used to identify conservatism in the original EQ analysis adequately quantifies the EQ equipment in-service environment (e.g., sensor locations and number, frequency of measurement, and calendar duration), and is shown to maintain qualification margins, conservatisms, and uncertainties per 10 CFR 50.49.</p> <p>Environmental data measurements are evaluated to establish the environmental parameter (e.g., temperature, radiation, cycles) used in an analysis. Plant environmental data may be used in the aging evaluation in different ways, such as (a) directly applying the plant environmental data in the evaluation or (b) using the plant environmental data to demonstrate conservatism when using plant design values for an evaluation. The methodology for environmental monitoring, data collection and the analysis of localized EQ equipment environmental data used in the reanalysis is documented in the record of the reanalysis qualification report. Any changes to material activation energy values included as part of a reanalysis are justified by the applicant on a plant-specific basis.</p>

<b>Table 4.4-1. Environmental Qualification Reanalysis and Ongoing Qualification Attributes</b>	
<b>Attributes</b>	<b>Description</b>
Underlying assumptions	<p>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.</p> <p>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).</p>
Acceptance criteria and corrective actions	<p>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.</p>
Ongoing Qualification	<p>Ongoing qualification techniques may be implemented when assessed margins, conservatisms, or assumptions do not support reanalysis of an EQ component of electric equipment important to safety. The requirements of 10 CFR 50.49 provide methods that may be used to evaluate and maintain equipment EQ, including qualified life, for the subsequent period of extended operation.</p>

<b>Table 4.4-2. Examples of FSAR Supplement for Environmental Qualification Electric Equipment TLAA Evaluation</b>			
	<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
4.4	Environmental qualification of electric equipment	The original environmental qualification qualified life has been shown to remain valid for the subsequent period of extended operation.	Completed
<b>10 CFR 54.21(c)(1)(ii) Example</b>			
	<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
4.4	Environmental qualification of electric equipment	The environmental qualification has been projected to the end of the period of extended operation. Reanalysis addresses attributes of analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions.	Summary report on the methods and assumptions are submitted in the SLRA.
<b>10 CFR 54.21(c)(1)(iii) Example</b>			
	<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule</b>
4.4	Environmental qualification of electric equipment	The existing environmental qualification process, in accordance with 10 CFR 50.49, will adequately manage aging of environmental qualification equipment for the subsequent period of extended operation because equipment will be replaced prior to reaching the end of its qualified life.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation

4.4-11

1 **4.5 Concrete Containment Unbonded Tendon Prestress Analysis**

2 **Review Responsibilities**

3 **Primary**—Branch responsible for structural engineering

4 **Secondary**—None

5 **4.5.1 Areas of Review**

6 The prestressing tendons in prestressed concrete containments undergo losses in prestressing  
7 forces with time due to creep and shrinkage of concrete and relaxation of the prestressing steel.  
8 During the design phase, engineers estimated these losses to the end of the prestressed  
9 containment operating life, normally 40 years. Operating experiences with the trend of  
10 prestressing forces indicate the prestressing tendons may lose their prestressing forces at a rate  
11 higher than predicted due to sustained high temperature, as discussed in Information Notice  
12 (IN) 99-10, "Degradation of Prestressing Tendon Systems in Prestressed Concrete  
13 Containments." In addition, loss of prestress or reduction in tendon force can occur due to  
14 breakage of tendon wires or improper anchorages. Stress corrosion cracking (SCC) in individual  
15 tendons can also occur and contribute to the loss of tendon prestress if there is a susceptible  
16 material and environment combination. Moreover, consideration should be given to an increased  
17 tendon relaxation when replacing existing in service tendons with new. Thus, it is necessary to  
18 ensure that the applicant addresses existing Time-Limited Aging Analyses (TLAAs) for the  
19 subsequent period of extended operation. Plant-specific TLAAs regarding loss of prestress  
20 (e.g., predicted tendon prestress force lower limit–predicted lower limit (PLL), bonded tendons)  
21 are addressed and reviewed in Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses."

22 The adequacy of the prestressing forces in prestressed concrete containments is reviewed for the  
23 subsequent period of extended operation.

24 **4.5.2 Acceptance Criteria**

25 The acceptance criteria for the area of review described in Subsection 4.5.1 delineate acceptable  
26 methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC)  
27 regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1).

28 **4.5.2.1 Time-Limited Aging Analysis**

29 Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

- 30 (i) The analyses remain valid for the subsequent period of extended operation;
- 31 (ii) The analyses have been projected to the end of the subsequent period of extended  
32 operation; or
- 33 (iii) The effects of aging on the intended function(s) will be adequately managed for the  
34 subsequent period of extended operation.

1 4.5.2.1.1 10 CFR 54.21(c)(1)(i)

2 The existing prestressing force evaluation remains valid because (a) losses of the prestressing  
3 force are less than the predicted losses, as evidenced from the trend lines constructed from the  
4 recent inspection, (b) the period of evaluation covers the subsequent period of extended  
5 operation, and (c) the trend lines of the measured prestressing forces remain above the minimum  
6 required prestress force specified at anchorages for each group of tendons for the subsequent  
7 period of extended operation.

8 4.5.2.1.2 10 CFR 54.21(c)(1)(ii)

9 The prediction line of prestressing forces for each group of tendons initially developed for 40 years  
10 of operation should be extended to 80 years. The applicant demonstrates through analysis the  
11 unbonded tendon prestressed concrete containment design adequacy remains valid and that the  
12 trend lines of the measured prestressing forces will stay above the design Minimum Required  
13 Value (MRV) in the current licensing basis (CLB) for each group of tendons during the subsequent  
14 period of extended operation.

15 4.5.2.1.3 10 CFR 54.21(c)(1)(iii)

16 In Chapter X of the Generic Aging Lessons Learned for Subsequent License Renewal  
17 (GALL-SLR) Report, the NRC staff evaluated a program that assesses the concrete containment  
18 tendon prestressing forces (aging management program (AMP) X.S1, "Concrete Containment  
19 Unbonded Tendon Prestress"), and has determined that it is an acceptable AMP to address  
20 concrete containment tendon prestress according to 10 CFR 54.21(c)(1)(iii), except for operating  
21 experience (OE). Further evaluation is recommended of the applicant's OE related to the  
22 containment prestress force. However, the GALL-SLR Report contains one acceptable way and  
23 not the only way to manage aging. The GALL-SLR report may be referenced in a subsequent  
24 license renewal application (SLRA), and is treated in the same manner as an approved  
25 topical report.

26 In referencing the GALL-SLR report, an applicant indicates that the material referenced is  
27 applicable to the specific plant involved and should provide the information necessary to adopt the  
28 finding of program acceptability as described and evaluated in the report. An applicant also  
29 verifies that the approvals set forth in the GALL-SLR report for the generic program apply to the  
30 applicant's program.

31 4.5.2.2 *Final Safety Analysis Report Supplement*

32 The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
33 evaluation of TLAAAs for the subsequent period of operation in the FSAR Supplement is sufficiently  
34 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
35 contains information associated with the TLAAAs regarding the basis for determining that the  
36 applicant has made the demonstration required by 10 CFR 54.21(c)(1).

37 **4.5.3 Review Procedures**

38 For each area of review described in Subsection 4.5.1, the following review procedures should  
39 be followed:

1 4.5.3.1 *Time-Limited Aging Analysis*

2 For a concrete containment prestressing tendon system, the review procedures, depending on the  
3 applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), are:

4 4.5.3.1.1 *10 CFR 54.21(c)(1)(i)*

5 The results of a recent inspection to measure the amount of prestress loss are reviewed to ensure  
6 that the reduction of prestressing force is less than the predicted loss in the existing analysis. The  
7 reviewer verifies that the trend line of the measured prestressing force, when plotted on the  
8 predicted prestressing force curve, shows that the existing analysis remains valid for the  
9 subsequent period of extended operation.

10 4.5.3.1.2 *10 CFR 54.21(c)(1)(ii)*

11 The reviewer reviews the trend lines of the measured prestressing forces to ensure that individual  
12 tendon lift-off forces (rather than average lift-off forces of the sampled tendon group) are  
13 considered in the regression analysis for the subsequent period of extended operation, as  
14 discussed in IN 99-10, "Degradation of Prestressing Tendon Systems in Prestressed Concrete  
15 Containments." The reviewer then verifies that the trend lines will stay above the minimum  
16 required prestressing forces for each group of tendons during the subsequent period of  
17 extended operation so that the design adequacy is maintained in the subsequent period of  
18 extended operation.

19 4.5.3.1.3 *10 CFR 54.21(c)(1)(iii)*

20 An applicant may reference the GALL-SLR Report in its SLRA, as appropriate. The reviewer  
21 verifies that the applicant has stated that the report is applicable to its plant with respect to its  
22 program that assesses the concrete containment tendon prestressing forces. The reviewer  
23 verifies that the applicant has identified the appropriate program (i.e., GALL-SLR Report  
24 AMP X.S1) as described and evaluated in the GALL-SLR Report. The reviewer also ensures that  
25 the applicant has stated that its program contains the same program elements that the NRC staff  
26 evaluated and relied upon in approving the corresponding generic program in the GALL-SLR  
27 Report.

28 Further evaluation is recommended of the applicant's OE related to the containment prestress  
29 force. The applicant's program should incorporate the relevant OE that occurred at the applicant's  
30 plant as well as at other plants. The applicant considers applicable portions of the experience  
31 with prestressing systems described in IN 99-10. Tendon OE could vary among plants with  
32 prestressed concrete containments. The difference could be due to the prestressing system  
33 design (for example, button-heads, wedge or swaged anchorages), environment, or type of  
34 reactor (pressurized water reactor (PWR) or boiling water reactor (BWR)). The reviewer reviews  
35 the applicant's program to verify that the applicant has adequately considered plant-specific OE.

36 If the applicant does not reference the GALL-SLR Report in its SLRA, additional NRC staff  
37 evaluation is necessary to determine whether the applicant's program is acceptable for this area  
38 of review. The reviewer uses the guidance provided in Branch Technical Position RLSB-1 of this  
39 Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear  
40 Power Plants to ensure that loss of prestress in the concrete containment prestressing tendons is  
41 adequately managed so that trend lines will remain above the minimum required prestressing  
42 forces for each group of tendons for the subsequent period of extended operation.

1    4.5.3.2    *Final Safety Analysis Report Supplement*

2    The reviewer verifies that the applicant has provided information, to be included in the FSAR  
3    Supplement, that includes a summary description of the evaluation of the tendon prestress TLAA.  
4    Table 4.5-1 contains examples of acceptable FSAR Supplement information for this TLAA. The  
5    reviewer verifies that the applicant has provided an FSAR Supplement with information equivalent  
6    to that in Table 4.5-1.

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

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

20   **4.5.4    Evaluation Findings**

21   The reviewer determines whether the applicant has provided sufficient information to satisfy the  
22   provisions of Section 4.5 and whether the NRC staff's evaluation supports conclusions of the  
23   following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be  
24   included in the Safety Evaluation Report:

25            On the basis of its review, as discussed above, the NRC staff concludes that  
26            the applicant has provided an acceptable demonstration, pursuant to  
27            10 CFR 54.21(c)(1), that, for the concrete containment tendon prestress TLAA,  
28            [choose which is appropriate] (i) the analyses remain valid for the subsequent  
29            period of extended operation, (ii) the analyses have been projected to the end of  
30            the subsequent period of extended operation, or (iii) the effects of aging on the  
31            intended function(s) will be adequately managed for the subsequent period of  
32            extended operation. The NRC staff also concludes that the FSAR Supplement  
33            contains an appropriate description of the concrete containment tendon prestress  
34            TLAA evaluation for the subsequent period of extended operation.

35   **4.5.5    References**

- 36    1.    NRC. Regulatory Guide 1.35.1, "Determining Prestressing Forces for Inspection of  
37    Prestressed Concrete Containments." Agencywide Documents Access and Management  
38    System (ADAMS) Accession No. ML003740040. Washington, DC: U.S. Nuclear  
39    Regulatory Commission. July 1990.
- 40    2.    NRC. Information Notice 99-10, "Degradation of Prestressing Tendon Systems in  
41    Prestressed Concrete Containments." ADAMS Accession No. ML031500244.  
42    Washington, DC: U.S. Nuclear Regulatory Commission. April 1999.

**Table 4.5-1. Examples of FSAR Supplement for Concrete Containment Tendon Prestress TLAA Evaluation**

<b>10 CFR 54.21(c)(1)(i) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Concrete Containment Tendon Prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a loss of coolant accident (LOCA). The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The existing prestressing force review and evaluation remains valid to the end of the subsequent period of extended operation, and the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Completed, validation provided in the SLRA
<b>10 CFR 54.21(c)(1)(ii) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
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, validation provided in the SLRA
<b>10 CFR 54.21(c)(1)(iii) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
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 as supplemented. If the trend lines cross the predicted lower	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.

**Table 4.5-1. Examples of FSAR Supplement for Concrete Containment Tendon Prestress TLAA Evaluation**

	limit lines, corrective actions should be taken. The program incorporates plant-specific and industry OE.	
<p>*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.</p>		

1

## 1 **4.6 Containment Liner Plate, Metal Containments, and Penetrations** 2 **Fatigue Analysis**

### 3 **Review Responsibilities**

4 **Primary**—Branch responsible for structural engineering

5 **Secondary**—Branch responsible for mechanical engineering

### 6 **4.6.1 Areas of Review**

7 This section addresses fatigue analyses for containment metal liner plates, metal containments  
8 [including boiling water reactor (BWR) containment suppression chamber and the vent system,  
9 and penetrations (including personnel airlocks, equipment hatches, sleeves, dissimilar metal  
10 welds, and bellows)].

11 The interior surface of a concrete containment structure is lined with thin metallic plates to provide  
12 a leak-tight barrier against the uncontrolled release of radioactivity to the environment, as required  
13 by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix J. The thickness of  
14 the liner plates is generally between 1/4-in (6.2 mm) and 3/8-in (9.5 mm). The liner plates are  
15 attached to the concrete containment wall by stud anchors or structural rolled shapes or both.  
16 The design process assumes that the liner plates do not carry loads. However, imposed loads or  
17 conditions (e.g., dead, seismic, thermal, internal pressure, creep and shrinkage) induce cyclic  
18 stresses in the liner plates. Thus, under design-basis conditions, the liner plates could experience  
19 cyclic strains. Some plants may have metal containments instead of concrete containments with  
20 liner plates. The metal containments are designed to carry dead loads and seismic loads in  
21 addition to the internal pressure and temperature loads. For BWR Mark I metal containments, the  
22 containment suppression pool torus chamber (wetwell) and the vent system are designed or  
23 evaluated for hydrodynamic loads associated with actuation of safety relief valves and the  
24 discharge into the suppression pool chamber.

25 Fatigue of the containment liner plates or metal containments may be considered in the design  
26 based on an assumed number of occurrences and severities of cyclic loads for the current  
27 operating term. The cyclic loads include reactor building interior temperature variations during  
28 heatups and cooldowns of the reactor coolant system, loss of coolant accident as applicable,  
29 annual outdoor temperature variations, thermal loads due to the high energy containment  
30 penetration piping lines (such as steam and feedwater lines), seismic loads, and pressurization  
31 due to periodic Type A integrated leak rate tests. The BWR containment suppression pool  
32 chamber and the vent system are designed or evaluated for the hydrodynamic cyclic loads as  
33 described in Section 6.2.1.1.C, "Pressure-Suppression Type BWR Containments," of  
34 NUREG-0800, "Standard Review Plan."

35 Electrical penetration assemblies are usually sealed canisters penetrating the containment liner  
36 plate or metal containment barrier such that a pressure boundary between the inboard and  
37 outboard sides of the penetration exists while maintaining electrical continuity through the device.  
38 Mechanical penetrations include piping penetrations, access penetrations, drywell head, and fuel  
39 transfer tubes. High energy piping penetrations and the fuel transfer tubes in some plants are  
40 equipped with stainless steel (SS) bellow assemblies. These penetrations accommodate loads  
41 from relative movements between the containment wall (including the liner) and the adjoining  
42 structures, and from Type B, local leak rate tests. The penetrations have sleeves (up to 3 m  
43 (10 ft) in length, with a 5- to 8-cm (2- to 3-inch) annulus around the piping) to penetrate the

1 concrete containment wall and allow movement of the piping system. Dissimilar metal welds  
2 connect the piping penetrations to the bellows or SS plates to provide essentially leak-tight  
3 penetrations. Historical maintenance records, industry operating experience (OE), and aging  
4 mechanisms that include degradation due to fatigue and their effects on electrical and mechanical  
5 penetrations, are discussed in Electric Power Research Institute (EPRI) Topical Report  
6 TR-1003456, "Aging Management Guideline for Commercial Nuclear Power Plants Electrical and  
7 Mechanical Penetrations."

8 The containment metal liner plates, metal containments (including BWR containment suppression  
9 chamber and the vent system), and penetrations (including personnel airlocks, equipment  
10 hatches, sleeves, dissimilar metal welds, and bellows), may be designed in accordance with  
11 requirements of Section III of the American Society of Mechanical Engineers Boiler and Pressure  
12 Vessel Code (ASME Code). If a plant's code of record requires a fatigue parameter evaluation  
13 (fatigue analysis or fatigue waiver), then this analysis may be a time-limited aging analysis (TLAA)  
14 and should be evaluated in accordance with 10 CFR 54.21(c)(1) for the subsequent period of  
15 extended operation.

16 The adequacy of the fatigue parameter evaluations of the containment liner plates, metal  
17 containments, and penetrations is reviewed in this section for the subsequent period of extended  
18 operation. The number of cyclic load occurrences assumed in the fatigue parameter evaluations  
19 should be clearly identified in Section 4.6 of the applicant's subsequent license renewal  
20 application (SLRA). The fatigue parameter evaluations of the pressure boundary of process  
21 piping are reviewed separately following the guidance in Standard Review Plan for Review of  
22 Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 4.3,  
23 "Metal Fatigue."

#### 24 4.6.1.1 *Time-Limited Aging Analysis (Fatigue Parameter Evaluations)*

25 The ASME Code contains explicit requirements for fatigue parameter evaluations  
26 (fatigue analyses or fatigue waivers), which are TLAAAs. Specific requirements are contained in  
27 the design code of reference for each plant. The severities and the numbers of cycles of actual  
28 loadings for each cyclic load assumed in the underlying analyses should be verified against the  
29 numbers and severities of the actual loads projected for the subsequent period of extended  
30 operation. Monitoring of cyclic loading is accomplished through a TLAA aging management  
31 program (AMP) consistent with the Generic Aging Lessons Learned for Subsequent License  
32 Renewal (GALL-SLR) Report, X.M1 "Fatigue Monitoring," or through a site-specific AMP  
33 consistent with the guidance provided in the SRP-SLR, Appendix A.1.

#### 34 4.6.1.1.1 *Fatigue Analyses (ASME Section III, MC or Class 1)*

35 The ASME Code, Section III, Division 2, "Code for Concrete Containments, Rules for Construction  
36 of Nuclear Facility Components," and ASME Code, Section III, Division 1, "Subsection NE, Class  
37 MC Components, Rules for Construction of Nuclear Facility Components," require a fatigue  
38 analysis for liner plates, metal containments, and penetrations that considers all cyclic loads  
39 based on the anticipated number of cycles. Containment components also may be designed to  
40 ASME Code Section III Class 1 requirements. A Section III, MC or Class 1 fatigue analysis  
41 requires the calculation of the cumulative usage factor (CUF) based on the fatigue properties of  
42 the materials and the expected fatigue service of the component. The ASME code limits the CUF  
43 to a value less than or equal to one for acceptable fatigue design. The fatigue resistance of the  
44 liner plates or metal containments, and penetrations during the subsequent period of extended  
45 operation is an area of review.

1 Other evaluations also contain metal fatigue analysis requirements based on a CUF calculation,  
2 such as metal bellows designed to ASME NC-3649.4(e)(3) or NE-3366.2(e)(3) standards.

3 **4.6.1.1.2 Fatigue Waiver Evaluations**

4 The current licensing basis may include fatigue waiver evaluations that preclude the need for  
5 performing CUF analyses of structural components. The ASME Code Section III rules for  
6 performing fatigue waiver evaluations for structural components are analogous to those in the  
7 Code for performing fatigue waiver evaluations of mechanical components. ASME Code  
8 NE-3131(d) (1974 editions or later) rules out consideration for earthquake transients unless they  
9 impact designated liner locations recognized in the specifications. ASME Code NE-3222.4(d)  
10 "Analysis for Cyclic Operations, Vessels Not Requiring Analysis for Cyclic Operation," provides for  
11 a waiver from fatigue analysis when certain cyclic loading criteria are met.

12 **4.6.1.2 Final Safety Analysis Report Supplement**

13 The SLRA contains TLAA information for containment liner plates, metal containments, and  
14 penetrations. A summary description of the evaluation of containment liner plates, metal  
15 containments, and penetrations TLAA's for the subsequent period of extended operation is also  
16 contained in the applicant's proposed final safety analysis report (FSAR) supplement. The FSAR  
17 Supplement is an area of review.

18 **4.6.2 Acceptance Criteria**

19 The acceptance criteria for the areas of review described in Subsection 4.6.1 delineate acceptable  
20 methods for meeting the requirements of the U.S. Nuclear Regulatory Commission (NRC)  
21 regulations in 10 CFR 54.21(c)(1).

22 **4.6.2.1 Time-Limited Aging Analysis**

23 In some instances, the applicant may identify activities to be performed to verify the assumption  
24 bases of the fatigue parameter evaluations, the fatigue analyses, or the fatigue waiver  
25 evaluations. Evaluations of those activities are provided by the applicant. The reviewer assures  
26 that the applicant's activities are sufficient to confirm the calculation assumptions for the  
27 subsequent license renewal (SLR) period.

28 Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following:

- 29 (i) The analyses remain valid for the subsequent period of extended operation;
- 30 (ii) The analyses have been projected to the end of the subsequent period of extended  
31 operation; or
- 32 (iii) The effects of aging on the intended function(s) will be adequately managed for  
33 the subsequent period of extended operation.

34 Specific acceptance criteria for fatigue of containment liner plates, metal containments, and  
35 penetrations are provided in the following subsections.

1    4.6.2.1.1       *Fatigue Parameter Evaluations*

2    For containment liner plates, metal containments, and penetrations that have fatigue parameter  
3    evaluations, the acceptance criteria are provided in the following subsections depending on the  
4    applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii). This section applies to the evaluations  
5    identified in Sections 4.6.1.1.1 and 4.6.1.1.2.

6    4.6.2.1.1.1     10 CFR 54.21(c)(1)(i)

7    The fatigue parameter evaluations remain valid because the numbers of occurrences and  
8    severities of assumed cyclic loads are not projected to be exceeded during the subsequent period  
9    of extended operation.

10   4.6.2.1.1.2    10 CFR 54.21(c)(1)(ii)

11   The fatigue parameter evaluations have been reevaluated based on revised numbers of  
12   occurrences and severities of assumed cyclic loads for the subsequent period of extended  
13   operation and have been shown to remain within the allowed limits.

14   4.6.2.1.1.3     10 CFR 54.21(c)(1)(iii)

15   The applicant proposes an AMP as the basis for demonstrating that the effects of aging on the  
16   intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will  
17   be adequately managed during the subsequent period of extended operation. GALL-SLR Report  
18   AMP X.M1 provides one method that may be used to demonstrate compliance with the  
19   requirement in 10 CFR 54.21(c)(1)(iii).

20   An applicant may also propose another AMP to demonstrate compliance with the requirement in  
21   10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP  
22   should be defined in terms of the 10 program elements defined in the SRP-SLR, Appendix A.1.

23   If an inspection program is proposed as the basis for aging management, the AMP implements  
24   inspections of the component(s) or structure(s) in the evaluation. The AMP justifies the inspection  
25   methods and frequencies that are applicable to the component(s) or structure(s), such that the  
26   TLAA will meet the requirement of 10 CFR 54.21(c)(1)(iii).

27   Consistent with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii), an AMP is proposed to  
28   accept the TLAA in accordance with 10 CFR 54.21(c)(1)(iii) and to manage the effects of  
29   cumulative fatigue damage or fatigue-induced cracking on the intended functions of the  
30   components during the subsequent period of extended operation. GALL-SLR Report AMP XI.M1  
31   provides one AMP that may be used as the basis for accepting the fatigue parameter evaluation  
32   in accordance with 10 CFR 54.21(c)(1)(iii). However, other GALL-SLR Report AMPs or  
33   plant-specific AMPs or activities may be used to accept the TLAA in accordance  
34   10 CFR 54.21(c)(1)(iii) if appropriately justified in the SLRA.

35   4.6.2.2       *Final Safety Analysis Report Supplement*

36   The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
37   evaluation of TLAA's for the subsequent period of operation in the FSAR Supplement is sufficiently  
38   comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description

1 contains information associated with the TLAA's regarding the basis for determining that the  
2 applicant has made the demonstration required by 10 CFR 54.21(c)(1).

### 3 **4.6.3 Review Procedures**

4 For each area of review described in Subsection 4.6.1, the review procedures in the following  
5 subsections should be used.

#### 6 *4.6.3.1 Time-Limited Aging Analysis*

##### 7 *4.6.3.1.1 Fatigue Parameter Evaluations*

8 For containment liner plates, metal containments, and penetrations with fatigue parameter  
9 evaluations, the review procedures are provided in the following subsections depending on the  
10 applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).

##### 11 *4.6.3.1.1.1 10 CFR 54.21(c)(1)(i)*

12 The projected number of occurrences and severities of cyclic loadings at the end of the  
13 subsequent period of extended operation is compared to the number of occurrences and  
14 severities of cyclic loadings used in the existing fatigue parameter evaluations. The comparison  
15 confirms that the number of occurrences and severities of cyclic loadings in the existing  
16 fatigue parameter evaluations will not be exceeded during the subsequent period of  
17 extended operation.

##### 18 *4.6.3.1.1.2 10 CFR 54.21(c)(1)(ii)*

19 The revised number of occurrences and severities of cyclic loadings projected to the end of the  
20 subsequent period of extended operation is reevaluated. The revised fatigue parameter  
21 evaluations based on the projected number of occurrences and severities of cyclic loads are  
22 reviewed to ensure that the calculated fatigue parameters remain less than the allowed values at  
23 the end of the subsequent period of extended operation.

24 If applicable, the code of record is used for the revised fatigue parameter evaluations, or the  
25 applicant may update to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the  
26 reviewer verifies that the requirements in 10 CFR 50.55a are met.

##### 27 *4.6.3.1.1.3 10 CFR 54.21(c)(1)(iii)*

28 Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant proposes an AMP or aging management  
29 activities as the basis for demonstrating that the effects of aging on the intended function(s) of the  
30 structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed  
31 during the subsequent period of extended operation. If an AMP corresponding to GALL-SLR  
32 Report AMP X.M1 is used as the basis for managing cumulative fatigue damage or cracking due  
33 to fatigue or cyclical loading in the structure(s) or component(s), the reviewer reviews the  
34 applicant's AMP against the program elements defined in GALL-SLR Report AMP X.M1.

35 An applicant also has the option of proposing another GALL-based AMP, plant-specific AMP, or  
36 plant-specific activities, or combination thereof, to demonstrate compliance with the requirement in  
37 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging  
38 management, the reviewer reviews the applicant's AMP against the program element criteria

1 defined in the applicable AMP section in Appendix A of the GALL-SLR Report. If the basis for  
2 aging management is a plant-specific AMP or plant-specific aging management activities, the  
3 reviewer reviews the program element criteria for the AMP or activities against the criteria defined  
4 in the SRP-SLR, Appendix A.1.

5 If a sampling based inspection program (a type of condition monitoring program) is proposed as  
6 the basis for aging management, the reviewer ensures that the AMP actually performs inspections  
7 of the component(s) or structure(s) in the evaluation and that the applicant has appropriately  
8 justified that the inspection bases are capable of managing cumulative fatigue damage or cracking  
9 by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be  
10 accepted in accordance with 10 CFR 54.21(c)(1)(iii).

#### 11 4.6.3.2 *Final Safety Analysis Report Supplement*

12 The reviewer verifies that the applicant has provided information, to be included in the FSAR  
13 Supplement, that includes a summary description of the fatigue parameter TLAA evaluations for  
14 the containment liner plates, metal containments, and penetrations. SRP-SLR Table 4.6-1  
15 contains examples of acceptable FSAR Supplement information for this TLAA. The reviewer  
16 verifies that the applicant has provided an FSAR Supplement with information equivalent to that in  
17 Table 4.6-1.

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

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

#### 31 **4.6.4 Evaluation Findings**

32 The reviewer determines whether the applicant has provided sufficient information to satisfy the  
33 provisions of this section and to support the following conclusions, depending on the applicant's  
34 choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be included in the Safety Evaluation Report:

35 On the basis of its review, as discussed above, the NRC staff concludes that  
36 the applicant has provided an acceptable demonstration, pursuant to  
37 10 CFR 54.21(c)(1), that the [the reviewer inserts the type of fatigue parameter  
38 evaluation] TLAA evaluations, [choose which is appropriate] (i) remains valid for the  
39 subsequent period of extended operation, (ii) has been projected to the end of the  
40 subsequent period of extended operation, or (iii) the effects of aging on the intended  
41 function(s) will be adequately managed during the subsequent period of extended  
42 operation. The NRC staff also concludes that the FSAR Supplement contains an  
43 appropriate summary description of the [the reviewer inserts the type of fatigue

1 parameter evaluation] TLAAs evaluations for the subsequent period of extended  
2 operation.

3 **4.6.5 References**

- 4 1. NRC. NUREG–0661, “Mark I Containment Long-Term Program Resolution of Generic  
5 Technical Activity A-7.” Agencywide Documents Access and Management System  
6 (ADAMS) Accession No. 40080000662. Washington, DC: U.S. Nuclear Regulatory  
7 Commission. July 1980.
- 8 2. NRC. NUREG–0800, “U.S. Nuclear Regulatory Commission, Standard Review Plan.”  
9 Section 6.2.1.1.C. ADAMS Accession No. ML070630046. Washington, DC: U.S. Nuclear  
10 Regulatory Commission. March 2007.
- 11 3. ASME. ASME Code, Section III, Division 2, “Code for Concrete Containments, Rules for  
12 Construction of Nuclear Facility Components.” New York, New York: The American  
13 Society of Mechanical Engineers, (as endorsed in Regulatory Guide 1.136, “Design Limits,  
14 Loading Combinations, Materials, Construction, and Testing of Concrete Containments.”)
- 15 4. ASME. ASME Code, Section III, Division 1, “Rules for Construction of Nuclear Facility  
16 Components.” New York, New York: The American Society of Mechanical Engineers.  
17 1974 or later as applicable.
- 18 5. EPRI. EPRI TR–1003456, “Aging Management Guideline for Commercial Nuclear Power  
19 Plants Electrical and Mechanical Penetrations.” Palo Alto, California: Electric Power  
20 Research Institute. April 2002.

<b>Table 4.6-1. Examples of FSAR Supplement for Containment Liner Plates, Metal Containments, and Penetrations Fatigue TLAA Evaluation</b>		
<b>10 CFR 54.21(c)(1)(i) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Containment Liner Plates, Metal Containments, and Penetrations Fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Current fatigue parameter evaluations remain valid during the subsequent period of extended operation.	Completed, validation provided in the SLRA
<b>10 CFR 54.21(c)(1)(ii) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
Containment Liner Plates, Metal Containments, and Penetrations Fatigue	The containment liner plates, metal containments, and penetrations provide an essentially leak-tight barrier. Fatigue parameter evaluations have been reevaluated based on revised numbers of occurrences and severities of cyclic loads projected for the subsequent period of extended operation. The revised fatigue parameter values remain within allowable limits for the subsequent period of extended operation.	Completed, validation provided in the SLRA
<b>10 CFR 54.21(c)(1)(iii) Example</b>		
<b>TLAA</b>	<b>Description of Evaluation</b>	<b>Implementation Schedule*</b>
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 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.	Program and SLR enhancements, when applicable, are implemented 6 months prior to the subsequent period of extended operation.
<p>*An applicant should incorporate the implementation schedule into its FSAR. The reviewer should verify that the applicant has identified and committed in the SLRA to any future aging management activities, including enhancements and commitments, to be completed before entering the subsequent period of extended operation. The NRC staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.</p> <p>Note: All containment components need not meet the same requirement. It is likely that the liner plate and the bellows may be evaluated per 10 CFR 54.21(c)(1)(i), while high energy penetrations may be evaluated per 10 CFR 54.21(c)(1)(ii).</p>		

1 **4.7 Other Plant-Specific Time-Limited Aging Analyses**

2 **Review Responsibilities**

3 **Primary**—Branch responsible for time-limited aging analysis (TLAA) issues

4 **Secondary**—Other branches responsible for systems, as appropriate

5 **4.7.1 Areas of Review**

6 There are certain plant-specific safety analyses that may involve time-limited assumptions defined  
7 by the current operating term of the plant (for example, aspects of the reactor vessel design)  
8 and may, therefore, be TLAAs. Pursuant to Title 10 of the *Code of Federal Regulations*  
9 (10 CFR) 54.21(c), a subsequent license renewal (SLR) applicant is required to evaluate TLAAs.  
10 The definition of TLAAs is provided in 10 CFR 54.3 and in Section 4.1 of this Standard Review  
11 Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants  
12 (SRP-SLR).

13 As indicated in 10 CFR 54.30, the adequacy of the plant's current licensing basis (CLB) is not an  
14 area within the scope of the SLR review. Any questions regarding the adequacy of the CLB must  
15 be addressed under the backfit rule (10 CFR 50.109) and are separate from the license renewal  
16 process. SLR reviews focus on the subsequent period of extended operation. Pursuant to  
17 10 CFR 54.30, if the reviews required by 10 CFR 54.21(a) or (c) show that there is not reasonable  
18 assurance during the current license term that licensed activities will be conducted in accordance  
19 with the CLB, the licensee is required to take measures under its current license to ensure that the  
20 intended functions of those systems, structures, and components (SSCs) are maintained in  
21 accordance with the CLB throughout the term of the current license. The adequacy of the  
22 measures for the term of the current license is not within the scope of the SLR review.

23 Pursuant to 10 CFR 54.21(c), an applicant must provide a listing of TLAAs and plant-specific  
24 exemptions that are based on TLAAs. The U.S. Nuclear Regulatory Commission (NRC) staff  
25 reviews the applicant's identification of TLAAs and exemptions separately, following the guidance  
26 in Section 4.1 of this SRP-SLR.

27 The NRC staff has developed review procedures for the evaluation of certain TLAAs. If an  
28 applicant identifies these TLAAs as applicable to its plant, the NRC staff reviews them separately,  
29 following the guidance in Sections 4.2 through 4.6 of this SRP-SLR.

30 Table 4.7-1 provides examples of potential plant-specific TLAA topics. The reviewer follows the  
31 generic guidance in this section of the SRP-SLR for reviewing these and any other plant-specific  
32 TLAAs that have been identified by the applicant. For particular systems, the reviewers  
33 from branches responsible for those systems may be requested to assist in the review,  
34 as appropriate.

35 The following subsections identify the areas of review for plant-specific TLAAs.

36 **4.7.1.1 *Time-Limited Aging Analysis***

37 The applicant's evaluation of the TLAA for the subsequent period of extended operation  
38 is reviewed.

1 4.7.1.2 *Final Safety Analysis Report Supplement*

2 The Final Safety Analysis Report (FSAR) supplement summarizing the applicant's evaluation of  
3 the TLAA for the subsequent period of extended operation is reviewed.

4 **4.7.2 Acceptance Criteria**

5 The acceptance criteria for the areas of review described in Section 4.7.1 delineate acceptable  
6 methods for meeting the requirements of 10 CFR 54.21(c)(1) and 10 CFR 54.21(d).

7 4.7.2.1 *Time-Limited Aging Analysis*

8 Pursuant to 10 CFR 54.21(c)(1), an applicant must demonstrate one of the following for TLAAs:

- 9 (i) The analyses remain valid for the period of extended operation;
- 10 (ii) The analyses have been projected to the end of the period of extended operation;  
11 or
- 12 (iii) The effects of aging on the intended function(s) will be adequately managed for the  
13 period of extended operation.

14 Acceptance criteria for each TLAA demonstration are discussed in the following subsections.

15 4.7.2.1.1 *10 CFR 54.21(c)(1)(i)*

16 The applicant must demonstrate that the analysis remains valid for the subsequent period of  
17 extended operation. The analysis remains valid because it is shown to be bounding even during  
18 the subsequent period of extended operation. No changes to the existing analysis are necessary.

19 4.7.2.1.2 *10 CFR 54.21(c)(1)(ii)*

20 The applicant must demonstrate that the analysis has been projected to the end of the  
21 subsequent period of extended operation. The existing analysis is updated or recalculated to  
22 show acceptable results for the subsequent period of extended operation.

23 4.7.2.1.3 *10 CFR 54.21(c)(1)(iii)*

24 The applicant must demonstrate that the effects of aging on the intended function(s) will be  
25 adequately managed for the subsequent period of extended operation. Appendix A.1 of this  
26 SRP-SLR provides the acceptance criteria for programs and activities used to manage the effects  
27 of aging.

28 4.7.2.2 *Final Safety Analysis Report Supplement*

29 The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the  
30 evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently  
31 comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description  
32 contains information associated with the TLAAs regarding the basis for determining that the  
33 applicant has made the demonstration required by 10 CFR 54.21(c)(1).

1 **4.7.3 Review Procedures**

2 For certain applicants, plant-specific analyses may meet the definition of a TLAA as given in  
3 10 CFR 54.3. The concern for SLR is that these analyses may not have properly considered the  
4 full length of the subsequent period of extended operation, which may change conclusions with  
5 regard to safety and the capability of SSCs within the scope of 10 CFR Part 54 to perform one or  
6 more safety functions. The review of these TLAAs provides assurance that the effects of aging  
7 are properly addressed through the subsequent period of extended operation.

8 The following subsections provide the review procedures for each area of review described in  
9 Section 4.7.1.

10 *4.7.3.1 Time-Limited Aging Analysis*

11 For each TLAA, the review procedures depend on the applicant's choice of methods of  
12 compliance in 10 CFR 54.21(c)(1)(i), (ii), or (iii).

13 *4.7.3.1.1 10 CFR 54.21(c)(1)(i)*

14 Justification provided by the applicant is reviewed to verify that the existing analysis remains valid  
15 for the subsequent period of extended operation. The existing analysis should be shown to be  
16 bounding even during the subsequent period of extended operation.

17 The applicant describes the TLAA with respect to the objectives of the analysis, assumptions used  
18 in the analysis, conditions, acceptance criteria, relevant aging effects, and intended function(s).  
19 For those analyses that consider cyclic loading, each load or transient type should be identified  
20 along with the corresponding number of total cycles assumed in the analysis and the number of  
21 cycles that are anticipated to occur through the subsequent period of extended operation. The  
22 applicant shows that (a) conditions and assumptions used in the analysis already address the  
23 relevant aging effects for the subsequent period of extended operation, and (b) acceptance  
24 criteria are maintained to provide reasonable assurance that the intended function(s) is  
25 maintained. Thus, no reanalysis is necessary.

26 In some instances, the applicant may identify activities to be performed to verify the assumption  
27 basis for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the  
28 applicant. The reviewer assures that the applicant's verification activities are sufficient to confirm  
29 the validity of the calculation assumptions for the subsequent period of extended operation.

30 If the TLAA must be modified or recalculated to extend the period of evaluation to consider the  
31 subsequent period of extended operation, then reevaluation should be addressed under  
32 10 CFR 54.21(c)(1)(ii).

33 *4.7.3.1.2 10 CFR 54.21(c)(1)(ii)*

34 The documented results of the revised analyses are reviewed to verify that their period of  
35 evaluation is extended such that they are valid for the subsequent period of extended operation.  
36 The applicable analysis technique can be the one that is in effect in the plant's CLB at the time  
37 that the subsequent license renewal application (SLRA) is filed.

38 The applicant may recalculate the TLAA using an 80-year period to show that the acceptance  
39 criteria continue to be satisfied for the subsequent period of extended operation. The applicant

1 also may revise the TLAA by recognizing and reevaluating any overly conservative conditions and  
2 assumptions. Examples include relaxing overly conservative assumptions in the original analysis,  
3 using new or refined analytical techniques, and performing the analysis using an 80-year period.  
4 The applicant should provide a sufficient description of the analysis and document the results of  
5 the reanalysis to show that it is satisfactory for the subsequent period of extended operation.

6 As applicable, the plant's code of record is used for the reevaluation, or the applicant may update  
7 to a later code edition pursuant to 10 CFR 50.55a. In the latter case, the reviewer verifies that the  
8 requirements in 10 CFR 50.55a are met.

9 In some cases, the applicant may identify activities to be performed to verify the assumption basis  
10 for the calculation (e.g., cycle counting). An evaluation of that activity is provided by the applicant.  
11 The reviewer assures that the applicant's verification activities are sufficient to confirm the validity  
12 of the calculation assumptions for the subsequent period of extended operation.

#### 13 4.7.3.1.3 10 CFR 54.21(c)(1)(iii)

14 Under this option, the applicant proposes to manage the aging effects associated with the TLAA  
15 by an aging management program (AMP) or aging management activities in the same manner as  
16 described in the integrated plant assessment (IPA) in 10 CFR 54.21(a)(3). The reviewer reviews  
17 the applicant's AMP or aging management activities to verify that the effects of aging on the  
18 intended function(s) are adequately managed consistent with the CLB for the subsequent period  
19 of extended operation.

20 The applicant identifies the structures and components (SCs) associated with the TLAA. The  
21 TLAA is described with respect to the objectives of the analysis, conditions, assumptions used,  
22 acceptance criteria, relevant aging effects, and intended function(s). The reviewer uses the  
23 guidance in Section A.1 of this SRP-SLR to ensure that the effects of aging on the SC-intended  
24 function(s) are adequately managed for the subsequent period of extended operation.

#### 25 4.7.3.2 Final Safety Analysis Report Supplement

26 The reviewer verifies that the applicant has provided information to be included in the FSAR  
27 Supplement that includes a summary description of the evaluation of each TLAA. Each such  
28 summary description is reviewed to verify that it is sufficiently comprehensive.

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

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

1 **4.7.4 Evaluation Findings**

2 The reviewer determines whether the applicant has provided sufficient information to satisfy the  
3 provisions of this Section 4.7 and whether the NRC staff's evaluation supports conclusions of the  
4 following type, depending on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), to be  
5 included in the Safety Evaluation Report:

6 On the basis of its review, as discussed above, the NRC staff concludes that  
7 the applicant has provided an acceptable demonstration, pursuant to  
8 10 CFR 54.21(c)(1), that, for the (name of specific) TLAA, [choose which  
9 is appropriate]

10 (i) The analyses remain valid for the subsequent period of extended  
11 operation,

12 (ii) The analyses have been projected to the end of the period of extended  
13 operation, or

14 (iii) The effects of aging on the intended function(s) will be adequately  
15 managed for the subsequent period of extended operation. The NRC staff  
16 also concludes that the FSAR Supplement contains an appropriate  
17 summary description of this TLAA evaluation for the period of extended  
18 operation, as required by 10 CFR 54.21(d).

19 **4.7.5 References**

20 None

<b>Table 4.7-1. Examples of Potential Plant-Specific TLAAs Topics</b>
<b>BWRs</b>
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
<b>PWRs</b>
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"
<b>BWRs and PWRs</b>
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

1

## 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**—Branch responsible for reviewing technical specifications (TS) requirements related to aging management programs (AMPs) or time-limited aging analyses (TLAAs)

**Secondary**—Other branches responsible for engineering, as appropriate

#### 5.1.1 Areas of Review

The requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.22 (Ref. 1) require an applicant to identify any new TS or TS changes (i.e., amendments) that are needed to manage the effects of aging during the subsequent period of extended operations. This section of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) provides guidance for determining whether plant TS changes need to be included in a plant-specific 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 (CLB) include these types of TS requirements), the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.
- For TS that include administrative controls section provisions that establish fuel oil testing requirements for emergency diesel fuel storage tanks (i.e., for applicant's whose SLRAs include diesel fuel oil testing AMPs and with CLBs that include these types of TS requirements), the AMPs should establish the relationship of the TS requirements to the applicable program element criteria for their AMPs, as applicable.
- For TS that include pressure-temperature (P-T) limits for their reactor vessels and reactor coolant pressure boundary components in the limiting conditions of operations (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

1 administrative controls section of their TS, the TS requirements may have direct bearing  
2 on how the P-T limit TLAAAs for the SLRA are accepted in accordance with  
3 10 CFR 54.21(c)(1)(i), (ii), or (iii).

4 Acceptance criteria for plant-specific TS are contained in the specific TS provisions or  
5 alternatively in referenced documents invoked by the TS requirements. For those SLRAs  
6 for plants whose CLBs include TS requirements that relate to an AMP's program element  
7 bases for managing specific aging effects, the TS requirements should be reviewed to  
8 confirm that they remain adequate for managing the aging effects that are within the scope  
9 of the AMPs. Otherwise, the TS requirements should be amended accordingly as part of  
10 the SLRA in accordance with 10 CFR 54.22 and the changes in the TS requirement  
11 criteria factored into the program element bases for the AMP, as appropriate.

12 For those TS requirements that relate to TLAAAs, the TS requirements and any  
13 methodologies or processes invoked by the TS requirements should be reviewed to see if  
14 they need to be amended or new TS requirements need to be proposed in  
15 order to demonstrate adequate compliance of the TLAAAs in accordance with  
16 10 CFR 54.21(c)(1)(i), (ii), or (iii). Otherwise, TS changes that are determined  
17 as being necessary to disposition TLAAAs in accordance with the requirements of  
18 10 CFR 54.21(c)(1)(i), (ii), or (iii) should be included in the SLRA as part of TS change  
19 requests under 10 CFR 54.22. This may include TS changes that may be needed for P-T  
20 limit TLAAAs controlled by PTLR processes, if it is determined that the current P-T limit  
21 methodologies approved and invoked by the current administrative controls TS  
22 requirements cannot generate P-T limits for the subsequent license renewal (SLR) period  
23 that will comply with the P-T limit requirements in 10 CFR Part 50, Appendix G (Ref. 2),  
24 and Appendix G of the ASME Code Section XI edition of record for the facility.

### 25 **5.1.3 Review Procedures**

26 The reviewer should review the applicant's operating license, including the TS that are included as  
27 part of the operating license, and procedures to ensure that the applicant has identified all  
28 appropriate TS changes or additions that may impact AMPs or TLAAAs during the subsequent  
29 period of extended operation. If it is determined that new TS requirements, or new operating  
30 license conditions are needed to manage specific aging effects, or that changes to the existing TS  
31 requirements need to be amended in order to manage such aging effects, the reviewer  
32 determines that those license amendments are submitted with the SLRA for U.S. Nuclear  
33 Regulatory Commission (NRC) approval in accordance with the requirement in 10 CFR 54.22.

34 Examples of existing TS requirements that may be used to manage the effects of aging include  
35 but are not limited to: (a) preventative maintenance and periodic visual inspection requirements  
36 for plant systems located outside of containment, (b) diesel fuel oil monitoring requirements or  
37 surveillance requirements that are listed in the administrative controls sections of the TS, which  
38 may form the bases for fuel oil chemistry programs used to manage loss of material due to  
39 general, pitting, crevice, and microbiologically-induced corrosion in emergency diesel fuel oil  
40 system components, and (c) requirements in the TS that govern the applicant's updates to the P-T  
41 limits of their plants that constitute part of the mandatory bases for managing and analyzing loss  
42 of fracture toughness due to neutron irradiation embrittlement in ferritic steel components of the  
43 reactor vessel and reactor coolant pressure boundary. This latter example is a TLAA.

1 **5.1.4 Evaluation Findings**

2 The reviewer determines whether the applicant has provided sufficient information to satisfy the  
3 provisions of this section, and whether the NRC staff's evaluation supports one of the following  
4 three conclusions listed below that is to be included in the NRC staff's safety evaluation report, as  
5 applicable for the review of the SLRA:

6 On the basis of its review, as discussed above, the NRC staff concludes that the  
7 applicant has provided an acceptable basis for concluding that the SLRA does not  
8 need to include any new TS requirements or TS amendments to manage the  
9 effects of aging during the subsequent period of extended operation.

10 On the basis of its review, as discussed above, the NRC staff concludes that the  
11 applicant has provided a list of all new TS provisions or TS changes in the SLRA  
12 that are needed to manage the effects of aging during the subsequent period of  
13 extended operation , as required by 10 CFR 54.22. The NRC staff also concludes  
14 that these TS changes will be capable of managing the effects of aging in  
15 accordance the requirement in 10 CFR 54.21(a)(3).

16 Pursuant to the requirement in 10 CFR 54.22, as discussed above, the NRC staff  
17 concludes that the applicant has provided those new TS provisions or TS changes  
18 in the SLRA needed to manage [INSERT APPLICABLE AGING EFFECT], as  
19 evaluated in [INSERT NAME of TLAA] for the subsequent period of extended  
20 operation. The NRC staff also concludes that these TS changes adequately  
21 demonstrate that the [INSERT NAME of TLAA and then INSERT one of the  
22 Following Statements to finish off this conclusion] . . .will remain valid for the  
23 subsequent period of extended operation, as required by 10 CFR 54.21(c)(1)(i),”  
24 has been adequately projected to the end of the subsequent period of extended  
25 operation, as required by 10 CFR 54.21(c)(1)(ii),” effects of [INSERT APPLICABLE  
26 AGING EFFECT AND MECHANISM] on the intended functions of the [INSERT  
27 APPLICABLE STRUCTURES OR COMPONENTS EVALUATED IN THE TLAA]  
28 during the SLR period, as required by 10 CFR 54.21(c)(1)(iii).

29 **5.1.5 References**

- 30 1. 10 CFR 54.22, “Contents of Application–Technical Specifications.” Washington, DC:  
31 U.S. Nuclear Regulatory Commission. 2016.
- 32 2. 10 CFR Part 50, Appendix G, “Fracture Toughness Requirements.” Washington, DC:  
33 U.S. Nuclear Regulatory Commission. 2016.

1

## **APPENDIX A**

2

## **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 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 (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 components and material testing programs that monitor for degradation in spent fuel pool neutron absorption materials.

Performance Monitoring Programs test the ability of a structure or component to perform its intended function(s). For example, the ability of the tubes on heat exchangers to transfer heat is tested.

More than one type of AMP may be implemented to 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.

1 **A.1.2 Branch Technical Position**

2 *A.1.2.1 Applicable Aging Effects*

- 3 1. The determination of applicable aging effects is based on degradation mechanisms that  
4 have occurred and those that potentially could cause SC degradation. The materials,  
5 environment, stresses, service conditions, operating experience (OE), and other relevant  
6 information should be considered in identifying applicable aging effects. The effects of  
7 aging on the intended function(s) of SCs also should be considered.
- 8 2. Relevant aging information may be contained in, but is not limited to, the following  
9 documents: (i) plant-specific maintenance and inspection records; (ii) plant-specific site  
10 deviation or issue reports; (iii) plant-specific U.S. Nuclear Regulatory Commission (NRC)  
11 and Institute of Nuclear Power Operations (INPO) inspection reports; (iv) plant-specific  
12 licensee self-assessment reports; (v) plant-specific and other licensee event report;  
13 (vi) NRC, INPO, and vendor generic communications; and (vii) generic safety issues/  
14 unresolved safety issues; NUREG reports; and Electric Power Research Institute  
15 (EPRI) reports.
- 16 3. If OE or other information indicates that a certain aging effect may be applicable and an  
17 applicant determines that it is not applicable to its specific plant, the reviewer may  
18 question the absence of this aging effect if the applicant has not provided a sufficient  
19 basis in its subsequent license renewal application. For example, the question could cite  
20 a previous application review, NRC generic communications, engineering judgment,  
21 relevant research information, or other industry experience as the basis for the question.  
22 Simply citing that the aging effect is listed in the Generic Aging Lessons Learned for  
23 Subsequent License Renewal (GALL-SLR) Report is not a sufficient basis. For  
24 example, it may be that the aging effect is applicable to a pressurized water reactor  
25 (PWR) component, but the applicant's plant is a boiling water reactor (BWR) and does  
26 not have such a component. In this example, using the GALL-SLR Report merely as a  
27 checklist is not appropriate.
- 28 4. An aging effect may not have been identified in the GALL-SLR Report, if it arises out of  
29 industry experience after the issuance of the GALL-SLR Report. The reviewer should  
30 ensure that the applicant has evaluated the latest industry experience to identify all  
31 applicable aging effects.
- 32 5. An aging effect should be identified as applicable for SLR even if there is a prevention or  
33 mitigation program associated with that aging effect. For example, water chemistry, a  
34 coating, or use of cathodic protection could prevent or mitigate corrosion, but corrosion  
35 should be identified as applicable for SLR, and the AMR should consider the adequacy  
36 of the AMP referencing water chemistry, coating, or cathodic protection.
- 37 6. Specific identification of aging mechanisms is not a requirement; however, it is an option  
38 to identify specific aging mechanisms and the associated aging effects in the integrated  
39 plant assessment.
- 40 7. The applicable aging effects to be considered for SLR include those that could result  
41 from normal plant operation, including plant or system operating transients and plant  
42 shutdown. Specific aging effects from abnormal events need not be postulated for SLR.  
43 However, if an abnormal event has occurred at a particular plant, its contribution to the

1 aging effects on SCs for SLR should be considered for that plant. For example, if a resin  
2 intrusion has occurred in the reactor coolant system at a particular plant, the contribution  
3 of this resin intrusion event to aging should be considered for that plant.

4 Design basis events (DBEs) are abnormal events; they include design basis pipe break,  
5 loss-of-coolant accident, and safe shutdown earthquake. Potential aging effects resulting from  
6 DBEs are addressed, as appropriate, as part of the plant's CLB. There are other abnormal events  
7 which should be considered on a case-by-case basis. For example, abuse due to human activity  
8 is an abnormal event; aging effects from such abuse need not be postulated for SLR. When a  
9 safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is  
10 required to take immediate corrective action under existing procedures (see 10 CFR Part 50  
11 Appendix B) to ensure functionality of the equipment. The equipment degradation is not due to  
12 aging; corrective action is not necessary solely for the subsequent period of extended operation.  
13 However, leakage from bolted connections should not be considered as abnormal events.  
14 Although bolted connections are not supposed to leak, experience shows that leaks do occur, and  
15 the leakage could cause corrosion. In addition, condensation frequently occurs during humid  
16 periods of normal plant operation and can also occur during plant shutdown when normally hot  
17 components might be below the dew point. The aging effects from leakage of bolted connections  
18 and condensation occurring during humid periods of normal plant operations should be evaluated  
19 for SLR. Condensation during plant shutdowns could result in aging effects such as reduced  
20 thermal insulation resistance due to moisture intrusion and should be evaluated for SLR. It is less  
21 likely that condensation during plant shutdowns would result in loss of material, unless plant-  
22 specific OE dictates otherwise (e.g., as a result of extended plant shutdowns).

23 An aging effect due to an abnormal event does not preclude that aging effect from occurring  
24 during normal operation for the subsequent period of extended operation. For example, a certain  
25 PWR licensee observed clad cracking in its pressurizer, and attributed that to an abnormal dry out  
26 of the pressurizer. Although dry out of a pressurizer is an abnormal event, the potential for clad  
27 cracking in the pressurizer during normal operation should be evaluated for SLR. This is because  
28 the pressurizer is subject to extensive thermal fluctuations and water level changes during plant  
29 operation, which may result in clad cracking given sufficient operating time. The abnormal dry out  
30 of the pressurizer at that certain plant may have merely accelerated the rate of the aging effect.

#### 31 A.1.2.2 *Aging Management Program for Subsequent License Renewal*

- 32 1. An acceptable AMP should consist of the 10 elements described in Table A.1-1, as  
33 appropriate. These program elements are discussed further in Position A.1.2.3 below.
- 34 2. All programs and activities that are credited for managing a certain aging effect for a  
35 specific structure or component should be described. These programs and activities  
36 may be evaluated together for the 10 elements described in Table A.1-1, as appropriate.
- 37 3. The risk significance of a structure or component could be considered in evaluating the  
38 robustness of an AMP. Probabilistic arguments may be used to develop an approach for  
39 aging management adequacy. However, use of probabilistic arguments alone is not an  
40 acceptable basis for concluding that, for those SCs subject to an AMR, the effects of  
41 aging will be adequately managed in the subsequent period of extended operation.  
42 Thus, risk significance may be considered in developing the details of an AMP for the  
43 structure or component for SLR, but may not be used to conclude that no AMP is  
44 necessary for SLR.

1 4. For programs that rely on NRC-endorsed technical or topical reports (TRs), the scope of  
2 the AMP includes the applicant's bases for resolving or addressing any NRC limitations  
3 or applicant/licensee action items that are placed on the activities for implementing a  
4 given report's methodology. These limitations or action items are identified in the NRC's  
5 safety evaluation on the TR's methodology and recommended activities. If it is  
6 determined that the response to a specific applicant action item will result in the need for  
7 augmentation of specific programmatic criteria beyond those activities recommended in  
8 the applicable TR, the applicant should define the AMP accordingly to identify the AMP  
9 program element or elements that are impacted by the basis for responding to the  
10 applicable action item and the adjustments that will need to be made to the TR guidance  
11 recommendations, as defined in the impacted program elements for the AMP and  
12 applicable to the CLB and design basis for the facility. It is also recommended that the  
13 applicants provide their bases for resolving the specific limitations or action items in  
14 Appendix C of their SLRAs.

15 *A.1.2.3 Aging Management Program Elements*

16 *A.1.2.3.1 Scope of Program*

17 The specific program necessary for SLR should be identified. The scope of the program should  
18 include the specific SCs, the aging of which the program manages.

19 *A.1.2.3.2 Preventive Actions*

- 20 1. The activities for prevention and mitigation programs should be described. These  
21 actions should mitigate or prevent aging degradation.
- 22 2. Some condition or performance monitoring programs do not rely on preventive actions  
23 and thus, this information need not be provided.
- 24 3. In some cases, condition or performance monitoring programs may also rely on  
25 preventive actions. The specific prevention activities should be specified.

26 *A.1.2.3.3 Parameters Monitored or Inspected*

- 27 1. This program element should identify the aging effects that the program manages and  
28 should provide a link between the parameter or parameters that will be monitored and  
29 how the monitoring of these parameters will ensure adequate aging management.
- 30 2. For a condition monitoring program, the parameter monitored or inspected should be  
31 capable of detecting the presence and extent of aging effects. Some examples are  
32 measurements of wall thickness and detection and sizing of cracks.
- 33 3. For a performance monitoring program, a link should be established between the  
34 degradation of the particular structure or component-intended function(s) and the  
35 parameter(s) being monitored. An example of linking the degradation of a passive  
36 component-intended function with the performance being monitored is linking the fouling  
37 of heat exchanger tubes with the heat transfer-intended function as identified by a  
38 change in the differential temperature across the heat exchanger tubes. This could be  
39 monitored by periodic heat balances. Since this example deals only with one intended  
40 function of the tubes (heat transfer), additional programs may be necessary to manage

1 other intended function(s) of the tubes, such as pressure boundary. Thus, a  
2 performance monitoring program must ensure that the SCs are capable of performing  
3 their intended functions by using a combination of performance monitoring and  
4 evaluation (if outside acceptable limits of acceptance criteria) that demonstrate that  
5 a change in performance characteristic is a result of an age-related  
6 degradation mechanism.

4. 7 For prevention or mitigation programs, the parameters monitored should be the specific  
8 parameters being controlled to achieve prevention or mitigation of aging effects. An example is  
9 the coolant oxygen level that is being controlled in a water chemistry program to mitigate pipe  
10 cracking.

#### 11 A.1.2.3.4 *Detection of Aging Effects*

12 1. Detection of aging effects should occur before there is a loss of the SC-intended  
13 function(s). The parameters to be monitored or inspected should be appropriate to  
14 ensure that the SC-intended function(s) will be adequately maintained for SLR under all  
15 CLB design conditions. Thus, the discussion for the “detection of aging effects” program  
16 element should address (a) how the program element would be capable of detecting or  
17 identifying the occurrence of age-related degradation or an aging effect prior to a loss of  
18 SC-intended function or (b) for preventive/mitigative programs, how the program would  
19 be capable of preventing or mitigating their occurrence prior to a loss of a SC-intended  
20 function. The discussion should provide information that links the parameters to be  
21 monitored or inspected to the aging effects being managed.

22 2. Nuclear power plants are licensed based on redundancy, diversity, and defense-in-depth  
23 principles. A degraded or failed component reduces the reliability of the system,  
24 challenges safety systems, and contributes to plant risk. Thus, the effects of aging on a  
25 structure or component should be managed to ensure its availability to perform its  
26 intended function(s) as designed when called upon. In this way, all system  
27 level-intended function(s), including redundancy, diversity, and defense-in-depth  
28 consistent with the plant’s CLB, would be maintained for SLR. A program based solely  
29 on detecting structure and component failure should not be considered as an effective  
30 AMP for SLR.

31 3. This program element describes “when,” “where,” and “how” program data are collected  
32 (i.e., all aspects of activities to collect data as part of the program).

33 4. For condition monitoring programs, the method or technique (such as visual, volumetric,  
34 or surface inspection), frequency, and timing of new, one-time inspections may be linked  
35 to plant-specific or industry-wide OE. The discussion provides justification, including  
36 codes and standards referenced, that the technique and frequency are adequate to  
37 detect the aging effects before a loss of SC-intended function. A program based solely  
38 on detecting SC failures is not considered an effective AMP.

39 For a condition monitoring program, when sampling is used to represent a larger  
40 population of SCs, applicants provide the basis for the inspection population and sample  
41 size. The inspection population is based on such aspects of the SCs as similarity of  
42 materials of construction, fabrication, procurement, design, installation, environment,  
43 operating conditions, and aging effects. The sample size is based on such aspects of the  
44 SCs as the specific aging effect, location, existing technical information, system and

1 structure design, materials of construction, environment, operating conditions, and  
2 previous failure history. The samples are biased toward locations most susceptible to the  
3 specific aging effect of concern in the subsequent period of extended operation.  
4 Provisions on expanding the sample size when degradation is detected in the initial  
5 sample should also be included. For multiunit sites, samples are conducted at all units.  
6 Provisions for expanding the sample size when degradation is detected in the initial  
7 sample are included.

8 5. For a performance monitoring program, the “detection of aging effects” program element  
9 should discuss and establish the monitoring methods that will be used for performance  
10 monitoring. In addition, the “detection of aging effects” program element should also  
11 establish and justify the frequency that will be used to implement these performance  
12 monitoring activities.

13 6. For a prevention or mitigation program, the “detection of aging effects” program element  
14 should discuss and establish the monitoring methods that the program will use to  
15 monitor for the preventive or mitigative parameters that the program controls and should  
16 justify the frequency of performing these monitoring activities.

#### 17 A.1.2.3.5 *Monitoring and Trending*

18 1. Monitoring and trending activities should be described, and they should provide a  
19 prediction of the extent of degradation and thus effect timely corrective or mitigative  
20 actions. Plant-specific and/or industrywide OE may be considered in evaluating the  
21 appropriateness of the technique and frequency. Results of inspections in the prior  
22 period of extended operation are used to provide input to trending results.

23 2. This program element describes “how” the data collected are evaluated. This includes  
24 an evaluation of the results against the acceptance criteria. Although aging indicators  
25 may be quantitative or qualitative, aging indicators should be quantified, to the extent  
26 possible, to allow trending. The parameter or indicator trended should be described.  
27 The methodology for analyzing the inspection or test results against the acceptance  
28 criteria should be described. Trending is a comparison of the current monitoring results  
29 with previous monitoring results in order to make predictions for the future.

30 3. For periodic programs, where practical, identified degradation is projected until the next  
31 scheduled inspection. The results are evaluated against acceptance criteria to confirm  
32 that the timing of subsequent inspections maintain the components’ intended functions  
33 throughout the subsequent period of extended operation based on the projected rate of  
34 degradation. For sampling-based inspections, results are evaluated against acceptance  
35 criteria to confirm that the sampling bases (e.g., selection, size, frequency) will maintain  
36 the components’ intended functions throughout the subsequent period of extended  
37 operation based on the projected rate and extent of degradation.

#### 38 A.1.2.3.6 *Acceptance Criteria*

39 1. The quantitative or qualitative acceptance criteria of the program and its basis should be  
40 described. For observed degradation during current inspections, the acceptance criteria,  
41 against which the need for corrective actions are evaluated, should ensure that the SC-  
42 intended function(s) are maintained consistent with all CLB design conditions during the

- 1 subsequent period of extended operation. The program should include a methodology  
2 for analyzing the results against applicable acceptance criteria.
- 3 2. Where it is practical to project observed degradation to the end of the subsequent period  
4 of extended operation, the projected degradation is evaluated to determine if it could  
5 impact the intended function of a system, structure, or component. Additional  
6 considerations are appropriate for one-time inspections such as whether the projected  
7 degradation could result in a potential leak.
- 8 3. Acceptance criteria could be specific numerical values, or could consist of a discussion  
9 of the process for calculating specific numerical values of conditional acceptance criteria  
10 to ensure that the SC-intended function(s) will be maintained under all CLB design  
11 conditions. Information from available references may be cited.
- 12 4. It is not necessary to justify any acceptance criteria taken directly from the design basis  
13 information that is included in the Final Safety Analysis Report, plant Technical  
14 Specifications, or other codes and standards incorporated by reference into NRC  
15 regulations; they are a part of the CLB. Nor is it necessary to justify the acceptance  
16 criteria that have been established in either NRC-accepted or NRC-endorsed  
17 methodology, such as those that may be given in NRC-approved or NRC-endorsed  
18 topical reports or NRC-endorsed codes and standards; the acceptance criteria  
19 referenced in these types of documents have been subject to an NRC review process  
20 and have been approved or endorsed for their application to an NRC-approved or  
21 NRC-endorsed evaluation methodology. Also, it is not necessary to discuss CLB design  
22 loads if the acceptance criteria do not permit degradation because a SC without  
23 degradation should continue to function as originally designed. Acceptance criteria for  
24 observed degradation during current inspections, which do permit degradation, are  
25 based on maintaining the intended function under all CLB design loads.

26 *A.1.2.3.7 Corrective Actions*

- 27 1. Results that do not meet the acceptance criteria are addressed in the applicant's  
28 corrective action program under those specific portions of the quality assurance (QA)  
29 program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50,  
30 Appendix B. Appendix A.2 describes how an applicant may apply its 10 CFR Part 50,  
31 Appendix B, QA program to fulfill the corrective actions element of this AMP for both  
32 safety-related and nonsafety-related SCs within the scope of this program.
- 33 2. Actions to be taken when the acceptance criteria are not met should be described in  
34 appropriate detail or referenced to source documents. Corrective actions, including  
35 causal evaluations, root cause determination, and prevention of recurrence, should be  
36 timely. For monitored programmatic parameters that fail to meet defined acceptance  
37 criteria or standards, corrective action is taken prior to a loss of intended function of the  
38 affected structure or component.
- 39 3. If corrective actions permit analysis without repair or replacement, the analysis should  
40 ensure that the SC-intended function(s) are maintained consistent with the CLB.
- 41 4. For plant-specific programs that rely on NRC-endorsed technical or topical reports, the  
42 corrective actions are implemented in accordance with corrective actions recommended

1 in the applicable reports, or the applicant's 10 CFR Part 50, Appendix B, QA process,  
2 as applicable.

3 5. For sampling-based programs, additional inspections are conducted for each inspection  
4 that did not meet acceptance criteria. The program specifies the number of additional  
5 inspections. If subsequent inspections do not meet acceptance criteria, an extent of  
6 condition and extent of cause analysis is conducted to determine the further extent of  
7 inspections.

8 6. For one-time based programs, when an aging effect identified during an inspection does  
9 not meet acceptance criteria or projected results of the inspections of a material,  
10 environment, an aging effect combination does not meet acceptance criteria; a periodic  
11 inspection program is developed for the specific combination(s) of material, environment,  
12 and aging effect.

13 7. For periodic condition monitoring programs where any projected inspection results will  
14 not meet acceptance criteria prior to the next scheduled inspection, the bases for the  
15 inspection frequency are verified and adjusted as necessary.

16 *A.1.2.3.8 Confirmation Process*

17 1. The confirmation process should be described. The process ensures that appropriate  
18 corrective actions have been completed and are effective.

19 2. The confirmation process is addressed through those specific portions of the QA program  
20 that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B.  
21 Appendix A.2 describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA  
22 program to fulfill the confirmation process element of this AMP for both safety-related and  
23 nonsafety-related systems, structures, and components within the scope of this program.

24 3. When significant conditions adverse to quality are identified, there should be follow-up  
25 activities to confirm that the corrective actions have been completed, a root cause  
26 determination was performed, and recurrence will be prevented.

27 4. For plant-specific condition monitoring programs that rely on the augmented inspection  
28 and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative  
29 controls for these types of programs, including their implementing procedures and review  
30 and approval processes, are implemented in accordance existing site 10 CFR 50  
31 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative  
32 controls criteria may apply as identified in the TRs or in other industry reports or  
33 guidelines, such as those developed by (but not limited to) Nuclear Energy Institute (NEI),  
34 the Electric Power Research Institute (EPRI) Boiling Water Reactor Vessel and Internals  
35 Project (BWRVIP), EPRI Materials Reliability Program (MRP), BWR Owners Group, PWR  
36 Owners Group, or industry vendors, such as AREVA, Westinghouse, or General Electric  
37 (GE) or GE-Hitachi.

38 *A.1.2.3.9 Administrative Controls*

39 1. The administrative controls of the program should be described. Administrative controls  
40 provide a formal review and approval process.

- 1 2. Administrative controls are addressed through the QA program that is used to meet the  
2 requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of  
3 aging (e.g., document control, special processes, and test control). Appendix A.2  
4 describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to  
5 fulfill the administrative controls element of this AMP for both safety-related and  
6 nonsafety-related SCs within the scope of this program.
- 7 3. For plant-specific condition monitoring programs that rely on the augmented inspection  
8 and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative  
9 controls for these types of programs, including their implementing procedures and  
10 review and approval processes, are implemented in accordance existing site 10 CFR 50  
11 Appendix B, QA Programs, or their equivalent, as applicable. Additional administrative  
12 controls criteria may apply as identified in the TRs or in other industry reports or  
13 guidelines, such as those developed by (but not limited to) NEI, the EPRI BWRVIP,  
14 EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors, such as  
15 AREVA, Westinghouse, or GE or GE-Hitachi.

16 *A.1.2.3.10 Operating Experience*

- 17 1. Consideration of future plant-specific and industry OE relating to AMPs should be  
18 discussed (See Appendix A.4). Reviews of OE by the applicant in the future may  
19 identify areas where AMPs should be enhanced or new programs developed. An  
20 applicant should commit to a future review of plant-specific and industry OE to confirm  
21 the effectiveness of its AMPs or indicate a need to develop new AMPs. This information  
22 should provide objective evidence to support the conclusion that the effects of aging will  
23 be managed adequately so that the SC intended function(s) will be maintained during  
24 the subsequent period of extended operation.
- 25 2. Currently available OE with existing programs should be discussed. The discussion  
26 should note any changes to the programs during the first period of extended operation.  
27 The OE of existing programs, including past corrective actions resulting in program  
28 enhancements or additional programs, should be considered. A past failure would not  
29 necessarily invalidate an AMP because the feedback from OE should have resulted in  
30 appropriate program enhancements or new programs. This information can show where  
31 an existing program has succeeded and where it has not been fully effective in  
32 intercepting aging degradation in a timely manner. This information should provide  
33 objective evidence to support the conclusion that the effects of aging will be managed  
34 adequately so that the SC-intended function(s) will be maintained during the subsequent  
35 period of extended operation.
- 36 3. Currently available OE applicable to new programs should also be discussed. For new  
37 AMPs that have yet to be implemented at an applicant's facility, the programs have not  
38 yet generated any OE. However, there may be other relevant plant-specific or generic  
39 industry OE that is relevant to the program elements, even though the OE was not  
40 identified through implementation of the new program. Thus, when developing the  
41 elements for new programs, an applicant should consider the impact of relevant OE from  
42 implementation of its existing AMPs and from generic industry OE.
- 43 4. For plant-specific condition monitoring programs that rely on the augmented inspection  
44 and evaluation methodologies in NRC-endorsed Technical or TRs, the administrative  
45 controls for these types of programs, including their implementing procedures and

1 review and approval processes, are implemented in accordance with existing site  
2 10 CFR 50 Appendix B, QA Programs, or their equivalent, as applicable. Additional  
3 administrative controls criteria may apply as identified in the TRs or in other industry  
4 reports or guidelines, such as those developed by (but not limited to) NEI, the EPRI  
5 BWRVIP, EPRI MRP, BWR Owners Group, PWR Owners Group, or industry vendors,  
6 such as AREVA, Westinghouse, or GE or GE-Hitachi.

7 **A.1.3 References**

- 8 1. NEI. NEI 95-10, "Industry Guideline for Implementing the Requirements of  
9 10 CFR Part 54--The License Renewal Rule." Revision 6. Agencywide Documents  
10 Access and Management System (ADAMS) Accession No. ML05186040.  
11 Washington, DC: Nuclear Energy Institute. June 2005.
- 12 2. NRC. NUREG-1800, (Ch. 3.3 - End) "Standard Review Plan for Review of License  
13 Renewal Applications for Nuclear Power Plants." ADAMS Accession No. ML012070409.  
14 Washington, DC: U.S. Nuclear Regulatory Commission. July 2001.

<b>Table A.1-1. Elements of an Aging Management Program for Subsequent License Renewal</b>	
<b>Element</b>	<b>Description</b>
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	<p>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</p> <p>In addition, the ongoing review of both plant-specific and industry OE ensures that the AMP is effective in managing the aging effects for which it is credited. The AMP is either enhanced or new AMPs are developed, as appropriate, when it is determined through the evaluation of OE that the effects of aging may not be adequately managed.</p>

## **A.2 Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)**

### **A.2.1 Background**

The subsequent license renewal application is required to demonstrate that the effects of aging on 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 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 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 (BTP) 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 BTP (IQMB-1) is to describe an acceptable process for implementing the corrective actions, the confirmation process, and administrative controls of aging management programs for subsequent license renewal (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 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 BTP RLSB-1 (Appendix A.1 of this SRP-SLR).

### **A.2.3 References**

1. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.

2. NRC. NUREG-1800, (Ch. 3.3 – End) “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants.” ADAMS Accession No. ML012070409. Washington, DC: U.S. Nuclear Regulatory Commission. July 2001.

## **A.3 Generic Safety Issues Related to Aging (Branch Technical Position RLSB-2)**

### **A.3.1 Background**

Unresolved safety issues (USIs) and generic safety issues (GSIs) are identified and tracked in the U.S. Nuclear Regulatory Commission (NRC) formal resolution process set forth in NUREG-0933, "Resolution of Generic Safety Issues," which is updated periodically. Appendix B to NUREG-0933 contains a listing of those issues that are applicable to operating and future plant. NUREG-0933 is a source of information on generic concerns identified by the NRC. Some of these concerns may be related to the effects of aging or 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 TLAAs 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 and all TLAAs must be evaluated, regardless of whether they are associated with GSIs or USIs. The agency's Generic Issues Program process for resolving GSIs is described in Management Directive 6.4, "Generic Issues Program," dated January 2, 2015, and SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program."

### **A.3.3 References**

1. NRC. NUREG-0933, "Resolution of Generic Safety Issues." Supplement 34. ADAMS Accession No. ML11353A382. Washington, DC: U.S. Nuclear Regulatory Commission. December 2011.
2. NRC. SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program." ADAMS Accession No. ML003744861. Washington, DC: U.S. Nuclear Regulatory Commission. January 2007.
3. NRC. NUREG-1800, (Ch. 3.3 – End) "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants." ADAMS Accession No. ML012070409. Washington, DC: U.S. Nuclear Regulatory Commission. July 2001.

## **A.4            Operating Experience for Aging Management Programs**

### **A.4.1            Background**

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 (SCs)-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 (OE), such as those established in accordance with Item I.C.5, "Procedures for Feedback of Operating Experience to Plant Staff," of NUREG-0737, "Clarification of TMI Action Plan Requirements" (Ref. 3).

### **A.4.2            Position**

The systematic review of plant-specific and industry OE 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 OE that the effects of aging may not be adequately managed. AMPs should be informed by the review of OE on an ongoing basis, regardless of the AMP's implementation schedule.

#### **Acceptable Use of Existing Programs**

Programs and procedures relied upon to meet the requirements of 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 OE concerning age-related degradation and aging management during the term of a renewed operating license. As part of meeting the requirements of NUREG-0737, Item I.C.5, the applicant should actively participate in the Institute of Nuclear Power Operations' OE program (formerly the Significant Event Evaluation and Information Network (SEEIN) program endorsed in U.S. Nuclear Regulatory Commission (NRC) Generic Letter 82-04, "Use of INPO SEEIN Program") (Ref. 2). These programs and procedures may also be used for the translation of recommendations from the OE evaluations into plant actions (e.g., enhancement of AMPs and development of new AMPs). While these programs and procedures establish a majority of the functions necessary for the ongoing review of OE, they are also subject to further review as discussed below.

#### **Areas of Further Review**

To ensure that the programmatic activities for the ongoing review of OE are adequate for SLR, the following points should be addressed:

- The programs and procedures relied upon to meet the requirements of 10 CFR Part 50, Appendix B, and NUREG-0737, Item I.C.5, explicitly apply to and otherwise would not preclude the consideration of OE on age-related degradation and aging management. Such OE can constitute information on the SCs identified in the integrated plant assessment; their materials, environments, aging effects, and aging mechanisms; the AMPs credited for managing the effects of aging; and the activities, criteria, and evaluations integral to the elements of the AMPs. To satisfy this criterion, the applicant

should use the option described in A.2.2.2 of Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants Appendix A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)," to expand the scope of its 10 CFR Part 50, Appendix B, program to include nonsafety-related SCs.

- The license renewal interim staff guidance documents and revisions to the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report should be considered as sources of industry OE and evaluated accordingly. There should be a process to identify such documents and process them as OE.
- All incoming plant-specific and industry OE should be screened to determine whether it may involve age-related degradation or impacts to aging management activities.
- A means should be established within the corrective action program to identify, track, and trend OE that specifically involves age-related degradation. There should also be a process to identify adverse trends and to enter them into the corrective action program for-evaluation.
- 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, (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 OE evaluation. If it is found through evaluation that any effects of aging may not be adequately managed, then a corrective action should be entered into the 10 CFR Part 50, Appendix B, program to either enhance the AMPs or develop and implement new AMPs.
- Assessments should be conducted on the effectiveness of the AMPs and activities. These assessments should be conducted on a periodic basis that is not to exceed once every 5 years. They should be conducted regardless of whether the acceptance criteria of the particular AMPs have been met. The assessments should also include evaluation of the AMP or activity against the latest NRC and industry guidance documents and standards that are relevant to the particular program or activity. If there is an indication that the effects of aging are not being adequately managed, then a corrective action is entered into the 10 CFR Part 50, Appendix B, program to either enhance the AMPs or develop and implement new AMPs, as appropriate.
- Training on age-related degradation and aging management should be provided to those personnel responsible for implementing the AMPs and those personnel who may submit, screen, assign, evaluate, or otherwise process plant-specific and industry OE. The scope of training should be linked to the responsibilities for processing OE. This training should occur on a periodic basis and include provisions to accommodate the turnover of plant personnel.
- Guidelines should be established for reporting plant-specific OE on age-related degradation and aging management to the industry. This reporting should be accomplished through participation in the Institute of Nuclear Power Operations' OE 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, including the Final Safety Analysis Report supplement. Alternate approaches for the future consideration of OE are subject to NRC review on a case-by-case basis.

#### **A.4.3           References**

1. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2016.
2. Generic Letter 82-04, "Use of INPO SEE-IN Program." ADAMS Accession No. ML031210688. Washington, DC: U.S. Nuclear Regulatory Commission. March 9, 1982.
3. NUREG-0737, "Clarification of TMI Action Plan Requirements." Washington, DC: U.S. Nuclear Regulatory Commission. November 1980.
4. NUREG-1801, "Generic Aging Lessons Learned (GALL) Report." Revision 2. ADAMS Accession No. ML103490041. Washington, DC: U.S. Nuclear Regulatory Commission. December 2010.