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NUREG–2221

Technical Bases for Changes in the Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192

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ABSTRACT

This document is a knowledge management and knowledge transfer document associated with NUREG–2191, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” and NUREG–2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants” (SRP-SLR).

This publication documents the technical changes that were made from the guidance contained in Revision 2 of NUREG–1801, “Generic Aging Lessons Learned (GALL) Report,” for utilities applying for first license renewal to provide guidance to utilities wishing to apply for subsequent license renewal (i.e., for operation from 60 to 80 years) along with the technical basis for these changes. Changes for the review of subsequent license renewal applications (SLRAs) from Revision 2 of NUREG–1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” are also discussed in this document. Consequently, this document provides the underlying rationale that the U.S. Nuclear Regulatory Commission (NRC) staff used to develop the subsequent license renewal guidance documents.

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EXECUTIVE SUMMARY

On July 14, 2017 (82 FR 32588), the U.S. Nuclear Regulatory Commission (NRC) announced the issuance and availability of the following final subsequent license renewal guidance documents:

- "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" (NUREG–2191), and

- "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants" (SRP-SLR) (NUREG–2192)

These subsequent license renewal (SLR) guidance documents describe methods acceptable to the staff for implementing the license renewal rule, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," as well as techniques used by the staff in evaluating applications for nuclear power plant (NPP) license renewals for operations from 60 to 80 years. The revisions incorporated changes described in Interim Staff Guidance issued since Revision 2 of NUREG–1801, "Generic Aging Lessons Learned (GALL) Report," and NUREG–1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," published in 2010, findings from NRC staff aging management program effectiveness audits, and comments from NRC staff and interested stakeholders.

This report, NUREG–2221, provides a summary of changes and a synopsis of the bases for these changes made as part of the development of the SRP-SLR and the GALL-SLR Report. These changes include those that were initiated by NRC staff as well as the changes made in response to public comments, as appropriate. This document provides the underlying rationale that the NRC used in developing the SLR guidance.

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ABBREVIATIONS

AAC	all aluminum conductor
ACI	American Concrete Institute
ADAMS	Agencywide Documents Access and Management System
AERM	aging effect requiring management
A/LAI	applicant / licensee action item
AMPs	aging management programs
AMR	aging management review
ANSI	American National Standards Institute
ASM	American Society for Metals
ASME	American Society of Mechanical Engineers
ASME Code	American Society of Mechanical Engineers Boiler and Pressure Vessel Code
ASTM	ASTM International
AUX	auxiliary
B&PV	boiler and pressure vessel
B&W	Babcock & Wilcox
BAC	boric acid concentrator
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CFR	*Code of Federal Regulations*
CLB	current licensing basis
CRD	control rod drive
CUF	cumulative usage factor
DLR	Division of License Renewal
EFPY	effective full-power year
EPRI	Electric Power Research Institute
EQ	environmental qualification
ESF	emergency safety feature
FAC	flow-accelerated corrosion
FE	further evaluation
FR	*Federal Register*
FRN	*Federal Register Notice*
FSAR	Final Safety Analysis Report
FWST	fire water storage tanks

GALL	Generic Aging Lessons Learned
GALL-SLR	Generic Aging Lessons Learned for Subsequent License Renewal
GL	generic letter
GSI	generic safety issue
HDPE	high density polyethylene
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
I&E	inspection and evaluation
IASCC	irradiation-assisted stress corrosion cracking
IGSCC	intergranular stress corrosion cracking
ILRT	integrated leak rate test
IN	Information Notice
ISGs	Interim staff guidance
ISI	inservice inspection
ISP	integrated surveillance program
ksi	kilo pounds per square inch
LERs	licensee event reports
LCOs	limiting conditions for operation
LR-ISG	license renewal interim staff guidance
LRAs	license renewal applications
LTOP	low temperature overpressure protection
M&TE	measuring and test equipment
MEB	metal enclosed bus
MIC	microbiologically influenced corrosion
MPa	megapascal
mpy	mils per year
NACE	National Association of Corrosion Engineers
NDE	Non-destructive examination
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NPS	nominal pipe size
NRC	U.S. Nuclear Regulatory Commission
NSSS	nuclear steam supply system

OCCW	open-cycle cooling water
OE	operating experience
P-T	pressure-temperature
PDI	performance demonstration initiative
PLL	Predicted lower limit
PoF	probability of failure
PTLRs	pressure-temperature limit reports
PTS	pressurized thermal shock
PVC	polyvinyl chloride
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
RAIs	request for additional information
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RG	Regulatory Guide
RIS	Regulatory Issue Summary
RPV	reactor pressure vessel
RVI	reactor vessel internal
RWCU	reactor water cleanup
RWT	refueling water tank
SCs	structures and components
SCC	stress corrosion cracking
SG	steam generator
SLR	subsequent license renewal
SLRAs	subsequent license renewal applications
SPC	steam and power conversion
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
TLAA	time-limited aging analysis
TRs	technical or topical reports
TS	technical specifications
TSTF	technical specification task force
UFSAR	updated final safety analysis report

UHS	ultimate heat sink
US	United States
USACE	U.S. Army Corps of Engineers
USAR	updated safety analysis report
USAS	United States of American Standards
USE	upper-shelf energy
UT	ultrasonic testing
UV	ultraviolet

1 INTRODUCTION

NUREG–2221, “Technical Bases for Changes in the Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192,” establishes the changes that constitute NUREG–2191, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” and NUREG–2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants” (SRP-SLR). These two subsequent license renewal guidance documents were published on July 12, 2017. NUREG–2221 is a knowledge management transfer document.

NUREG–2221 provides a summary of notable technical changes and the technical bases for the changes made by the U.S. Nuclear Regulatory Commission (NRC) staff to Revision 2 of NUREG–1801, “Generic Aging Lessons Learned (GALL) Report,” and Revision 2 of NUREG–1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (SRP-LR). NUREG–1950 “Disposition of Public Comments and Technical Bases for Changes in the License Renewal Guidance Documents NUREG–1801 and NUREG–1800,” is the knowledge management document for Revision 2 of GALL and SRP-LR.

Many public comments resulted in changes to the GALL-SLR Report and the SRP-SLR. NUREG–2222, “Disposition of Public Comments on the Draft Subsequent License Renewal Guidance Documents NUREG–2191 and NUREG–2192,” discusses the resolution of the public comments submitted to the NRC staff.

1.1 Purpose and Organization of the Document

This document is organized into three sections followed by the references. Section 1 contains background and overview information. Section 2 summarizes the changes to the GALL-SLR Report and the technical bases of these changes. Section 3 presents similar information for the SRP-SLR.

Tables are used to summarize technical materials whenever possible. Generic changes are discussed in the text at the beginning of each subsection of Sections 2 and 3, followed by tables showing changes to the documents.

Table 1-1 helps the reader navigate between the tables that summarize the notable technical changes and their technical bases.

Table 1-1 Crosswalk Between NUREG–2191/NUREG–2192 and the Change Summaries and Technical Bases Tables in NUREG–2221	
Source Document and Chapter	**Tables With Change Summaries and Technical Bases**
New aging management reviews (AMRs) – Structural Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Chapters II and III	Table 2-1 and Table 2-2
New AMRs – Mechanical GALL-SLR Chapters IV, V, VII, and VIII	Table 2-3, Table 2-4, Table 2-6, Table 2-7
New AMRs – Electrical GALL-SLR Chapter VI	Table 2-5
Deleted AMRs – Structural GALL-SLR Chapters II and III	Table 2-8 and Table 2-9
Deleted AMRs – Mechanical GALL-SLR Chapters IV, V, VII, and VIII	Table 2-10, Table 2-11, Table 2-13, Table 2-14
Deleted AMRs – Electrical GALL-SLR Chapter VI	Table 2-12
Revised AMRs – Mechanical GALL-SLR Chapters IV, V, VII, and VIII	Table 2-17, Table 2-18, Table 2-20, Table 2-21
Revised AMRs – Structural GALL-SLR Chapters II and III	Table 2-15 and Table 2-16
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SRP-SLR Chapter 5	Table 3-16
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2 SUBSEQUENT LICENSE RENEWAL REVISION CHANGES TO GENERIC AGING LESSONS LEARNED REPORT, REVISION 2 AND THEIR TECHNICAL BASES

The changes to the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report were made to clarify or improve the guidance provided in Generic Aging Lessons Learned (GALL) Report Revision 2. The U.S. Nuclear Regulatory Commission (NRC) staff believes that these changes make the GALL-SLR Report more useful to the applicant and to NRC staff reviewing the safety aspects of applications for subsequent license renewal (SLR). Additional changes have been made as a result of public comments received during the public comment period. The final version of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) NUREG–2192, incorporates these types of technical changes.

2.1 Overview of Changes to GALL Chapter I – Application of the ASME Code

The staff added a table to clarify which American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI Editions and Addenda are acceptable for use in aging management programs (AMPs). Also, a table was added to provide applicants and NRC technical reviewers a quick way to identify the ASME Code Section XI Editions and Addenda that were found acceptable by the NRC for use in AMPs.

In some cases, for specific AMPs, the NRC has recommended a later ASME edition or addenda than the one cited in GALL-SLR Report Table I-1. In those cases, in order for an applicant's program to be consistent with such an AMP, the later edition and addenda should be cited.

2.2 Overview of Changes to GALL-SLR Report, Chapters II, III, IV, V, VI, VII, and VIII

The aging management review (AMR) items in Chapters II, III, IV, V, VI, VII, and VIII of the GALL-SLR Report are divided into five categories:

1. AMR items where the material/environmental/aging effect/program combination has not changed from an equivalent item in Revision 2 of the GALL Report and there is no change in the recommendation regarding further evaluation. These unchanged items are blank in the column that identifies new (N), modified (M), edited (E), or deleted (D) items in the tables in the GALL-SLR Report.

2. AMR items that are new in the GALL-SLR Report. For these items, there is not a clear relationship with a similar item in the same chapter of Revision 2 of the GALL Report. These items are identified as new (N) in the column that identifies new (N), modified (M), edited (E), or deleted (D) items in the tables of the GALL-SLR Report.

3. AMR items where there is some change from Revision 2 of the GALL Report with regard to the material, environment, aging effect, and AMP combination or the recommendation regarding further evaluation. However, there is a clear relationship between the AMR item in the GALL-SLR Report and a related AMR item in Revision 2 of the GALL Report. These items are identified as modified (M) in the column that identifies new (N), modified (M), edited (E), or deleted (D) items in the tables of the GALL-SLR Report.

4. The changes to some AMR items were minor and editorial in nature. These items are identified as editorial (E) in the column that identifies new (N), modified (M), edited (E), or deleted (D) items in the tables of the GALL-SLR Report.

5. AMR items that were in Revision 2 but have been deleted in the GALL-SLR report are identified as deleted (D) in the column that identifies new (N), modified (M), edited (E), or deleted (D) items in the tables of the GALL-SLR Report.

Tables 2-1 through 2-21 present the changes to the AMR items that have been made for the GALL-SLR Report. The following describes the information presented in each column of these tables.

Column Heading	Description
AMR Item No.	Identifies the item number in GALL-SLR Report Chapters II through VIII presenting the detailed information summarized by this row. *Using II.B1.2.CP-114 as an example*: The first Roman numeral presents the GALL-SLR Chapter (II) which is followed by the subchapter (B1.2). The following letter identifies the discipline(s) that the precedent (P) is associated with (i.e., "A" for Auxiliary Systems, "E" for Engineered Safety Features Systems, "L" for Electrical Systems, "R" for Reactor Coolant Systems, "T" for "Structures and Component Supports, "S" for Steam and Power Conversion Systems, and "C" for Containment Structures). The second letter "P" identifies that there is a precedent for the material-environment-aging effect-program combination. This nomenclature convention is found throughout NUREG–2191 and NUREG–2192.
Technical Bases for Changes	Provides background on the staff's technical position for making the change.

2.3 Chapter IX—Use of Terms General Changes

Changes are made to Chapter IX to include new structures and components, materials, environments, and aging effects/mechanisms, and to help standardize expressions. Changes are also made to clarify some of the use of terms that were included in GALL Report, Revision 2. Specific changes to the use of terms for subchapters IX.B through IX.G are summarized in Tables 2-22 through 2-27. The following describes the information presented in each column of these tables.

Column Heading	Description
Defined Term	Identifies the term.
Summary of Significant Changes	Provides a summary of the change.
Technical Bases for Changes	Provides background on the staff's technical position for making the change.

2.4 Chapter X—Aging Management Programs That May Be Used to Demonstrate Acceptability of Time-Limited Aging Analyses in Accordance with 10 CFR 54.21(c)(1)(iii)

The title of Chapter X was revised as this chapter provides a list of AMPs (and the program element criteria for the AMPs) that are commonly used to demonstrate the acceptance of generic or plant-specific time-limited aging analyses (TLAAs) in accordance with Title 10 of the *Code of Federal Regulations (*10 CFR) 54.21(c)(1). Revisions to the TLAAs for mechanical, structural, and electrical analyses are discussed in Table 2-28. The following describes the information presented in each column of the table.

Column Heading	Description
Location of Change	Identifies the AMP element that changed.
Summary of Significant Changes	Provides a summary of the change.
Technical Bases for Changes	Provides background on the staff's technical position for making the change.

2.5 Chapter XI – Aging Management Programs

Tables 2-29 through 2-31 present the changes to the AMPs that have been made for the GALL-SLR Report. The following describes the information presented in each column of these tables.

Column Heading	Description
Location of Change	Identifies the AMP element that changed.
Summary of Significant Changes	Provides a summary of the change.
Technical Basis for Change	Provides background on the staff's technical position for making the change.

The generic changes to the AMPs include:

- In the Operating Experience program element, the staff included the use of research and development as part of the systematic and ongoing operating experience reviews. The change was needed to capture potentially new age-related degradation issues derived from research studies as plants operate beyond 60 years. The staff recognized that in some instances information of this nature may precede plant-specific and industry operating experience. The staff provided examples in GALL-SLR Report, Appendix B, and SRP-SLR, Appendix A.4, of what it considers "relevant research and development sources" to establish the staff's intent.

- The text was standardized for the Corrective Actions, Confirmation Process, and Administrative Controls program elements across all of the AMPs to cite the use of 10 CFR Part 50, Appendix B, "Quality Assurance Program" and guidance in GALL-SLR Report, Appendix A. The standardized recommendations use the same approach as GALL Report Revision 2 with no change in intent.

- The Final Safety Analysis Report Supplement Summary descriptions were revised to cover key aspects of the AMPs, which the staff concluded should be included in the current licensing basis during the subsequent period of extended operation.

- Several sampling based AMPs (e.g., AMP XI.M32, AMP XI.M38) recommend a representative sample size of 20 percent of each material, environment, and aging effect combination with a maximum of 25 inspections. This representative sample size was incorporated in GALL Report Revision 2. During the development of the GALL-SLR Report, the staff recognized that the basis for the use of sample size did not include a complete discussion of the staff's position. The staff's position is as follows.

In the Commission's Memorandum and Order of Entergy Nuclear Generation Company and Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station) CLI-10-14, 71 NRC 449, 465, 467 (2010), the Commission stated, "[i]n another license renewal case, we recently stated that 'reasonable assurance' is not quantified as equivalent to a 95% (or any other percent) confidence level, but is based on sound technical judgment of the particulars of a case and on compliance with our regulations," and "[n]or does any statute, regulation, or case law require the Commission to assign and apply a precise 'level or degree' of confidence to the 'reasonable assurance' standard." [Agencywide Documents Assess and Management System (ADAMS) Accession No. ML101680369].

Based on the Commissioner's position, the staff can judge the sample size for each proposed AMP on its individual merits using sound technical judgment. The staff used the methodology for determining a sample size in Electric Power Research Institute (EPRI) TR 107514, April 1998, "Age Related Degradation Inspection Method and Demonstration: In Behalf of Calvert Cliffs Nuclear Power Plant License Renewal Application," Chapter 4, "Sampling Program Description," as a basis for the maximum sample size of 25 components. This sample size provides a 90 percent confidence that 90 percent of the population does not contain an attribute. Although a quantitative confidence level is not required, the staff concluded that this level of confidence is appropriate to provide reasonable assurance versus using a higher confidence level. The staff accepted this method of establishing a representative population sample size based on the following:

- The AMPs recommend the inspection of the bounding or lead components most susceptible to aging due to time in service, and severity of operating conditions. A standard 90 percent confidence sample size is established based on the principle of inspecting random objects. By biasing the sample to those components most likely to experience degradation, there is a higher potential to detect an aging effect.

- The staff concluded that for most of the components that will be inspected (e.g., piping, piping components, tanks), industry consensus standard documents were used for construction. As such, the performance of each material, environment, and aging effect should have a reasonably common potential for degradation. Therefore, inspecting 25 components should be sufficient to reveal an aging effect.

- The 20 percent sample size was established to address smaller population sizes where a sample of 25 components could result in a larger portion of the population being inspected than is necessary to establish reasonable assurance.

2.5.1 Mechanical AMPs (XI.M Series of AMPs)

A summary of specific changes to the mechanical AMPs and their technical bases is provided in Table 2-29.

2.5.2 Structural AMPs (XI.S Series of AMPs)

A summary of specific changes to the structural AMPs and their technical bases is provided in Table 2-30.

2.5.3 Electrical AMPs (XI.E Series of AMPs)

A summary of specific changes to the electrical AMPs and their technical bases is provided in Table 2-31.

Table 2-1 New AMR Items Added in GALL-SLR Report, Chapter II, Containment Structures	
New AMR Item No.	**Technical Bases for Changes**
No new AMR items were added to Chapter II of the GALL-SLR Report.	

Table 2-2 New AMR Items Added in GALL-SLR Report, Chapter III, Structures and Component Supports	
New AMR Item No.	**Technical Bases for Changes**
III.A6.TP-25	The staff has concluded that accessible concrete is subject to cracking due to expansion from the reaction with aggregates in any environment. This aging effect is managed by the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, AMP XI.S6, and “Structures Monitoring.”
III.A1.TP-34 III.A2.TP-34 III.A3.TP-34 III.A6.TP-34	These were missing from Generic Aging Lessons Learned (GALL) Report Revision 2. The aging management review (AMR) item existed only in III.A5 and was copied to sections for Group 1, Group 2, Group 3, Group 6 structures.
III.A4.T-35	This new item addresses irradiation effects on concrete, which occur at fluence levels that may be reached during the subsequent period of extended operation. To account for the possible effects applicants should complete a plant-specific further evaluation.
III.A6.T-34	This item was added to the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) because it was missing from GALL Report Revision 2. It should have always been in the guidance.
III.B1.1.T-36a III.B1.2.T-36a III.B1.3.T-36a III.B1.1.T-36b III.B1.2.T-36b III.B1.3.T-36b III.B1.1.T-36c III.B1.2.T-36c III.B1.3.T-36c III.B2.T-37a III.B3.T-37a III.B4.T-37a III.B5.T-37a III.B2.T-37b III.B3.T-37b III.B4.T-37b III.B5.T-37b III.B2.T-37c III.B3.T-37c III.B4.T-37c III.B5.T-37c	SRP-SLR Section 3.5.2.2.2.4, “Cracking Due to Stress Corrosion Cracking, and Loss of Material Due to Pitting and Crevice Corrosion,” was revised and new line items, T-36 a - c and T-37 a - c were added to address aluminum and stainless steel support members; welds; bolted connections; and support anchorage to building structure exposed to air or condensation. The basis for the potential for aluminum and stainless-steel components to experience loss of material and cracking is established in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance Document Supplement issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090. An overview of this basis is as follows. The staff has concluded that air and condensation environments can be aggressive if halides are present. Halides can be present due to leakage from flanged connections or valve packing through insulation and raw water leakage from flanged connections or valve packing. The staff accepts that pressure boundary leakage would be considered as event driven and not as a potential source to transport halides to the surface of the aluminum component. However, SRP-SLR, Section A.1.2.1 states that, “leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion.” The outdoor air environment can contain halides due to nearby salted roads, ocean mist, cooling tower fallout if treatment chemicals contain halides, and nearby industrial facilities. Loss of material due to pitting or crevice corrosion, and cracking due to stress corrosion cracking (SCC) of stainless steel components were addressed in GALL Report Revision 2 for Chapters V, VII, and VIII. During the development of the GALL-SLR Report, the staff recognized that stainless

Table 2-2 New AMR Items Added in GALL-SLR Report, Chapter III, Structures and Component Supports	
New AMR Item No.	**Technical Bases for Changes**
	steel support members should be addressed in addition to piping system components. As a result, SRP-SLR, Section 3.5.2.2.2.4 was revised and new AMR items were added. Loss of material of aluminum components was addressed in GALL Report Revision 2 for Chapters V, VII, and VIII by periodic inspection programs. During the development of the GALL-SLR Report and SRP-SLR, the staff concluded that cracking of aluminum components should be addressed through a further evaluation section. During the development of the GALL-SLR Report and SRP-SLR, the staff concluded that it may not be necessary to conduct periodic inspections of aluminum components in order to manage aging effects associated with aluminum components. The staff noted that one-time inspections, as described by aging management program (AMP) XI.M32, "One-Time Inspection," for the subsequent license renewal period would occur after no less than 50 years of operation. The staff concluded that a one-time inspection of aluminum components prior to entry in the subsequent period of extended operation coupled with a search of plant-specific operating experience (OE) related to loss of material of aluminum components would provide sufficient input to determine whether periodic inspections should be conducted. As a result, SRP-SLR, Section 3.5.2.2.2.4 was revised to address loss of material and cracking, and new AMR items were added. If the OE search or one-time inspection results in conducting a periodic inspection of piping, piping components, and tanks, GALL-SLR Report, AMP XI.M36 recommends either surface examinations, American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI VT-1 inspections, or visual inspections where it has been analytically demonstrated that surface cracks can be detected by leakage prior to a crack challenging the structural integrity or intended function of the component. The staff did not include this specificity for aluminum and stainless steel support members; welds; bolted connections; and support anchorage to building structure in AMP XI.S3 and AMP XI.S6 because piping, piping components and tanks are less flaw tolerant than supports in that minor through-wall loss of material or cracking will result in leakage. The leakage, in and of itself may not result in a loss of intended function; however, it could impact components in the vicinity of the flaw. In contrast, for a support, minor loss of material or cracking that might not be detectable during a walkdown inspection will likely not impact the intended function of the support. Loss of material and cracking of aluminum and stainless steel will only occur in the presence of contaminants. These contaminants would likely result in water staining, which would be observable as a precursor to loss of material or cracking. ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Table IWF-2500-1, "Examination Categories," for Class 1, Class 2, Class 3, and Supports, other than piping supports requires that an owner conduct VT-3 inspections. The purpose of a VT-3, as stated in IWA-2213 is:

Table 2-2 New AMR Items Added in GALL-SLR Report, Chapter III, Structures and Component Supports	
New AMR Item No.	**Technical Bases for Changes**
	VT-3 examination is conducted to determine the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements; and to detect discontinuities and imperfections, such as loss of integrity at bolted or welded connections, lose or missing parts, debris, corrosion, wear, or erosion. VT-3 includes examination for conditions that could affect operability or functional adequacy of constant load and spring-type supports. In contrast, the purpose of VT-1 examinations, which are used to inspect pressure retaining components (e.g., nuts; bolts; flange surfaces; internal core support structures; welded attachments to Class 3 vessels, piping, pumps, and valves) is: "VT-1 examination is conducted to detect discontinuities and imperfections on the surface of components, including such conditions as cracks, wear, corrosion, or erosion." This demonstrates the utilization of a more rigorous inspection methodology between piping and supports.

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
IV.A1.R-409	The staff added a new aging management review (AMR) item No. 113 for Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Table 3.1-1 and a new AMR item in Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Table IV.A1 (item IV.A1.R-409) that may be used as an AMR basis for managing loss of material due to general, pitting, and crevice corrosion in steel boiling water reactor (BWR) reactor vessel external attachments and supports. The staff determined that several of the previous application had included analogous AMR items (Pilgrim, Vermont Yankee, Grand Gulf, and Fermi). Therefore, the inclusion of the new AMR items is based on generic applicability from past applications. Inspections performed in accordance with aging management program (AMP) XI.M1, “ASME Section XI Inservice Inspections, Subsections IWB, IWC, and IWD,” are appropriate for these items. In addition, use of AMP XI.M2, “Water Chemistry,” is appropriate for prevention or mitigation of those listed aging effects that are induced by corrosion-related or chemistry-related mechanisms. Therefore, implementation of these AMPs may be used as the basis for managing any loss of material that may be occurring in the components as a result of general, pitting, or crevice corrosion mechanisms, without the need for performing further evaluation of the program element criteria that will be used to manage the aging effect.
IV.A1.R-412	Consistent with the staff modifications of AMR items No. 97 and No. 128 in SRP-SLR Table 3.1-1, the staff established a new AMR item (IV.A1.R-412) in GALL-SLR Table IV.A1 for managing cracking induced by stress corrosion cracking (SCC) or intergranular stress corrosion cracking (IGSCC) mechanisms in control rod drive (CRD) return line nozzle or nozzle safe ends that have been capped, including nozzle-to-cap welds or nozzle safe end-to-cap welds. The new line item cites that GALL-SLR Report, AMP XI.M7, “BWR Stress Corrosion Cracking,” and AMP XI.M2, “Water Chemistry,” are acceptable AMPs that may be used to manage cracking due to SCC or IGSCC in the components. Both the staff and the industry agree that augmented inspection of these types of nozzles is well established under existing industry program criteria that address the staff’s recommendations in NUREG–0313. Since these criteria are included in the staff’s update of GALL-SLR Report, AMP XI.M7, further evaluation of the inspection base for CRD return line nozzles is no longer necessary. Thus, the aging management programs and activities in AMR item IV.A1.R-412 are not subject to any further evaluation criteria in the SRP-SLR report. For a more detailed discuss related to these changes, refer to the technical basis discussion for changes made to AMR item IV.A1.R-68 in Table 2-17 of this report.
IV.A1.R-448 IV.C1.R-448	The staff developed these AMR as new AMR items that may be used to manage long term loss of material due to general corrosion in steel BWR RCS components that are exposed to treated water (including steel components exposed to the reactor coolant). Specifically, BWR designs may include steel RCS vessel or piping components whose surfaces are in direct contact with reactor coolant or other types of treated water sources. Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water), the staff has concluded that a one-time inspection for loss of material is

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	appropriate. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program AMP element to not conduct a one-time inspection if a representative sample of wall thickness measurements has been conducted every 5 years up to at least 10 years prior to the subsequent period of extended operation.
IV.A1.R-450 IV.A2.R-450 IV.C1.R-450 IV.C2.R-450 IV.D1.R-450 IV.D2.R-450	The staff developed these new AMR items and AMR item #134 in Table 3.1-1 of NUREG–2192) for as AMR items that may be used to manage reduced thermal insulation resistance due to moisture intrusion in reactor coolant pressure boundary components that are insulated with jacketed thermal insulation materials. The insulation materials serve an intended function of minimizing heat losses that may occur in the system or precluding overheating of nearby in-scope systems, structures, and components (SSCs) that may be in the vicinity of the system. Collectively, these items include jacketed insulation materials that may be used to insulate reactor pressure vessels, reactor coolant pressure boundary piping and piping components, and for PWRs, pressurizers and steam generators. The new items are based on changes that were incorporated into GALL-SLR Report, AMP XI.M36, "External Surfaces Monitoring," where visual examinations applied to insulated components are used to ensure that the jacketed thermal insulation materials are maintaining their thermal insulation intended functions (i.e., providing protection against thermal losses in the components). Specifically, non-metallic thermal insulation exposed to an air or condensation environment was added to the GALL-SLR Report to address reduced thermal insulation resistance due to moisture intrusion for thermal insulation with an intended function to control heat loss in order to preclude overheating of nearby in-scope SSCs or retain heat in the system. When first included in GALL Report Revision 2 by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," AMR items were generated for calcium silicate, fiberglass, and foamglass® insulation. AMP XI.M36 was revised to include periodic external visual inspections of the jacketing to ensure that there is no damage to the jacketing that would permit in-leakage of moisture. External visual inspections of jacketing are sufficient to detect potential moisture intrusion as long as the jacketing has been installed in accordance with plant-specific procedures that include configuration features such as minimum overlap, location of seams, etc. If plant-specific procedures do not include these features, an alternative inspection methodology is proposed by the applicant. Based on further review the staff concluded that reduced thermal insulation resistance could be as effectively managed by AMP XI.M36 for all insulation types as long as they were jacketed and the jacket installation met the recommendations in AMP XI.M36.

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
IV.A1.R-61b	The staff developed this AMR item to manage cracking due to SCC or IGSCC in the BWR stainless steel or nickel alloy reactor vessel top head flange enclosure assembly leakage detection lines exposed to indoor uncontrolled air or reactor coolant leakage. Refer to the technical basis discussion for AMR items IV.A1.R-61a and IV.A1.R-61b in Table 2-17 of this report, which addresses the development of this new AMR item.
IV.A2.R-413 IV.A2.R-414	The staff developed new AMR item IV.A2.R-413 to manage loss of material due to wear in PWR CRD penetration nozzles. The corresponding new item in the SRP-SLR is AMR item No. 116 in Table 3.1-1. The new AMR items are as based on operating experience (OE) summaries in submitted licensee event reports (LERs) and the staff's processing of previous license renewal application (LRA) reviews. The further evaluation (FE) acceptance criteria in SRP-SLR, Section 3.1.2.2.10.1 and the review procedures in SRP-SLR, Section 3.1.3.2.10.1 apply to the evaluation of these penetration nozzles. Similarly, the staff developed the new AMR item IV.A2.R-414 that may be used to manage loss of material due to wear in PWR control rod drive penetration nozzle thermal sleeves. The corresponding new item in the SRP-SLR is AMR item No. 117 in Table 3.1-1. The new AMR items are based on OE summarized in LERs and the staff's processing of previous LRA reviews. The FE acceptance criteria in SRP-SLR, Section 3.1.2.2.10.2 and the review procedures in SRP-SLR, Section 3.1.3.2.10.2 apply to the evaluation of these penetration nozzle thermal sleeves.
IV.A2.R-74b	The staff developed this AMR item to manage cracking due to SCC in the PWR stainless steel or nickel alloy reactor vessel top head flange enclosure assembly leakage detection line exposed to indoor uncontrolled air or reactor coolant leakage. Refer also to the technical basis line item discussion for AMR items IV.A2.R-74a and IV.A2.R-74b in Table 2-17 of this report, which addresses the development of this new AMR item.
IV.B1.R-422	The staff developed this AMR item to manage cracking due to irradiation-assisted stress corrosion cracking (IASCC) in BWR stainless steel or nickel alloy reactor vessel internals (RVIs) exposed to reactor coolant and neutron flux. Refer also to the technical basis discussion for AMR item IV.B1.R-100 in Table 2-17 of this NUREG report.
IV.B1.R-416 IV.B1.R-417 IV.B1.R-419	The staff developed these AMR items to manage loss of fracture toughness due to thermal aging or neutron irradiation embrittlement in BWR cast austenitic stainless steel (CASS) RVI components exposed to reactor coolant >250 °C (>482 °F) and neutron flux. AMR item IV.B1.R-416 addresses the control rod guide tube base; IV.B1.R-417 addresses the core spray spargers and sparger nozzles; IV.B1.R-419 addresses the low-pressure coolant injection (LPCI) coupling. The new AMR items, and the corresponding item in AMR item No. 99 in SRP-SLR Table 3.1-1, reference GALL-SLR AMP XI.M9, "BWR Vessel Internals" may be used to manage loss of fracture toughness due to thermal aging or neutron irradiation embrittlement in these CASS components, as subject to the further evaluation guidelines in Section 3.1.2.2.13 of the NUREG–2192 report. For more information, refer to the discussion on the technical basis for AMR items IV.B1.RP-182, IV.B1.RP-200, IV.B1.RP-219,

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	and IV.B1.RP-220 in Table 2-17 of this report, which addresses the development of these new AMR items.
IV.B1.R-420	The staff developed new AMR item IV.B1.R-420 in Table IV.B1 of NUREG–2191 and new AMR item No. 120 in Table 3.1-1 of NUREG–2192 that may be used to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR core plate rim holddown bolts. For past-approved LRAs, the licensees are managing this aging effect using one or more of the three following approaches to aging management: (a) replacement of the bolts with the wedges as the load bearing components in the core plate, (b) implementation of their AMPs that correspond to GALL-SLR AMP XI.M9, “BWR Vessel internals,” or (c) through use of a plant-specific time-limited aging analysis (TLAA) that assesses the potential for loss of preload to occur in the components through the end of the period of extended operation. The staff has created new further evaluation acceptance criteria guidelines for BWR core plates and core plate rim hold-down bolts in SRP-SLR, Section 3.1.2.2.14, to explain how these approaches may be used to ensure the integrity of a BWR plant’s core plate assemblies during a subsequent period of extended operation. Not every utility licensed to operate a United States (U.S.) BWR was relicensed (for initial renewal) with the requirement to evaluate a TLAA for managing loss of preload in its core plate rim hold-down bolts. In addition, the core plate assemblies for some BWRs were already designed with wedges that serve as the load bearing components for protecting the core plates against lateral movement during normal operating, upset, emergency, and faulted loading conditions. The guidance in the draft version of SRP-SLR, Section 3.1.2.2.14 already explains that loss of preload is not an aging concern for BWR core plate assemblies that rely on wedges as the load bearing components. For BWR core plate assemblies with core plate rim hold-down bolts, the past BWR license renewal applicants proposed aging management of the bolt preload losses either using a TLAA or through implementation of BWRVIP-defined inspections. These inspections would be performed in accordance with the applicant’s AMP that corresponds to AMP XI.M9, “BWR Vessel Internals,” which includes the guidance in Electric Power Research Institute (EPRI) BWRVIP-25 report. However, for some past BWR LRAs, the applicants had identified that the BWRVIP-defined inspections in BWRVIP-25 for the core plate rim hold-down bolts were infeasible for implementation due to obstructions inherent in the RVI design or accessibility issues with the state-of-the-art inspection devices that were relied upon at the time of the LRAs. Such statements in the LRAs left the applicants with aging management issues (i.e., Open items) in the applications because the applicants: (a) did not have an applicable TLAA associated with core plate rim hold-down bolt preload loss, and (b) were unable to demonstrate adequate aging management of bolt preload loss using BWRVIP inspection techniques demonstrated by the EPRI as being capable of detecting loosening

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	or preload losses in the bolts. For these cases, the applicants may have addressed the open item regarding the loss of preload issues by committing either to a modification of core plate assembly designs for inclusion of wedges or to the submittal of a supplemental augmented inspection program for the bolts, with the stipulation that the inspection frequency for the examinations would be based on establishment of a new time-dependent preload analysis. SLRA cases involving a need for additional commitments will only apply if the SLRA applicant is unable to demonstrate adequate aging management of the preload loss using either EPRI BWRVIP-defined inspection techniques that are capable of detecting loosening or preload loss in the bolts or through implementation of an existing TLAA that assesses preload loss on the structural integrity function of the rim hold-down bolts. EPRI has already taken steps to address these options in its first revision of the BWRVIP-25 report, which has been submitted to the staff and is pending staff and approval. As the license renewal regulation specifies, if the current licensing basis (CLB) for a BWR SLRA includes a core plate rim hold-down bolt preload analysis that is defined as a TLAA in conformance with the criteria in 10 CFR 54.3(a), the applicant is required by 10 CFR 54.21(c)(1) to identify that analysis as a TLAA for the SLRA and to demonstrate acceptance of the TLAA using one or more of the three criteria for accepting TLAAs in 10 CFR 54.21(c)(1)(i), (ii), or (iii). In this case, this disposition of the preload TLAA is required even if the applicant is proposing to credit its BWR Vessel Internals Program and applicable BWRVIP defined inspection techniques for aging management of preload loss in the core plate rim hold-down bolts. The further evaluation guidelines in Section 3.1.2.2.14 of NUREG–2192 were updated to be consistent with the technical basis for these AMR items.
IV.B1.R-421	The staff developed new AMR item IV.B1.R-421 in the GALL-SLR Report and new AMR item No. 121 in SRP-SLR Table 3.1-1 to manage loss of preload due to thermal or irradiation-enhanced stress relaxation in BWR jet pump assembly hold-down beam bolts. Similar to other AMR items for BWR internals, the AMR items rely on the aging management activities of GALL-SLR Report, AMP XI.M9, “BWR Vessel Internals,” and applicable BWRVIP inspection and evaluation report criteria for managing this aging effect. The applicable BWRVIP report that applies to these jet pump assembly components is BWRVIP-41.
IV.B2.R-423 IV.B3.R-423 IV.B4.R-423 IV.B2.R-424 IV.B3.R-424 IV.B4.R-424	The staff reduced the number of AMR items for Westinghouse-designed, Combustion Engineering (CE)-designed, and Babcock and Wilcox (B&W)-designed PWR internals due to fact that EPRI MRP has not updated the MRP-227-A methodology referenced in AMP XI.M16A, “PWR Vessel Internals,” in NUREG–1801, Revision 2 to cover an assessment of aging effects and mechanisms through 80 years of plant operations. Specifically, the staff replaced the AMR items in NRC Interim Staff Guidance (ISG) No. LR-ISG-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors,” for managing cracking effects in PWR RVI components with a new AMR in AMR item No. 118 of SRP-SLR Table 3.1-1 and new AMR items IV.B2.R-423, IV.B3.R-423, and IV.B4.R-423, which apply to management of cracking in Westinghouse-designed, CE-designed, and B&W-designed PWR RVI components. Similarly, the staff replaced the AMR items in ISG No. LR-ISG-2011-04 for managing non-cracking effects in PWR RVI components with a new AMR in

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	AMR item No. 119 of SRP-SLR Table 3.1-1 and new AMR items IV.B2.R-424, IV.B3.R-424, and IV.B4.R-424, which apply to management of non-cracking effects in Westinghouse-designed, CE-designed, and B&W-designed PWR RVI components. These new AMR items are subject to the new FE acceptance criteria guidance recommendations in SRP-SLR, Section 3.1.2.2.9 and the associated review procedure guidelines in SRP-SLR, Section 3.1.3.2.9.The staff determined that the commodity group-based or component-specific AMR items for Westinghouse, CE, and B&W designed RVI components in LR-ISG-2011-04, "Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors," could be reinserted into Table 3.1-1 of the SRP-SLR and into Tables IV.B2, IV.B3, and IV.B4 of the GALL-SLR Report because the staff agreed that EPRI MRP-227-A could be used as a starting point for assessing aging in the components. However, this was predicated on the staff's conclusion that SRP-SLR, Sections 3.1.2.2.9 and 3.1.3.2.9 would need to be amended to account for this, with inclusion of additional criteria in FE sections that would call for performance and inclusion of a gap analysis in the SLRA. Specifically, the industry admits that the sampling based program in MRP-227-A is based only on an assessment of aging through 60-years of licensed operations. The purpose of the additional criteria for PWR RVI gap analysis is intended to provide PWR SLRA applicants with an opportunity to assess the impacts that 80-years of licensed operations would have on the assumptions and results of the sampling-based condition monitoring criteria (i.e., sampling-based inspection criteria) for PWR RVI components in the MRP-227-A report, or in the applicable background reports for MRP-227-A (e.g., MRP-191 or MRP-189). Thus, based on these changes to the SRP-SLR, FE Sections 3.1.2.2.9 and 3.1.3.2.9, the AMR items in LR-ISG-2011-04 will be re-inserted and included in the NUREG–2191 and NUREG–2192, but modified to state "Yes" for FE in the versions of the items that are retained in NUREG–2191 and NUREG–2192.
IV.B3.R-455	The staff developed a new AMR item in AMR item IV.B3.R-455 to manage loss of fracture toughness due to neutron irradiation embrittlement in upper cylinders (including base metal and welds of PWR reactor vessel internal core support structure assemblies that are designed by CE. The technical basis write-up of AMR items IV.B3.RP-317, IV.B3.RP-331, IV.B3.RP-359a, IV.B3.RP-361, IV.B3.RP-362b, and IV.B3.R-455 in Table 2-17 of this report provides the staff's technical basis for developing item IV.B3.R-455 in the NUREG–2191.
IV.C1.R-431 IV.C2.R-431	The AMRs in AMR item IV.C1.R-431 of Table IV.C1 of the draft NUREG–2191 report, AMR item IV.C2.R-431 in Table IV.C2 of the GALL-SLR Report, and AMR item No. 124 in Table 3.1-1 of the draft NUREG–2192 provided the staff's new AMRs for managing loss of material due to general, pitting, and crevice corrosion in BWR or PWR piping and piping components that are exposed to indoor air – uncontrolled, air–outdoor, or condensation environments and are made from steel materials. Specifically, staff added these AMR items to cite air environments and condensation that could result in moisture on the surfaces of a component in GALL-SLR Report, Chapter IV. Condensation frequently occurs during humid periods of normal plant operation and can also occur during plant shutdown when normally hot components might be below the dew point. The aging effects from condensation occurring during humid periods of normal plant operation should be evaluated for license renewal. The staff recognizes that during normal plant operations, most of the reactor coolant

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	pressure boundary piping should be above the dew point; however, based on plant-specific configurations, that may not be the case. The staff concluded that It is less likely that condensation during plant shutdowns would result in loss of material, unless plant-specific operating experience dictates otherwise (e.g., as a result of extended plant shutdowns). Therefore, if the plant had experienced extended shutdowns during operating periods prior to the proposed period of extended operation, loss of material due to exposure to condensation should be addressed. GALL-SLR Report, AMP XI.M36 includes recommendations for periodic visual inspections of the external surfaces (both insulated and uninsulated) of in-scope components that are capable of detecting loss of material. These AMR items are analogous to the AMR items for steel emergency safety feature components, auxiliary system components, or steam and power conversion system components that are listed in the Chapters V, VII, or VIII of GALL-SLR Report and may be exposed to these environments. AMR item No. 128 in Table 3.1-1 of NUREG–2192 was amended accordingly. For additional information, refer to the technical basis change discussion for deleting AMR items IV.C1.R-429 and IV.C2.R-429 from the scope of the GALL-SLR Report, as given in Table 2-10 of this NUREG report.
IV.C1.R-432	For subsequent license renewal applications, the staff developed new AMR item IV.C1.R-432 in Table IV.C1 of NUREG–2191 and new AMR item No. 129 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage cracking due to cyclical loading in BWR control rod drive return line piping that has been rerouted (i.e., modified) and welded to inlet piping that provides return line flow back into the reactor pressure vessel (RPV). The new items identify that GALL-SLR Report, AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," may be used as a basis for managing cracking in the components that may be induced by fatigue loads or a cyclical loading mechanism, without any need for further evaluation of the condition monitoring methods used for aging management. Any rerouted piping would be subject to applicable inservice inspection requirements in 10 CFR 50.55a(g) and Section XI of the ASME Boiler and Pressure Vessel Code, Division 1. The staff did not receive any comments or objections on the staff's basis for including these new items in the GALL-SLR Report and SRP-SLR.
IV.C1.R-451 IV.C2.R-451 IV.C1.R-452 IV.C2.R-452 IV.C1.R-452a IV.C2.R-452a IV.C1.R-452b IV.C2.R-452b IV.C1.R-452c IV.C2.R-452c IV.C1.R-452d IV.C2.R-452d	For subsequent license renewal application objectives, the staff initially developed new AMR items (IV.C1.R-451 and IV.C2.R-451 in Tables IV.C1 and IV.C2 of the draft NUREG–2191 and AMR item No. 135 in Table 3.1-1 of the draft NUREG–2192 report that may be used to manage loss of material due to pitting or crevice corrosion in BWR or PWR non-ASME Code Class 1 piping and piping components that are made from stainless steel and are exposed to any type of air environment other than dry air or air with condensation environments. Similarly, for subsequent license renewal application objectives, the staff initially developed new AMR items IV.C1.R-452 and IV.C2.R-452 in Tables IV.C1 and IV.C2 of the draft NUREG–2191 and AMR item No. 136 in Table 3.1-1 of the draft NUREG–2192 report that may be used to manage loss of material due to pitting or crevice corrosion in BWR or PWR piping and piping components that are made from stainless steel or nickel alloy materials and are exposed to any type of air environment other than dry air or air with condensation environments. The staff originally associated these AMR items with new further evaluation acceptance criteria guidelines in SRP-SLR, Section 3.1.2.2 recommended that a plant-specific program be proposed to

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	manage loss of material that may occur in these components as a result of a pitting corrosion or crevice corrosion mechanism. The AMR criteria in these items were subject to the NRC's further evaluation acceptance criteria guidelines that were originally provided in Section 3.1.2.2.X of the draft NUREG–2192. The staff has developed new AMR items in the final version of the GALL-SLR Report and updated SRP-SLR further evaluation (FE) guideline criteria in Section 3.1.2.2.16 of the SRP-SLR that apply to nickel alloy or stainless steel RCS piping and piping components that may be exposed to an air or condensation environments. The new items replace the previous issuance of AMR items IV.C1.R-451, IV.C2.R-451, IV.C1.R-452, and IV.C2.R-452 in the draft GALL-SLR Report and the updated FE criteria in SRP-SLR, Section 3.1.2.2.16 explain how the new AMR items may be applied to contents of a subsequent license renewal application. The versions of AMR items IV.C1.R-451, IV.C2.R-451, IV.C1.R-452, and IV.C2.R-452 in the draft version of the NUREG–2191 report have not been retained for the final version of the report. Based on the updated FE criteria, the new AMR basis in either AMR item IV.C1.R-452a for BWR RCS designs or AMR item IV.C2.R-452a for PWR RCS designs may be used if the components have yet to experience any occurrence of pitting or crevice corrosion in the systems. For such cases, the SRP-SLR FE section explains that an AMP corresponding to AMP XI.M2, "One-Time Inspection," may be used as a valid basis for determining whether loss of material due to pitting or crevice corrosion is occurring in the nickel alloy or stainless steel piping components during the subsequent period of extended operation. Based on the updated FE criteria, the new AMR basis in either AMR item IV.C1.R-452b for BWR RCS designs or AMR item IV.C2.R-452b for PWR RCS designs may be used if the stainless steel or nickel ally components are exposed to either an air or condensation environment on their external surfaces and have experienced the occurrence of pitting or crevice corrosion on the external surfaces of the piping component in the past systems, such that a periodic condition monitoring AMP corresponding to AMP XI.M36, "External Surfaces Monitoring," may be justified for management of the loss of material aging effect. Based on the updated FE criteria, the new AMR basis in AMR item IV.C1.R-452c for BWR RCS designs or in AMR item IV.C2.R-452c for PWR RCS designs may be used if the nickel alloy or stainless steel components are unlined or uncoated and exposed to either an air or condensation environment on their internal surfaces, and the components have experienced the occurrence of pitting or crevice corrosion on the internal surfaces of the piping component in the past. For these types of cases, the SRP-SLR FE acceptance criteria guidelines explain that use of a periodic condition monitoring AMP corresponding to the GALL-SLR Report, AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," may be justified for management of the loss of material aging effect. Based on the updated FE criteria, the new AMR basis in AMR item IV.C1.R-452d for BWR RCS designs or in AMR item IV.C2.R-452d for PWR

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	RCS designs may be used if the nickel alloy or stainless steel components are lined or coated and exposed to either an air or condensation environment on their internal surfaces, and the piping components have experienced the occurrence of pitting or crevice corrosion on the internal surfaces of the components in the past. For these types of cases, the SRP-SLR FE acceptance criteria guidelines explain that use of a periodic condition monitoring AMP corresponding to GALL-SLR Report, AMP XI.M41, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," may be justified for management of the loss of material aging effect. For application of these items, the further evaluation basis in SRP-SLR, Section 3.1.2.2.16 is associated with the need for performing an operating experience review of the RCS systems, and not necessarily on the capability of the program element activities in the referenced GALL-based AMPs to accomplish their intended aging management objectives. SRP-SLR Section 3.1.3.2.16 provides the staff's corresponding review procedures for reviewing these AMR bases.
IV.C1.R-11 IV.D2.R-10	These new AMR items were developed to provide a summary of how AMP XI.M18, "Bolting Integrity" can be used to manage cracking due to SCC in the BWR and PWR high-strength low-alloy steel or stainless steel closure bolting exposed to indoor uncontrolled air. The basis for developing these new AMR items is given in the staff's technical basis discussion for AMR items IV.C1.R-11, IV.C2.R-11, IV.D1.R-10, and IV.D2.R-10, as given in Table 2-17 of this report.
IV.D1.RP-166 IV.D2.RP-166	These new AMR items were developed to provide a summary of how GALL-SLR Report, AMP XI.M18 "Bolting Integrity," can be used to manage loss of material due to general (steel only), pitting, crevice corrosion, or wear in the BWR and PWR steel or stainless steel closure bolting exposed to indoor uncontrolled air. The basis for developing these new AMR items is given in the staff's technical basis discussion for AMR items IV.C2.RP-166, IV.D1.RP-166, and IV.D2.RP-166, as given in Table 2-17 of this report.
IV.C2.RP-44	This new AMR item was developed to provide a summary of how the TLAA on metal fatigue can be used to manage cumulative fatigue damage, cracking due to fatigue, or cyclic loading in the PWR steel or stainless steel pump and valve closure bolting exposed to system temperature up to 288 °C (550 °F). The basis for developing this new AMR item is given in the staff's technical basis discussion for AMR items IV.C1.RP-44 and IV.C2.RP-44, as given in Table 2-17 of this report.
IV.D1.R-31	For subsequent license renewal applications, the staff developed new AMR item IV.D1.R-31 in Table IV.D1 of NUREG–2191 to provide an AMR item that may be used to manage loss of material due to erosion in the cover seating surfaces of steel secondary side manway and handhold covers that are located in recirculating steam generator designs and are exposed to either a treated water or steam environment. The creation of the new line is analogous to the modified AMR item for these types of components in once-through SG designs, as given in AMR item IV.D2.R-31 of the draft GALL-SLR Report, Table IV.D2. GALL AMR item IV.D1.R-31 and the staff's modification to the draft GALL-SLR Report, AMR item IV.D2.R-31 incorporate changes such that the listed

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	environments should be administratively changed to list “treated water, steam,” and the area of concern for erosion in the manway or handhold covers should be limited to the cover seating surfaces. AMR item No. 044 in SRP-SLR, Table 3.1-1 was modified accordingly consistent with the development of new GALL-SLR AMR item IV.D1.R-31 and the modification to the draft GALL-SLR AMR item IV.D2.R-31.
IV.D1.R-407 IV.D2.R-407	For subsequent license renewal applications, the staff developed new AMR item IV.D1.R-407 in Table IV.D1 of NUREG–2191, new AMR item IV.D2.R-407 in Table IV.D2 of the GALL-SLR Report, and new AMR item No. 111 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage reduction of heat transfer due to fouling in the surfaces of nickel alloy steam generator tubes that are located in either a PWR recirculating or once-through steam generator and are exposed to secondary-side coolant water or steam. The new items identify that the programs GALL-SLR Report, AMP XI.M19, “Steam Generators,” and GALL-SLR, AMP XI.M2, “Water Chemistry,” may be used to manage reduction of heat transfer capability of the components, without any need for performing further evaluation of the program element criteria for managing cracking in these components. AMP XI.M19, “Steam Generators,” includes provisions to monitor for deposits that may cause fouling on the components. AMP XI.M2, “Water Chemistry,” includes water chemistry control activities that are designed to minimize adverse deposits that can occur in the steam generator system.
IV.D1.R-436 IV.D2.R-440	For subsequent license renewal applications, the staff developed new AMR item IV.D1.R-436 in Table IV.D1 of NUREG–2191 and new AMR item No. 127 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage loss of material due to boric acid corrosion in steel steam generator channel heads and tubesheets that are included in recirculating steam generator s and are exposed to reactor coolant. For consistency the staff developed new AMR item IV.D2.R-440 in Table IV.D2 of NUREG–2191 and new AMR item No. 127 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage the same aging effect in steel steam generator upper and lower heads and tubesheets that are included in once-through steam generators and are exposed to reactor coolant. The new items in the draft versions of the NUREG reports originally identified that the AMPs in GALL-SLR Report, AMP XI.M19, “Steam Generators,” and GALL-SLR Report, AMP XI.M2, “Water Chemistry,” may be used to manage loss of material due to boric acid corrosion of the components, as subject to the further evaluation of the program element criteria in SRP-SLR, Section 3.1.2.2.15. The corresponding further evaluation review procedures were provided in Section 3.1.3.2.15 of the draft SRP-SLR. The draft versions of the new AMR items were originally based on the information and operating experience discussed in NRC Information Notice (IN) 2013-20, “Steam Generator Channel Head and Tubesheet Degradation” (ADAMS Accession No. ML13204A143). Since the issuance of new further evaluation acceptance criteria guidance in Section 3.1.2.2.15 of the draft NUREG–2192, the staff issued License Renewal Interim Staff Guidance Document LR-ISG-2016-01, “Changes to Aging Management Guidance for Various Steam Generator Components.” The LR-ISG includes updated augmented inspection recommendations for PWR steam generator head and tubesheet components, as described in AMP XI.M19, “Steam Generators.” Based on issuance of the updated guidance in LR-ISG-2016-01, the staff partially agreed that further evaluation, as evaluated in accordance with the guidance in SRP-SLR, Section 3.1.2.2.15, would not

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	need to be applied to use of these AMR items. Therefore, the staff has deleted the draft versions of the further evaluation acceptance criteria in SRP-SLR, Section 3.1.2.2.15 and the corresponding review procedures in SRP-SLR, Section 3.1.3.2.15 from the scope of the final NUREG–2192. In addition, Sections 3.1.2.2.15 and 3.1.3.2.15 in the final version of NUREG–2192 have been reformatted to now contain the staff's further evaluation acceptance criteria and review procedures guidance for managing loss of material and cracking in steel piping and piping that is exposed to concrete. However, based on issuance of LR-ISG-2016-01, the staff's perspective is that the programs consistent with GALL-SLR Report, AMP XI.M19, "Steam Generators," and GALL-SLR Report, AMP XI.M2, "Water Chemistry," remain as valid AMPs that may be used to manage any loss of material that may occur in these components as a result of boric acid corrosion mechanism. Thus, the applicable AMR items will continue to identify that GALL-SLR Report, AMP XI.M19, "Steam Generators," is the appropriate AMP for performing inspections of the steam generator head and tubesheet components and that AMP XI.M2, "Water Chemistry," is appropriate for controlling the concentrations of reactor coolant additives and impurities that, if left uncontrolled, could potentially induce loss of material due to boric acid corrosion in the components. Given that the guidance describes one of the acceptable methods for aging management, a PWR subsequent license renewal applicant may propose to using another inservice inspection program (e.g., the program that corresponds to GALL-SLR Report, AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD") as an alternative condition monitoring program for the components. Consistent with the guidance in NEI 95-10, Revision 6, the alternative AMR basis for using another program as an alternative AMP would be identified in the applicable SLRA AMR table using NEI 95-10, Revision 6, Generic AMR Note E, and potential plant-specific AMR footnotes associated with the items, as appropriate.
IV.D1.R-437	This new AMR item references GALL-SLR Report, AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators" to manage cracking due to flow-induced vibration or high-cycle fatigue in PWR nickel alloy steam generator tubes (at tube support plate locations) exposed to secondary feedwater or steam. See also technical basis discussion for AMR items IV.D1.R-47, IV.D1.R-48, and IV.D1.R-437 in Table 2-17 of this NUREG report.
IV.D2.R-442	This new AMR item references AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators" to manage cracking due to flow-induced vibration or high-cycle fatigue in PWR nickel alloy steam generator tubes (at tube support plate locations) exposed to secondary feedwater or steam. See technical basis discussion for AMR items IV.D2.R-47, IV.D2.R-48, and IV.D2.R-442 in Table 2-17 of this NUREG report.
IV.E.R-444	The staff developed new AMR item IV.E.R-444 in Table IV.E of NUREG–2191 and new AMR item No. 114 in Table 3.1-1 of NUREG–2192 to provide a generic set of AMR items that may be used to manage cracking and loss of material in miscellaneous reactor coolant system components. The items apply to and may be used for those components in the reactor coolant system that are: (a) defined as ASME Code, Section XI reactor coolant pressure

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
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	boundary or core support components (including component supports, vessel appurtenances and associated pressure boundary welds), and (b) are outside the scope of other AMR items for ASME Code Class components in the system specific tables of Chapter IV of the GALL-SLR Report (i.e., not specifically covered by AMR items for ASME Code Class 1 components in Tables IV.A1, IV.A2, IV.B1, IV.B2, IV.B3, IV.B4, IV.C1, IV.C2, IV.D1, or IV.D2 of the GALL-SLR Report). The new generic AMR items identify that the AMPs in 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) may be used to manage any cracking or loss of material that may occur in the components, without any need for further evaluation of the program element criteria used to manage the affects.
IV.E.R-453	The staff developed new AMR item IV.E.R-453 in Table IV.E of NUREG–2191 and new AMR item No. 137 in Table 3.1-1 of NUREG–2192 to provide a new set of AMRs that may be used for RCS piping and piping components that are made from copper alloy materials and are exposed to either an air–indoor uncontrolled, gas, or condensation environment. Copper alloy components in air–indoor uncontrolled, gas, or condensation environments would not be subject to any aging effects would require aging management during a proposed subsequent period of extended operations. Copper alloy materials would be protected from corrosion in these types of environments due to the presence of metallic oxides that would provide corrosion resistance in the materials. Therefore, RCS piping and piping components that are made from copper alloy and exposed to an air–indoor uncontrolled, gas, or condensation environment are now addressed in new AMR item IV.E.R-453, which identifies that there are not any aging effects that need to be managed for copper alloy components exposed to these environments or any AMPs that would otherwise be needed to manage aging if there were specific aging effects that were applicable to these material-environmental combinations.
IV.B2.R-423 IV.B3.R-423 IV.B4.R-423 IV.B2.R-424 IV.B3.R-424 IV.B4.R-424	The staff reduced the number of AMR items for Westinghouse-designed, Combustion Engineering (CE)-designed, and Babcock and Wilcox (B&W)-designed PWR internals due to fact that EPRI MRP has not updated the MRP-227-A methodology referenced in AMP XI.M16A, "PWR Vessel Internals," in NUREG–1801, Revision 2 to cover an assessment of aging effects and mechanisms through 80 years of plant operations. Specifically, the staff replaced the AMR items in NRC Interim Staff Guidance (ISG) No. LR-ISG-2011-04, "Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors," for managing cracking effects in PWR RVI components with a new AMR in AMR item No. 118 of SRP-SLR Table 3.1-1 and new AMR items IV.B2.R-423, IV.B3.R-423, and IV.B4.R-423, which apply to management of cracking in Westinghouse-designed, CE-designed, and B&W-designed PWR RVI components. Similarly, the staff replaced the AMR items in ISG No. LR-ISG-2011-04 for managing non-cracking effects in PWR RVI components with a new AMR in AMR item No. 119 of SRP-SLR Table 3.1-1 and new AMR items IV.B2.R-424, IV.B3.R-424, and IV.B4.R-424, which apply to management of non-cracking effects in Westinghouse-designed, CE-designed, and B&W-designed PWR RVI components. These new AMR items are subject to the new FE acceptance criteria guidance recommendations in SRP-SLR, Section 3.1.2.2.9 and the associated review procedure guidelines in SRP-SLR, Section 3.1.3.2.9.

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	The staff received a number of comments from stakeholders that basically recommended that AMP XI.M16A, "PWR Vessel Internals," in NUREG–1801, Revision 2 be retained in the GALL-SLR Report and that the AMR items for PWR RVI components in Interim Staff Guidance Document LR-ISG-2011-04 should be retained in NUREG–2191 (i.e., the GALL-SLR report). The staff's basis for resolving stakeholder comments and proposed changes for the contents of the draft SRP-SLR FE sections for PWR RVI components (i.e., SRP-SLR, Sections 3.1.2.2.9 and 3.1.3.2.9) is addressed in Table 3-3 of this NUREG report under the table's line item that addresses NEI Comment Attachment 2, Comment No. 2. The staff's basis for resolving stakeholder comments for restoring AMP XI.M16A and proposed changes to that AMP is addressed in Table 2-28 of this NUREG report. Based on its review, the staff determined that the commodity group-based or component-specific AMR items for Westinghouse, CE, and B&W designed RVI components in LR-ISG-2011-04, "Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors," could be reinserted into Table 3.1-1 of the SRP-SLR and into Tables IV.B2, IV.B3, and IV.B4 of the GALL-SLR Report because the staff agreed that EPRI MRP-227-A could be used as a starting point for assessing aging in the components. However, this was predicated on the staff's conclusion that SRP-SLR, Sections 3.1.2.2.9 and 3.1.3.2.9 would need to be amended to account for this, with inclusion of addition criteria in FE sections that would call for performance and inclusion of a gap analysis in the SLRA. The purpose of the additional criteria for PWR RVI gap analysis is intended to provide PWR SLRA applicants with an opportunity to assess the impacts that 80-years of licensed operations would have on the assumptions and results of the sampling-based condition monitoring criteria (i.e., sampling-based inspection criteria) for PWR RVI components in the MRP-227-A report, or in the applicable background reports for MRP-227-A (e.g., MRP-191 or MRP-189). Thus, based on these changes to the SRP-SLR, FE Sections 3.1.2.2.9 and 3.1.3.2.9, the AMR items in LR-ISG-2011-04 will be re-inserted and included in the NUREG–2191 and NUREG–2192, but modified to state "Yes" for FE in the versions of the items that are retained in NUREG–2191 and NUREG–2192. However, the staff also determined that a plant-specific AMR and AMP option for PWR RVI components should be retained in SRP-SLR, Sections 3.1.2.2.9 and 3.1.3.2.9 and in the version of these AMR items in the SRP-SLR and GALL-SLR Report because a license renewal applicant always has the option of proposing a plant-specific AMP for aging management of its RVI components. Thus, the AMR items No. 118 and No. 119 in SRP-SLR, Table 3.1-1 will remain as originally drafted in NUREG–2912 (the SRP-SLR) and the AMRs in GALL-SLR AMR items IV.B2.R-423, IV.B2.R-424, IV.B3.R-423, IV.B3.R-424, IV.B4.R-423, and IV.B4.RP-424 will remain as drafted in NUREG–2191 report . These items will still state "Yes" for further evaluation and will be subject to the further evaluation acceptance criteria guidelines in SRP-SLR Section 3.1.2.2.9 and the corresponding review procedure guidelines in SRP-SLR Section 3.1.3.2.9.

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
IV.B3.R-455	The staff developed a new AMR item in AMR item IV.B3.R-455 to manage loss of fracture toughness due to neutron irradiation embrittlement in upper cylinders (including base metal and welds of PWR reactor vessel internal core support structure assemblies that are designed by CE. The technical basis write-up of AMR items IV.B3.RP-317, IV.B3.RP-331, IV.B3.RP-359a, IV.B3.RP-361, IV.B3.RP-362b, and IV.B3.R-455 in Table 2-17 of this report provides the staff's technical basis for developing item IV.B3.R-455 in the NUREG–2191.
IV.C1.R-431 IV.C2.R-431	The AMRs in AMR item IV.C1.R-431 of Table IV.C1 of the draft NUREG–2191 report , AMR item IV.C2.R-431 in Table IV.C2 of the GALL-SLR Report, and AMR item No. 124 in Table 3.1-1 of the draft NUREG–2192 provided the staff's new AMRs for managing loss of material due to general, pitting, and crevice corrosion in BWR or PWR piping and piping components that are exposed to indoor air – uncontrolled, air–outdoor, or condensation environments and are made from steel materials. Specifically, staff added these AMR items to cite air environments and condensation that could result in moisture on the surfaces of a component in GALL-SLR Report, Chapter IV. Condensation frequently occurs during humid periods of normal plant operation and can also occur during plant shutdown when normally hot components might be below the dew point. The aging effects from condensation occurring during humid periods of normal plant operation should be evaluated for license renewal. The staff recognizes that during normal plant operations, most of the reactor coolant pressure boundary piping should be above the dew point; however, based on plant-specific configurations, that may not be the case. The staff concluded that it is less likely that condensation during plant shutdowns would result in loss of material, unless plant-specific operating experience dictates otherwise (e.g., as a result of extended plant shutdowns). Therefore, if the plant had experienced extended shutdowns during operating periods prior to the proposed period of extended operation, loss of material due to exposure to condensation should be addressed. GALL-SLR Report, AMP XI.M36 includes recommendations for periodic visual inspections of the external surfaces (both insulated and uninsulated) of in-scope components that are capable of detecting loss of material. These AMR items are analogous to the AMR items for steel emergency safety feature components, auxiliary system components, or steam and power conversion system components that are listed in the Chapters V, VII, or VIII of GALL-SLR Report and may be exposed to these environments.
IV.C1.R-432	For subsequent license renewal applications, the staff developed new AMR item IV.C1.R-432 in Table IV.C1 of NUREG–2191 and new AMR item No. 129 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage cracking due to cyclical loading in BWR control rod drive return line piping that has been rerouted (i.e., modified) and welded to inlet piping that provides return line flow back into the reactor pressure vessel (RPV). The new items identify that GALL-SLR Report, AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," may be used as a basis for managing cracking in the components that may be induced by fatigue loads or a cyclical loading mechanism, without any need for further evaluation of the condition monitoring methods used for aging management. Any rerouted piping would be subject to applicable inservice inspection requirements in 10 CFR 50.55a(g) and Section XI of the ASME Boiler and

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	Pressure Vessel Code, Division 1. The staff did not receive any comments or objections on the staff's basis for including these new items in the GALL-SLR Report and SRP-SLR.
IV.C1.R-451 IV.C2.R-451 IV.C1.R-452 IV.C2.R-452 IV.C1.R-452a IV.C2.R-452a IV.C1.R-452b IV.C2.R-452b IV.C1.R-452c IV.C2.R-452c IV.C1.R-452d IV.C2.R-452d	The staff developed new AMR items IV.C1.R-452a – IV.C1.R-452d and IV.C2.R-452a – IV.C2.R-452d in the final version of the GALL-SLR Report and updated SRP-SLR further evaluation (FE) guideline criteria in Section-3.1.2.2.16 of the SRP-SLR that apply to nickel alloy or stainless steel RCS piping and piping components that may be exposed to an air or condensation environments. The new items replace the previous issuance of AMR items IV.C1.R-451, IV.C2.R-451, IV.C1.R-452, and IV.C2.R-452 in the draft GALL-SLR Report and the updated FE criteria in SRP-SLR, Section 3.1.2.2.16 explain how the new AMR items may be applied to contents of a subsequent license renewal application. The versions of AMR items IV.C1.R-451, IV.C2.R-451, IV.C1.R-452, and IV.C2.R-452 in the draft version of the NUREG–2191 report have not been retained for the final version of the report. Based on the updated FE criteria, the new AMR basis in either AMR item IV.C1.R-452a for BWR RCS designs or AMR item IV.C2.R-452a for in PWR RCS designs may be used if the components have yet to experience any occurrence of pitting or crevice corrosion in the systems. For such cases, the SRP-SLR FE section explains that an AMP corresponding to AMP XI.M2, "One-Time Inspection," may be used as a valid basis for determining whether loss of material due to pitting or crevice corrosion is occurring in the nickel alloy or stainless steel piping components during the subsequent period of extended operation. Based on the updated FE criteria, the new AMR basis in either AMR item IV.C1.R-452b for BWR RCS designs or AMR item IV.C2.R-452b for PWR RCS designs may be used if the stainless steel or nickel ally components are exposed to either an air or condensation on their external surfaces and have experienced the occurrence of pitting or crevice corrosion on the external surfaces of the piping component in the past systems, such that a periodic condition monitoring AMP corresponding to AMP XI.M36, "External Surfaces Monitoring," may be justified for management of the loss of material aging effect. Based on the updated FE criteria, the new AMR basis in AMR item IV.C1.R-452c for BWR RCS designs or in AMR item IV.C2.R-452c for PWR RCS designs may be used if the nickel alloy or stainless steel components are unlined or uncoated and exposed to either an air or condensation environment on their internal surfaces, and the components have experienced the occurrence of pitting or crevice corrosion on the internal surfaces of the piping component in the past. For these types of cases, the SRP-SLR FE acceptance criteria guidelines explain that use of a periodic condition monitoring AMP corresponding to program in GALL-SLR Report, AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," may be justified for management of the loss of material aging effect. Based on the updated FE criteria, the new AMR basis in AMR item IV.C1.R-452d for BWR RCS designs or in AMR item IV.C2.R-452d for PWR RCS designs may be used if the nickel alloy or stainless steel components are lined or coated and exposed to either an air or condensation on their internal

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	surfaces, and the piping components have experienced the occurrence of pitting or crevice corrosion on the internal surfaces of the components in the past. For these types of cases, the SRP-SLR FE acceptance criteria guidelines explain that use of a periodic condition monitoring AMP corresponding to program in GALL-SLR Report, AMP XI.M41, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," may be justified for management of the loss of material aging effect. For application of these items, the further evaluation basis in SRP-SLR, Section 3.1.2.2.16 is associated with the need for performing an operating experience review of the RCS systems, and not necessarily on the capability of the program element activities in the referenced GALL-based AMPs to accomplish their intended aging management objectives. SRP-SLR Section 3.1.3.2.16 provides the staff's corresponding review procedures for reviewing these AMR bases.
IV.C1.R-11 IV.D2.R-10	These new AMR items were developed to provide a summary of how AMP XI.M18, "Bolting Integrity" can be used to manage cracking due to SCC in the BWR and PWR high-strength low-alloy steel or stainless steel closure bolting exposed to indoor uncontrolled air. The basis for developing these new AMR items is given in the staff's technical basis discussion for AMR items IV.C1.R-11, IV.C2.R-11, IV.D1.R-10, and IV.D2.R-10, as given in Table 2-17 of this report.
IV.D1.RP-166 IV.D2.RP-166	These new AMR items were developed to provide a summary of how GALL-SLR Report, AMP XI.M18 "Bolting Integrity," can be used to manage loss of material due to general (steel only), pitting, crevice corrosion, or wear in the BWR and PWR steel or stainless steel closure bolting exposed to indoor uncontrolled air. The basis for developing these new AMR items is given in the staff's technical basis discussion for AMR items IV.C2.RP-166, IV.D1.RP-166, and IV.D2.RP-166, as given in Table 2-17 of this report.
IV.C2.RP-44	This new AMR item was developed to provide a summary of how the TLAA on metal fatigue can be used to manage cumulative fatigue damage, cracking due to fatigue, or cyclic loading in the PWR steel or stainless steel pump and valve closure bolting exposed to system temperature up to 288 °C (550 °F). The basis for developing this new AMR item is given in the staff's technical basis discussion for AMR items IV.C1.RP-44 and IV.C2.RP-44, as given in Table 2-17 of this report.
IV.D1.R-31	For subsequent license renewal applications, the staff developed new AMR item IV.D1.R-31 in Table IV.D1 of NUREG–2191 (GALL-SLR) to provide an AMR item that may be used to manage loss of material due to erosion in the cover seating surfaces of steel secondary side manway and handhold covers that are located in recirculating steam generator designs and are exposed to either a treated water or steam environment. The creation of the new line item is analogous to the modified AMR item for these types of components in once-through SG designs, as given in GALL-SLR AMR item IV.D2.R-31. GALL AMR item IV.D1.R-31 and the staff's modification of AMR item IV.D2.R-31 incorporate the following changes based on the staff's resolution of stakeholder comments received on these items: (a) amend the listed environments to be "treated water, steam," and (b) amend the AMR items to identified that area of

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	concern for erosion in the manway or handhold covers is the cover seating surfaces. AMR item No. 044 in SRP-SLR, Table 3.1-1 was modified accordingly consistent with the development of new GALL-SLR AMR item IV.D1.R-31 and the modification to the AMR item IV.D2.R-31.
IV.D1.R-407 IV.D2.R-407	The staff developed new AMR item IV.D1.R-407 in Table IV.D1 of NUREG–2191 (GALL-SLR), new AMR item IV.D2.R-407 in Table IV.D2 of the GALL-SLR Report, and new AMR item No. 111 in Table 3.1-1 of NUREG–2192 to provide a set of AMR items that may be used to manage reduction of heat transfer due to fouling in the surfaces of nickel alloy steam generator tubes that are located in either a PWR recirculating or once-through steam generator and are exposed to secondary-side coolant water or steam. The new items identify that the programs consistent with GALL-SLR Report, AMP XI.M19, "Steam Generators," and GALL-SLR, AMP XI.M2, "Water Chemistry," may be used to manage reduction of heat transfer capability of the components, without any need for performing further evaluation of the program element criteria for managing cracking in these components. AMP XI.M19, "Steam Generators," includes provisions to monitor for deposits that may cause fouling on the components. AMP XI.M2, "Water Chemistry," includes water chemistry control activities that are designed to minimize adverse deposits that can occur in the steam generator system.
IV.D1.R-436 IV.D2.R-440	The staff developed new AMR item IV.D1.R-436 in Table IV.D1 of NUREG–2191 (GALL-SLR) and new AMR item No. 127 in Table 3.1-1 of NUREG–2192 (SRP-SLR) to provide a set of AMR items that may be used to manage loss of material due to boric acid corrosion in steel steam generator (SG) channel heads and tubesheets that are included in recirculating steam generators and are exposed to reactor coolant. The staff also developed new AMR item IV.D2.R-440 in GALL-SLR Table IV.D2 and new AMR item No. 127 in SRP-SLR Table 3.1-1 to provide a set of AMR items that may be used to manage the same aging effect in steel steam generator upper and lower heads and tubesheets that are included in once-through steam generators and are exposed to reactor coolant. The new items in the draft versions of the NUREG reports originally identified that the AMPs in GALL-SLR Report, AMP XI.M19, "Steam Generators," and GALL-SLR Report, AMP XI.M2, "Water Chemistry," may be used to manage loss of material due to boric acid corrosion of the components, as subject to the further evaluation of the program element criteria in SRP-SLR, Section 3.1.2.2.15. The corresponding further evaluation review procedures were provided in Section 3.1.3.2.15 of the draft SRP-SLR. The draft versions of the new AMR items were originally based on the information and operating experience discussed in NRC Information Notice (IN) 2013-20, "Steam Generator Channel Head and Tubesheet Degradation" (ADAMS Accession No. ML13204A143). Since the issuance of new further evaluation acceptance criteria guidance in Section 3.1.2.2.15 of the draft NUREG–2192, the staff issued License Renewal Interim Staff Guidance Document LR-ISG-2016-01, "Changes to Aging Management Guidance for Various Steam Generator Components." The LR-ISG includes updated augmented inspection recommendations for PWR steam generator head and tubesheet components, as described in AMP XI.M19, "Steam Generators." Based on issuance of the updated guidance in LR-ISG-2016-01, the staff determined that the draft further evaluation guidelines in draft SRP-SLR Section 3.1.2.2.15 would no longer be necessary in relation to these AMR items. Therefore, the staff has deleted the draft versions of the further evaluation acceptance criteria in SRP-SLR,

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	Section 3.1.2.2.15 and the corresponding review procedures in SRP-SLR, Section 3.1.3.2.15 from the scope of the final NUREG–2192 report. In addition, Sections 3.1.2.2.15 and 3.1.3.2.15 in the final version of NUREG–2192 have been reformatted to now contain the staff's further evaluation acceptance criteria and review procedures guidance for managing loss of material and cracking in steel piping and piping that is exposed to concrete. However, based on issuance of LR-ISG-2016-01, the staff's perspective is that the programs consistent with GALL-SLR Report, AMP XI.M19, "Steam Generators," and GALL-SLR Report, AMP XI.M2, "Water Chemistry," remain as valid AMPs that may be used to manage any loss of material that may occur in these components as a result of boric acid corrosion mechanism. Thus, the applicable AMR items will continue to identify that GALL-SLR Report, AMP XI.M19, "Steam Generators," is the appropriate AMP for performing inspections of the steam generator head and tubesheet components and that AMP XI.M2, "Water Chemistry," is appropriate for controlling the concentrations of reactor coolant additives and impurities that, otherwise if left uncontrolled, could potentially induce loss of material due to boric acid corrosion in the components. Alternatively, a PWR subsequent license renewal applicant may propose an alternative AMP basis (e.g., the program that corresponds to GALL-SLR Report, AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD") for managing any loss of material that may occur in these components as a result of boric acid corrosion. Consistent with the guidance in NEI 95-10, Revision 6, the alternative AMR basis for using another program as an alternative AMP would be identified in the applicable SLRA AMR table using NEI 95-10, Revision 6, Generic AMR Note E, and potential plant-specific AMR footnotes associated with the items, as appropriate.
IV.D1.R-437	This new AMR item references GALL-SLR Report, AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators" to manage cracking due to flow-induced vibration or high-cycle fatigue in PWR nickel alloy steam generator tubes (at tube support plate locations) exposed to secondary feedwater or steam. See also technical basis discussion for AMR items IV.D1.R-47, IV.D1.R-48, and IV.D1.R-437 in Table 2-17 of this NUREG report.
IV.D2.R-442	This new AMR item references AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators" to manage cracking due to flow-induced vibration or high-cycle fatigue in PWR nickel alloy steam generator tubes (at tube support plate locations) exposed to secondary feedwater or steam. See technical basis discussion for AMR items IV.D2.R-47, IV.D2.R-48, and IV.D2.R-442 in Table 2-17 of this NUREG report.
IV.E.R-444	The staff developed new AMR item IV.E.R-444 in Table IV.E of NUREG–2191 and new AMR item No. 114 in Table 3.1-1 of NUREG–2192 to provide a generic set of AMR items that may be used manage cracking and loss of material in miscellaneous reactor coolant system components. The items apply to and may be used for those components in the reactor coolant system that are: (a) defined as ASME Code, Section XI reactor coolant pressure boundary or core support components (including component supports, vessel appurtenances and associated pressure boundary welds), and (b) are outside the scope of other AMR items for ASME Code Class components in the system specific tables of Chapter IV of the GALL-SLR Report (i.e., not specifically

Table 2-3 New AMR Items Added in GALL-SLR Report, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
New AMR Item No.	**Technical Bases for Changes**
	covered by AMR items for ASME Code Class 1 components in Tables IV.A1, IV.A2, IV.B1, IV.B2, IV.B3, IV.B4, IV.C1, IV.C2, IV.D1, or IV.D2 of the GALL-SLR Report. The new generic AMR items identify that the AMPs in 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) may be used to manage any cracking or loss of material that may occur in the components, without any need for further evaluation of the program element criteria used to manage the affects.
IV.E.R-453	The staff developed new AMR item IV.E.R-453 in Table IV.E of NUREG–2191 and new AMR item No. 137 in Table 3.1-1 of NUREG–2192 to provide a new set of AMRs that may be used for RCS piping and piping components that are made from copper alloy materials and are exposed to either an air–indoor uncontrolled, gas, or condensation environment. The changes resolve stakeholder comments that copper alloy components in air–indoor uncontrolled, gas, or condensation environments would not be subject to any aging effects that require aging management during a proposed subsequent period of extended operations. The staff determined that copper alloy materials would be protected from corrosion in these types of environments due to the presence of metallic oxides that would render corrosion resistance in the materials. Therefore, RCS piping and piping components that are made from copper alloy and exposed to an air–indoor uncontrolled, gas, or condensation environment are now addressed in new AMR item IV.E.R-453, which identifies that there are not any aging effects that need to be managed for copper alloy components exposed to these environments or any AMPs that would otherwise be needed to manage aging if there were specific aging effects that were applicable to these material-environmental combinations.

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
V.C.E-09 V.D1.E-09	These two items were added to E 09 to include Table C, "Containment Isolation Components," and D1, "Emergency Core Cooling Systems (Pressurized Water Reactor)," components, which are equally applicable to the material, environment, aging effect, and aging management program combination as Table D1, "Emergency Core Cooling Systems (Boiling Water Reactor)," components.
V.E.E-418	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report aging management review (AMR) items citing bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The periodic visual inspections recommended in GALL-SLR Report, aging management program (AMP) XI.M18 are sufficient to detect loss of material for these material and environment combinations. In addition, GALL-SLR Report, AMP XI.M18 was revised to include recommendations for managing loss of material for bolting that is submerged (e.g., bolted components in a drainage sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage.
V.A.E-420 V.E.E-420 V.D1.E-420 V.D2.E-420	GALL-SLR Report AMR items citing piping, piping components, and tanks exposed to soil or concrete were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	Report. GALL-SLR Report, AMP XI.M41 includes recommendations addressing cracking for these material and environment combinations. Potential cracking of steel materials was addressed in LR-ISG-2015-01, "Changes to Buried and Underground Piping and Tank Recommendations." The term, "steel in carbonate/bicarbonate environment only" was added to clarify that cracking of steel components would only occur in these two environments. The staff concluded this based on a review of National Association of Corrosion Engineers (NACE) SP0169-2013, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," Figure 2, "SCC Range of Pipe Steel in Carbonate/Bicarbonate Environments." Although other stainless steel and aluminum components cite a Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) further evaluation to determine whether one-time or periodic inspections are conducted to detect potential cracking, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of cracking. The items citing Tables A, D1, and D2 were editorially consolidated into a single item citing GALL-SLR Report, Table E, "External Surfaces of Components, and Miscellaneous Bolting."
V.E.E-421	GALL-SLR Report AMR items citing closure bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Due to the potential presence of halides in any of the cited environments, stress corrosion cracking (SCC) is an applicable aging effect for stainless steel (SS) closure bolting. The periodic visual inspections recommended in GALL-SLR Report, AMP XI.M18 are sufficient to detect cracking for these material and environment combinations. The items citing Tables A, D1, and D2 were editorially consolidated into a single item citing GALL-SLR Report, Table E, "External Surfaces of Components and Miscellaneous Bolting."
V.E.E-422	Non-metallic thermal insulation exposed to an air or condensation environment was initially added in GALL Report Revision 2, Chapter VIII by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation." The previously cited materials (calcium silicate, fiberglass, and foamglass®) were consolidated into "any" type of non-metallic thermal insulation. Metallic thermal insulation is not included because insufficient moisture could accumulate to significantly, adversely affect thermal insulation resistance.
V.E.E-423a V.E.E-423b V.E.E-423c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, [Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090] and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components.

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-424	AMR items for heat exchanger tubes exposed to air or condensation were added in recognition of air to water heat exchangers that are within the scope of license renewal. This category of heat exchangers is included in Generic Letter (GL) 89-13, which permits visual inspections on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. Not all in-scope heat exchangers are also within the scope of GL 89-13; however, the above provides a basis for visual inspections on the air side of these heat exchangers. Periodic visual inspections conducted by AMP XI.M36 can be capable of detecting this aging effect. The condensation environment was included because depending on the humidity level and internal tube temperature, condensation may be present on the tubes.
V.A.E-427 V.B.E-427 V.D1.E-427 V.D2.E-427	Although the GALL AMR item is new, the material, environment, and aging effect is the same as GALL Revision 2 AMR item EP-58. Piping and piping components were added to ensure that components such as flex hoses are included. The environment is cited as air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report Chapter IX.D. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination.
V.A.E-428 V.D1.E-428 V.D2.E-428	Based on a review of Electric Power Research Institute (EPRI) 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change is documented in the response to comment No. 015-007. Microbiologically influenced corrosion (MIC) was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect nickel alloy materials in a treated water environment as cited in ASM Handbook Volume 13A, Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-63 for additional information. The staff noted that EPRI 1010639 states, "[t]here are many treated water systems such as the borated emergency core cooling systems in PWRs that have not experienced MIC problems during the life of the plant. The potential for MIC contamination of these systems is highly unlikely and is not expected to be a concern during the license renewal period." However, given the potential for stagnant flow locations and a longer interval for exposing the component to potential contamination, the staff concluded that loss of material due to MIC should be managed.

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
V.A.E-434 V.B.E-434 V.C.E-434 V.D1.E-434 V.D2.E-434	Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water) and a review of general rates of corrosion for steel piping, the staff has concluded that a one-time inspection for loss of material is appropriate. Details of the staff's review of general rates of corrosion for steel piping are documented in the response to comment No. 015-003. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some existing GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program program element to not conduct a one-time inspection if a representative sample of wall thickness measurements had been conducted within the 50 to 60 year time frame. The staff concluded that wall thickness measurements conducted within this time period would provide sufficient data to project loss of material rates through 80 years of operation.
V.D1.E-439	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. The cited aging effect requiring management in this new AMR item is consistent with GALL Report Revision 2, AMR items AP-55 and AP-183; however, the staff added flow blockage due to fouling. Flow blockage due to fouling was added as an aging effect requiring management (AERM) based on the staff's review of industry operating experience (OE). Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source or corrosion from upstream piping that is subject to loss of material due to general corrosion. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. AMP XI.M38 includes inspections that are capable of detecting loss of material and flow blockage.
V.D2.E-440	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report, AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. The cited aging effect requiring management in this new AMR item is consistent with GALL

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	Report Revision 2, AMR items AP-55 and AP-183; however, the staff added flow blockage due to fouling. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source or corrosion from upstream piping that is subject to loss of material due to general corrosion. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. AMP XI.M38 includes inspections that are capable of detecting loss of material and flow blockage.
V.D1.E-441 V.D2.E-441	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of ASM Handbook, Volume 13B, Corrosion: Materials, Corrosion of Copper and Copper Alloys, ASM International, 2006, pages 129–133, the staff has concluded that copper alloy (>15% Zn or >8% Al) components exposed to potential ground water in the soil environment are susceptible to selective leaching. AMP XI.M33 contains specific recommendations for managing loss of material due to selective leaching for buried copper alloy (>15% Zn or >8% Al) components.
V.E.E-442a V.E.E-442b V.E.E-442c V.E.E-442d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The four environments were cited because any of these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.2.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-444b V.E.E-444c V.E.E-444d	Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The air and condensation environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.2.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.D1.E-445a V.D1.E-445b V.D1.E-445c V.D2.E-445a V.D2.E-445b V.D2.E-445c	Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys, B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. These environments were cited because any of these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR Section 3.2.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.D1.E-446a V.D1.E-446b V.D1.E-446c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
V.D2.E-446a V.D2.E-446b V.D2.E-446c	Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.D1.E-447 V.D2.E-447	These AMR items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other aluminum components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material.
V.D1.E-448a V.D1.E-448b V.D1.E-448c V.D2.E-448a V.D2.E-448b V.D2.E-448c	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interact with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.2.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.D1.E-449a V.D1.E-449b V.D1.E-449c V.D2.E-449a V.D2.E-449b V.D2.E-449c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639 Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
V.E.E-450a V.E.E-450b V.E.E-450c V.E.E-450d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-451a V.E.E-451b V.E.E-451c V.E.E-451d	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-452a V.E.E-452b V.E.E-452c V.E.E-452d	Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The air and condensation environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.2.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-453a V.E.E-453b V.E.E-453c	Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The underground environment was cited because it could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.2.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-454a V.E.E-454b V.E.E-454c	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.2.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-455a V.E.E-455b V.E.E-455c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
V.B.E-457 V.C.E-457 V.D2.E-457	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. This material, environment, aging effect, and AMP combination is consistent with existing GALL Report Revision 2 items AP-112.
V.A.E-458 V.D1.E-458 V.D2.E-458	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5, are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2, items AP-139, EP-74, SP-96, and SP-100.
V.F.E-459	This item was added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Grade 9 was added based on the staff's review of Materials Properties Handbook: Titanium Alloys, Gerhard Welsch, Rodney Boyer, E. W. Collings, ASM International, 1993, page 217.
V.A.E-460 V.D1.E-460 V.D2.E-460	This item was added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5, are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2 items such as SP-41, where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
V.F.E-461	This item was added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Grade 9 was added based on the staff's review of Materials Properties Handbook: Titanium Alloys, Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217.
V.E.E-462a V.E.E-462b V.E.E-462c V.E.E-462d	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.2.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-463	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other aluminum components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting loss of material.
V.E.E-464a V.E.E-464b V.E.E-464c V.E.E-464d	This item was added based on the staff's review of Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur in water environments that could potentially contain deleterious materials (e.g., raw water, ground water, waste water). The staff determined that the most accurate and practical method for determining the susceptibility materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR Section 3.2.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.E-465	Although the GALL AMR item is new, the material, environment, and aging effect is the same as GALL Revision 2, AMR item AP-113. Piping and piping components were added to ensure that components such as flex hoses are included. The environment cites air in lieu of specific air environments (e.g., air-indoor uncontrolled) because loss of material due to wear can be independent of the air environment. For example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Section IX.F). Wear can also occur due to abrasive particles in the air. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M36 are sufficient to detect loss of material due to wear for this material and environment combination.
V.A.E-466 V.B.E-466 V.C.E-466 V.D1.E-466 V.D2.E-466	Although the GALL AMR item is new, the material, environment, and aging effect is the same as GALL Revision 2, AMR item AP-103. Piping and piping components were added to ensure that components such as flex hoses are included.

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	The environment cites air in lieu of specific air environments (e.g., air-indoor uncontrolled) because loss of material due to wear can be independent of the air environment. For example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Section IX.F). Wear can also occur due to abrasive particles in the air. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect loss of material due to wear for this material and environment combination.
V.F.E-467	The staff has concluded that aluminum is not susceptible to loss of material in an air with borated water leakage. Uhlig's Corrosion Handbook, 3rd Edition, Chapter B11, "Chemicals," states that, "[b]oric acid solutions in all concentrations up to saturated have negligible actions on aluminum alloys."
V.E.E-468	The staff added this new item based on its review of license renewal applications (LRAs). MIC is an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.
V.E.E-469	The staff added this item to address additional materials that are cited in AMP XI.M41. The likelihood of these aging effects progressing to the point where a loss of intended function could occur is low, although not nonexistent (due to the potential presence of acidic ground water or the groundwater contains chlorides and sulfates). Based on the low likelihood of a potential loss of intended function, AMP XI.M41 only recommends opportunistic inspections. The staff has concluded that titanium components are not susceptible to MIC based on its review of the following documents: • Microbiologically Influenced Corrosion, Titanium and Titanium Alloys, Brenda Little, John Wiley and Sons, 2007 • Microbiologically Influenced Corrosion Handbook, Section 5.5.1, "Titanium, By Susan Watkins Borenstein, Woodhead Publishing, 1994 • Uhlig's Corrosion Handbook, John Wiley and Sons, 2011 These sources state that biofouling can occur; however, there are no known cases of MIC occurring. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	examine the surface of the concrete to detect cracking that could admit ground water.
V.F.E-470	Based on the staff's review of the following documents, there is reasonable assurance that the aging effects associated with copper alloy components exposed to concrete will not be significant enough to result in a loss of intended function. • Corrosion of Nonferrous Metals in Contact with Concrete, Portland Cement Association, "Modern Concrete, February 1970, https://www.copper.org/applications/plumbing/techcorner/ pdf/corrosion_nonferrous_metals_contact_concrete.pdf, accessed on October 31, 2016. • "Corrosion of Embedded Material Other than Reinforcing Steel," Research and Development Laboratories of the Portland Cement Association, Research Department Bulletin 198, Hubert Woods/Significance of Tests and Properties of Concrete and Concrete-Making Materials STP No.169A, published by ASTM 1967. • ASM Handbook Volume 13B, "Corrosion: Materials," 2005. This document states that copper alloys are corrosion resistant or corrode at negligible rates except when exposed to oxidizing acids, oxidizing heavy-metal salts, sulfur, ammonia, and some sulfur and ammonia compounds. Concrete, which is primarily composed of calcium, silicon, and oxide compounds, is not a corrosive environment for copper alloys. The staff noted that the reference to SCC of copper piping exposed to concrete is in reference to copper alloys with greater than 15% zinc, not the copper alloys that are cited in this item.
V.E.E-471	The staff concluded that copper alloys are not susceptible to loss of material unless exposed to a water environment. See the basis for EP-10 for further information. The staff recognizes that underground vaults can experience in-leakage from groundwater and rain. In addition, the soil environment is subject to groundwater. As a result, loss of material for copper alloy components is managed for the soil and underground environments.
V.D1.E-472 V.D2.E-472	This item was added to address the tank interface surface with a soil or concrete environment. Citing loss of material due to pitting, crevice corrosion, and MIC (soil only) is consistent with other items such as A-758 and S-447. Although other stainless steel components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
V.A.E-473 V.D1.E-473 V.D2.E-473	This item was added to address potential loss of material for steel heat exchanger components exposed to lubricating oil. The change is consistent with item EP-77.
V.A.E-474 V.B.E-474 V.D1.E-474 V.D2.E-474	This item was added to address flow blockage due to fouling in aluminum piping exposed to raw water. It was added as an AERM based on the staff's review of industry OE. Aluminum piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. AMP XI.M38 includes inspections that are capable of detecting loss of material and flow blockage.
V.A.E-475 V.D1.E-475 V.D2.E-475	Based on its review of: (a) Materials Properties Handbook: Titanium Alloys, Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217; (b) Metals Handbook: Failure Analysis, 9th Edition. Volume 11. ASM International, p. 415. 1980; (c) http://www.azom.com/article.aspx?ArticleID=1547 (accessed on April 24, 2017); and (d) http://www.arcam.com/wp-content/uploads/Arcam-Ti6Al4V-Titanium-Alloy.pdf (accessed on April 24, 2017), the staff has concluded that: • Grades 3 and 4 are susceptible to cracking in a raw water environment. • Grade 5 has an aluminum content ranging from 5.5 to 6.76% and is therefore susceptible to cracking in a raw water environment. Subsequent to issuance of the GALL-SLR Report, the staff recognized that to be consistent with other GALL-SLR Report items associated with heat exchanger tubes, E-475 should have also cited reduction of heat transfer due to fouling. This is consistent with GALL Report Revision 2 item SP-41 where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
V.B.E-476 V.C.E-476 V.D2.E-476	This item was added to address instances where the specific grade of titanium could not be identified. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5, are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. A review of Uhlig's Corrosion Handbook, 3rd Edition, page 866 states "Excellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 °C [482 °F]. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such

Table 2-4 New AMR Items Added in GALL-SLR Report, Chapter V, Engineered Safety Features	
New AMR Item No.	**Technical Bases for Changes**
	as metal ions, sulfides, sulfates, and carbonates." As a result, the staff has concluded that titanium is not susceptible to loss of material in a raw water environment.
V.A.E-477b V.B.E-477b V.D1.E-477b V.D2.E-477b V.E.E-477a	This item was added as an informal request from the industry as discussed during a public meeting on April 13, 2017 (ADAMS Accession No. ML17108A491). These items would be used when the specific type of polymeric material has not been identified. As a result of the specific material type not being known, the staff included all applicable AERM. GALL-SLR Report, Chapter IX.C, "various polymeric materials," describes the intent of the term. For item E-477a, flow blockage due to fouling is not an applicable AERM because it is not an applicable AERM for the external environment of polymeric components
V.C.EP-42 V.C.EP-43 V.D1.EP-42 V.D1.EP-43 V.D1.EP-71	The technical basis for these item is available in Table 2-18.

Table 2-5 New AMR Items Added in GALL-SLR Report, Chapter VI, Electrical Components	
New AMR Item No.	**Technical Bases for Changes**
VI.A.L-07	Added to clarify and separate the aging mechanisms and effects due to fatigue from ohmic heating, thermal cycling, and electrical transients from those of chemical contamination, corrosion, and oxidation.
VI.A.L-09	Addition of cable bus
VI.A.L-11	Addition of cable bus
VI.A.L-12	Addition of cable bus
VI.A.L-13	Addition of cable bus
VI.A.L-14	Addition of cable bus

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.E1.A-69a	The U.S. Nuclear Regulatory Commission (NRC) staff added this new aging management review (AMR) item to address pressurized water reactor (PWR) regenerative heat exchangers where plant-specific operating experience (OE) revealed cracking. Based on its review of many license renewal applications (LRAs), the staff concluded that for most PWR plants, plant-specific OE did not reveal cracking in the nonregenerative heat exchangers. When cracking is not revealed, cracking is managed by item VII.E1.A-69. In the Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR), this item cited a plant-specific aging management program (AMP). The NRC staff recognized that the augmented actions recommended in the further evaluation (i.e., temperature and radioactivity monitoring of the shell side water, and where component configuration permits, periodic eddy current testing of tubes) would typically be included in AMP XI.M21A. By citing AMP XI.M21A in the AMR item in lieu of a plant-specific AMP, applicants can cite a consistency with the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report rather than justifying a plant-specific AMP in its further evaluation response.
VII.C1.A-417 VII.F1.A-417 VII.F2.A-417 VII.F3.A-417 VII.F4.A-417	The staff added this new AMR item to address air to water side heat exchangers. Loss of material is known to occur for steel components in a condensation environment. See Generic Aging Lessons Learned (GALL) Report Revision 2 items A-08 and A-81. The periodic inspections recommended in AMP XI.M36 are capable of detecting loss of material.
VII.C1.A-419 VII.F1.A-419 VII.F2.A-419 VII.F3.A-419 VII.F4.A-419	The staff added these new AMR items to address air to water side heat exchangers located within ducts. Fouling is known to occur in air environments due to the potential for the accumulation of deposits on surfaces. These deposits occur due to particles in the air surrounding the component (e.g., dust, maintenance debris). The deposits can result in a reduction in heat transfer because they act as insulators. The basis for conducting a visual inspection in accordance with AMP XI.M38 is Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment," which states that it may not be possible to obtain enough heat load to conduct an efficiency test. As an alternative, GL 89-13 recommends that a visual inspection be conducted on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting reduction of heat transfer for these types of heat exchangers because the deposits would be visible on the surface of the tubes.
VII.I.A-423	GALL-SLR Report AMR items citing bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report, AMP XI.M18 was revised to include recommendations for managing loss of material for bolting that is submerged (e.g., bolted components in a drainage sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage in these environments. The periodic visual inspections recommended in AMP XI.M18 are sufficient to detect loss of material for this material and environment combination.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.I.A-425	GALL-SLR Report AMR items citing piping, piping components, and tanks exposed to soil or concrete were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M41 includes recommendations addressing cracking for these material and environment combinations. Potential cracking of steel materials was addressed in LR-ISG-2015-01, "Changes to Buried and Underground Piping and Tank Recommendations." The term, "steel in carbonate/bicarbonate environment only" was added to clarify that cracking of steel components would only occur in these two environments. The staff concluded this based on a review of National Association of Corrosion Engineers (NACE) SP0169-2013, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," Figure 2, "SCC Range of Pipe Steel in Carbonate/Bicarbonate Environments." The items citing Tables C3, E5, G, H1, and H2 were editorially consolidated into a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.I.A-426	GALL-SLR Report AMR items citing closure bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Due to the potential presence of halides in any of the cited environments, stress corrosion cracking (SCC) is an applicable aging effect for stainless steel (SS) closure bolting. The periodic visual inspections recommended in AMP XI.M18 are sufficient to detect cracking for this material and environment combination. The items citing Tables C1, C3, E5, G, H1, and H2 were editorially consolidated into a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.I.A-428	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The matrix of fiberglass piping can be constructed of different materials (e.g., epoxy resin, reinforced vinyl ester resin). These materials are influenced differently when exposed to an air-outdoor environment. *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Roff, W.J., Academic Press Inc., New York, 1956, Plastic Piping Institute, Recommended Design Factors and Design Coefficients for Thermoplastic Pressure Pipe, Topical Report (TR)-9/2002, October 2002 states that stressors for fiberglass reinforced piping and piping components include light, high radiation, or ozone concentrations. The periodic visual inspections recommended by AMP XI.M36 can detect cracking, blistering or loss of material.
VII.A3.A-439 VII.A4.A-439 VII.C2.A-439 VII.E1.A-439 VII.E2.A-439 VII.E3.A-439 VII.G.A-439 VII.H2.A-439	Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water) and a review of general rates of corrosion for steel piping, the staff has concluded that a one-time inspection for loss of material is appropriate. Details of the staff's review of general rates of corrosion for steel piping are documented in the response to comment No. 015-003. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some existing GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program program element to not conduct a one-time inspection if a representative sample of wall thickness measurements had been conducted within the 50 to 60 year time frame. The staff concluded that wall thickness measurements conducted within this time period would provide sufficient data to project loss of material rates through 80 years of operation.
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 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	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 3.3.2.2.8. Raw water (potable) was added as a result of a review of several LRAs. Some applicants are using raw water (potable) as a source for fire water systems. Raw water (potable) could potentially contain halides. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
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	
VII.C1.A-454	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report, AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. The cited aging effect requiring management in this new AMR item is consistent with GALL Report Revision 2, AMR item AP-206; however, the staff added loss of material due to microbiologically influenced corrosion (MIC) and flow blockage due to fouling. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect nickel alloy materials as cited in the American Society for Metals (ASM) Handbook Volume 13A, Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. In addition, Electric Power Research Institute (EPRI) 1010639 Figure 3, "Raw Water / Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys Tool," states that MIC is a concern if the pH is less than 10.5. Flow blockage due to fouling was added as an aging effect requiring management (AERM) based on the staff's review of industry OE. Nickel alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	Loss of material due to MIC and flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M38.
VII.C1.A-458 VII.E5.A-458 VII.G.A-458	As discussed in the technical basis for a change to GALL-SLR Report AMR item AP-269, polyvinyl chloride (PVC) is not susceptible to any chemicals that would be found in the outdoor air environment at nuclear power plants. However, based on a review of JM Eagle™ Technical Bulletin, "The Effects of Sunlight Exposure on PVC Pipe and Conduit," JM Manufacturing Company Inc., January 2009, Long-term (2 years or longer) exposure of PVC piping and piping components to sunlight can result in a reduction in impact strength. Other polymeric materials are subject to embrittlement due to environmental conditions such as sunlight, ozone, chemical vapors, or loss of plasticizers due to evaporation." As submitted for public comment, this item cited sunlight as the environment and a plant-specific aging management program. The staff used the term "sunlight" to limit the applicability of the AMR item to the actual environment that results in the aging effect. For example, a PVC component could be exposed to outdoor air; however, be located in such a way as to shelter the component from sunlight. An industry comment proposed that it would be conservative to cite outdoor air as the environment. The staff agreed that it would be conservative and made the change. See the response to comment No. 015-009. An industry comment also recommended that AMP XI.M36 be cited in lieu of a plant-specific AMP. The staff noted that the "parameters monitored and inspected" program element of AMP XI.M36 states, "[t]he aging effects for elastomeric and flexible polymeric components are monitored through a combination of visual inspection and manual or physical manipulation of the material. Manual or physical manipulation of the material includes touching, pressing on, flexing, bending, or otherwise manually interacting with the material. The purpose of the manual manipulation is to reveal changes in material properties, such as hardness, and to make the visual examination process more effective in identifying aging effects such as cracking." In order to provide clarity on the recommendation associated with this material, environment, and aging effect combination, the staff revised the "parameters monitored and inspected" program element of AMP XI.M36. "[f]lexing and bending of PVC piping exposed directly to sunlight (i.e., not located in a structure restricting access to sunlight such as manholes, enclosures, and vaults or isolated from the environment by coatings) is conducted to detect indications of the potential for reduction of impact strength such as a crackling sound when flexed or surface cracks."
VII.C1.A-460	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. A common AERM was developed for all fiberglass items. As a result, loss of material was added to the aging effects based on the staff's in-field observation of degrading fiberglass piping. In some items such as this one where the environment is raw water, not all of the aging mechanisms apply (i.e., ultraviolet light, ozone). Change in color was not included as an aging effect because the

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was included as an AERM based on the staff's review of industry OE. Fiberglass piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. AMP XI.M38 includes periodic visual inspections, which are capable of detecting these aging effects.
VII.C1.A-461	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report, AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Fiberglass components exposed to raw water are subject to loss of material due to wear due to the potential presence of abrasive particles. Flow blockage due to fouling was included as an AERM based on the staff's review of industry OE. Fiberglass piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. The internal visual inspections recommended by AMP XI.M38 are capable of detecting these aging effects.
VII.I.A-462	Buried fiberglass piping is susceptible to mechanical wear due to ground movement of deleterious materials in the backfill. AMP XI.M41 includes recommended periodic inspections that are capable of detecting loss of material in buried fiberglass piping. The items citing Tables E5 and G were editorially consolidated into a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.C2.A-471	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4," the staff has concluded that closed-cycle systems are susceptible to MIC. In addition, EPRI 1010639, Figure 1, "Treated Water/Stainless Steel and Nickel-Base Alloys," if oxygen levels are above 100 ppb, crevice corrosion could occur. If oxygen levels are above 100 ppb and halides or sulfate levels are above 150 ppb, pitting can occur. The staff has concluded that cracking is not an applicable aging effect because it is not expected that the temperature in closed-cycle cooling water systems will exceed 260 °C [500 °F], the threshold in EPRI 1010639, Table 4-1, "Aging Effects Summary - Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys."
VII.C1.A-473b VII.C2.A-473a VII.E5.A-473c	The staff has concluded that copper alloy (>15% Zn or >8% Al) exposed to closed-cycle cooling water, raw water, and waste water can be susceptible to cracking due to stress corrosion cracking. EPRI 1010639 states, "[t}he necessary chemical substance to cause SCC in copper and copper alloys is ammonia or other ammonium compounds. These chemical substances are sometimes used in treated water systems to control the fluid pH or can be present as a result of an

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	ammonium based cleaning solvent. Ammonia can also be present in the atmosphere as a result of organic decay. In addition to ammonia or ammonium compounds, oxygen and moisture are also required to promote SCC in the copper alloys while other contaminants such as carbon dioxide may act as catalysts to increase the rate of cracking." Likewise for raw water and waste water, these deleterious compounds can be present. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, pages 129–133, the staff concluded that copper alloy (>15% Zn) is susceptible to cracking due to SCC in air or condensation environments depending on the presence of ammonia-based compounds. In addition to being present in the outdoor air environment, they could be conveyed to the surface of a copper alloy (>15% Zn or >8% Al) component via leakage through the insulation from bolted connections (e.g., flange joints, valve packing).
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	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.3.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Polymeric materials are susceptible to loss of material due to wear when exposed to abrasive particles, see GALL-SLR Report, Chapter IX F. The staff has concluded that the air environment could contain enough abrasive particles (although probably low in concentration), that could cause wear over time. The periodic visual inspections recommended by AMP XI.M38 can detect loss of material for this material and environment combination.
VII.E1.A-504 VII.E2.A-504 VII.E3.A-504 VII.E4.A-504 VII.E5.A-504 VII.F1.A-504 VII.F2.A-504 VII.F3.A-504 VII.F4.A-504	Although the GALL-SLR AMR item is new, the material, environment, and aging effect is the same as GALL Revision 2, AMR item EP-58. Piping and piping components were added to ensure that components such as flex hoses are included. The environment is cited as air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report, Chapter IX.D. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.G.A-504	sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination.
VII.C1.A-532 VII.C3.A-532 VII.E4.A-532 VII.G.A-532 VII.H2.A-532	Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water, raw water (potable)] and a review of general rates of corrosion for steel piping, the staff has concluded that a one-time inspection for loss of material is appropriate. Details of the staff's review of general rates of corrosion for steel piping are documented in the response to comment No. 015-003. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some existing GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program program element to not conduct a one-time inspection if a representative sample of wall thickness measurements had been conducted within the 50 to 60 year time frame. The staff concluded that wall thickness measurements conducted within this time period would provide sufficient data to project loss of material rates through 80 years of operation.
VII.I.A-537	Based on a review of "PVC Degradation and Stabilization," George Wypych, Chem Tec Publishing, 2008, and Advances in Polymer Nanocomposites - Types and Applications, Fengge Gao, Woodhead Publishing, 2012; buried PVC is not susceptible to thermal, UV, or radiation related degradation. In addition, based on the typical range of environments within the pipe and the soil composition, PVC is not susceptible to chemical degradation. However, PVC is susceptible to mechanical wear due to ground movement of deleterious materials in the backfill. The item citing Table E5 was consolidated to a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolding."
VII.E5.A-547	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, pages 129–133, the staff has concluded that copper alloy (>15% Zn or >8% Al) components exposed to waste water are susceptible to selective leaching. The staff has concluded that loss of material due to selective leaching should be managed for ductile iron components exposed to waste water. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090). Loss of material due to selective leaching is consistent with existing GALL Report Revision 2, item A-51 because the staff concluded that waste water would be at least as aggressive as the raw water environment cited in item A-51. AMP XI.M33 contains specific recommendations for managing loss of material due to selective leaching for these material types.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.E5.A-550	GALL-SLR Report, AMR item A-550 citing elastomeric piping, piping components, and seals exposed to waste water was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Elastomers are susceptible to loss of material due to wear when exposed to abrasive particles, see GALL-SLR Report, Chapter IX.F. The staff has concluded that the waste water environment could contain abrasive particles. The environment cites air because loss of material due to wear can occur in an air environment. For example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Chapter IX.F). Wear can also occur due to abrasive particles in the air. Flow blockage can occur due to potential intrusion of fouling products from the waste water source.
VII.E5.A-551	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. A common AERM was developed for all fiberglass items. As a result, loss of material was added to the aging effects based on the staff’s in-field observation of degrading fiberglass piping. In some items, such as this one where the environment is waste water, not all of the aging mechanisms apply (i.e., ultraviolet light, ozone). Change in color was not included as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was included as an AERM based on the staff’s review of industry OE. Fiberglass piping exposed to waste water is subject to this aging effect due to the potential intrusion of fouling products from the water source. AMP XI.M38 includes periodic visual inspections, which are capable of detecting these aging effects.
VII.E5.A-552	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Fiberglass components exposed to waste water environments are subject to loss of material due to wear due to the potential presence of abrasive particles. Fiberglass components exposed to waste water are subject to flow blockage due to fouling due to the potential intrusion of fouling products from the water source. AMP XI.M38 includes periodic visual inspections, which are capable of detecting these aging effects.
VII.F1.A-565 VII.F2.A-565 VII.F3.A-565 VII.F4.A-565 VII.G.A-565 VII.H2.A-565	The staff added a series of material, environment, and aging effects for components exposed to condensation. Fouling is known to occur in air environments due to the potential for the accumulation of deposits on surfaces. These deposits occur due to particles in the air surrounding the component (e.g., dust, maintenance debris). The deposits can result in a reduction in heat transfer because they act as insulators. In regard to air to water side heat exchangers, GL 89-13 states that it may not be possible to obtain enough heat load to conduct an efficiency test. As an alternative, GL 89-13 recommends that a visual inspection be conducted on the air (condensation) and water side of the heat exchanger to ensure cleanliness of

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	the heat exchanger. The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting this aging effect.
VII.F1.A-566 VII.F2.A-566 VII.F2.A-566 VII.F4.A-566	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Managing loss of material for steel components exposed to steam with AMPs XI.M2 and XI.M32 is consistent with GALL Report Revision 2 AMR item SP-71. In addition, and in regard to copper in particular, ASM Handbook, Volume 11, "Failure Analysis and Prevention," William T. Becker and Roch J. Shipley, 2002, Section 75.5.2, "Corrosion of Components Exposed to Steam," page 615, states, "[s]urfaces exposed to steam in superheaters, reheaters, steam piping, and turbines usually do not corrode. However, certain conditions that exist during start-up, shutdown, and idle periods may cause corrosion of these components." The handbook also states that oxygen, present during shutdown periods, is the principal reason for loss of material. General corrosion was deleted as an aging mechanism for copper alloy components exposed to steam. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to steam. EPRI 1010639, Appendix A, "Treated Water," Section 3.1.1, includes steam environments. Therefore, the staff's conclusions related to copper alloy components exposed to treated water (general corrosion is not an applicable aging mechanism) apply to copper alloy components exposed to steam. The staff also reviewed Oilfield Water Technology, NACE International, 2006, Section 6.5, "Copper Alloys," page 95, which states, "[c]opper and its alloys are generally resistant to corrosion by steam…" The one-time inspections recommended in AMP XI.M32 can be effective at determining whether during shutdown periods, loss of material sufficient to challenge the intended function of the components has occurred. AMP XI.M32 further recommends that when inspection results do not meet acceptance criteria, a periodic inspection program is developed for the particular material, environment, and aging effect combination.
VII.F1.A-567 VII.F2.A-567 VII.F2.A-567 VII.F4.A-567	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Managing loss of material for stainless steel components exposed to steam with AMPs XI.M2 and XI.M32 is consistent with GALL Report Revision 2, AMR item SP-155.
VII.G.A-623	An AMR item for aluminum fire water storage tanks was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other aluminum components exposed to air and condensation cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential cracking, for fire water storage tanks, the further evaluation section is not cited because AMP XI.M27 recommends periodic inspections of the internal and external surfaces of these tanks to detect cracking. The more frequent inspections (i.e., external surfaces annually or refueling outage interval, internally noncoated surfaces every 3 years, internally coated surfaces every 5 years) will reasonably suffice to detect cracking that is growing prior to the point where a loss of intended function would occur Raw water (potable) and treated water were added as a result of a review of several LRAs. Some applicants are using raw water (potable) as a source for fire water systems.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	Although AMP XI.M27 does not cite surface examinations to detect cracking for these tanks, the more frequent inspections (i.e., external surfaces annually or refueling outage interval, internally noncoated surfaces every 3 years, internally coated surfaces every 5 years) will reasonably suffice to detect cracking that is growing prior to the point where a loss of intended function would occur. In addition, the tank bottoms exposed to soil or concrete are volumetrically inspected.
VII.G.A-626	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Masonry walls are subject to cracking over time when exposed to any air environment consistent with GALL Report Revision 2, AMR item T-12. Loss of material and cracking can occur when moisture enters the masonry wall material and freezes due to cold temperature exposure to outdoor air. The visual inspections conducted with AMP XI.M26 and AMP XI.S5 are capable of detecting cracking in masonry walls.
VII.G.A-644	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. A common AERM was developed for all fiberglass items. As a result, loss of material was added to the aging effects based on the staff's in-field observation of degrading fiberglass piping. In some items such as this one where the environment is soil, not all of the aging mechanisms apply (i.e., ultraviolet light, ozone, radiation). Change in color was not included as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was included as an AERM based on the staff's review of industry OE. Fiberglass piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the water source. The staff concluded that there is reasonable assurance that there would not be enough fouling products from raw water (potable) or treated water sources to result in flow blockage due to fouling. AMP XI.M38 includes periodic visual inspections, which are capable of detecting these aging effects.
VII.G.A-645	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Fiberglass components exposed to raw water, raw water (potable), and treated water environments are subject to loss of material due to wear due to the potential presence of abrasive particles or flow velocity changes (for all water environments) where the configuration of the piping system causes perturbations in flow velocity. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. The staff concluded that there is reasonable assurance that components exposed to raw water (potable) and treated water would not be susceptible to flow blockage due to fouling because there is a low likelihood that there would be sufficient fouling products from these sources of water. The periodic internal visual inspections recommended by AMP XI.M38 are capable of detecting these aging effects.
VII.G.A-647	This item was added based on the staff's review of LRAs. Cementitious piping and piping components exposed to raw water was not an available AMR item in the fire water protection table, VII.G. In addition, the staff added the treated water and raw (potable) environment because some sites use these as sources of makeup for their fire water systems.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	The aging effects and mechanisms were developed from: • Sections 21, “Cracking,” and 2.2, “Distress,” in ACI 201.1R-08, “Guide for Conducting a Visual Inspection of Concrete in Service.” • Section 1.3, “Cracking of Hardened Concrete,” in ACI 224.1R-07, “Causes, Evaluation, and Repair of Cracks in Concrete Structures.” AMP XI.M27 can be effective at detecting aging in these components based on the recommendation in the detection of aging effects, which states that water-based fire protection systems are normally maintained at required operating pressure and monitored in such a way that loss of system pressure is immediately detected and corrected when acceptance criteria are exceeded. Continuous system pressure monitoring or equivalent methods (e.g., number of jockey fire pump starts or run time) are conducted. In addition, visual inspections, when conducted, can detect these aging effects. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Cementitious piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. The staff concluded that there is reasonable assurance that there would not be enough fouling products from raw water (potable) or treated water sources to result in flow blockage due to fouling. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M27.
VII.G.A-648	This item was added based on the staff’s review of LRAs. High density polyethylene (HDPE) piping and piping components exposed to raw water, treated water, and raw water (potable) was not an available AMR item in the fire water protection table, VII.G. The staff added the treated water and raw (potable) environment because some sites use these as sources of makeup for their fire water systems. Cracking and blistering are appropriate aging effects, consistent with GALL Report Revision 2, item AP-239. Change in color was not included as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. HDPE piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. The staff concluded that there is reasonable assurance that there would not be enough fouling products from raw water (potable) or treated water sources to result in flow blockage due to fouling. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M27. AMP XI.M27 can be effective at detecting aging in these components based on the recommendation in the detection of aging effects, which states that water-based fire protection systems are normally maintained at required operating pressure and monitored in such a way that loss of system pressure is immediately detected and corrected when acceptance criteria are exceeded. Continuous system pressure monitoring or equivalent methods (e.g., number of jockey fire pump starts or run time) are conducted.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.G.A-649	Based on industry feedback, the staff revised AMP XI.M27 to allow aging effects associated with fire water system components having only a leakage boundary (spatial) or structural integrity (attached) intended function as defined in SRP-SLR Table 2.1-4(b), to be managed by AMP XI.M36, "External Surfaces Monitoring of Mechanical Components." The basis for this change is that the piping that falls within this category does not have an in-scope fire water function. The only intended functions, in brief, are to not leak, fall down, or cause the failure of an in-scope portion of piping that has an in-scope fire water function. This being the case, AMP XI.M36 is sufficient to manage the associated aging effects.
VII.G.A-650	Based on industry feedback, the staff revised AMP XI.M27 to allow aging effects associated with fire water system components having only a leakage boundary (spatial) or structural integrity (attached) intended function SRP-SLR Table 2.1-4(b), to be managed AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components." The staff also revised the AMP to state that flow blockage due to fouling need not be managed for these components. The basis for this change is that the piping that falls within this category does not have an in-scope fire water function. The only intended functions, in brief, are to not leak, fall down, or cause the failure of an in-scope portion of piping that has an in-scope fire water function. This being the case, AMP XI.M38 is sufficient to manage the associated loss of material aging effects.
VII.H1.A-660	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. As cited in GALL-SLR Report, Chapter IX.C, elastomers are an encompassing term used to refer to a variety of viscoelastic polymers including natural and synthetic rubbers. Depending on the composition of the elastomeric material and fuel oil, hardening or loss of strength could occur. Plant-specific evaluation of the specific material and environment is necessary to evaluate this material, environment, and aging effect combination. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination.
VII.H2.A-677	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Depending on the composition of the elastomeric material and lubricating oil, hardening or loss of strength could occur. In addition, as stated in GALL-SLR Report, Chapter IX.E, hardening or loss of strength of elastomers can be induced by elevated temperature. Plant-specific evaluation of the specific material and environment is necessary to evaluate this material, environment, and aging effect combination. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening or loss of strength due to elastomer degradation I for this material and environment combination.
VII.J.A-703	Based on a review of Uhlig's Corrosion Handbook, 3rd Edition, 2011, pages 867–868, the staff has concluded that titanium exposed to condensation is not susceptible to loss of material due to pitting and crevice corrosion. • Titanium does not exhibit spontaneous pitting corrosion under normal circumstances and pitting corrosion failures of titanium in service are extremely rare (page 867).

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	• Crevice corrosion of titanium has rarely, if ever, been observed under field or laboratory testing conditions at temperature less than 70 °C [158 °F] (page 867). • A very narrow (on the order of 0.01 mm), deep (greater than 1 cm) crevice is required to initiate crevice corrosion in titanium (pages 867–868). • A temperature limit of 80 °C [176 °F] has served as a conservative upper limit for titanium in brine environments with a pH less than or equal to 9 (page 867). The staff also notes that a brine environment is more aggressive than condensation. The staff has concluded that titanium is not susceptible to general corrosion based on its review of Uhlig's Corrosion Handbook, 3rd Edition. Page 866 states "Excellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 °C [482 °F]. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such as metal ions, sulfides, sulfates, and carbonates." Condensation is a less aggressive environment than sea water.
VII.I.A-704	Non-metallic thermal insulation exposed to an air or condensation environment was initially added in GALL Report, Revision 2, Chapter VIII by LR-ISG-2012-02, Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation." The previously cited materials (calcium silicate, fiberglass, and foamglass®) were consolidated into "any" type of non-metallic thermal insulation. Metallic thermal insulation is not included because insufficient moisture could accumulate to significantly, adversely affect thermal insulation resistance.
VII.I.A-706a VII.I.A-706b VII.I.A-706c	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The underground environment is cited because it could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides or halides could be present due to in-leakage of groundwater. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR Section 3.3.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.J.A-709	Based on a review of PVC Degradation and Stabilization, George Wypych, Chem Tec Publishing, 2008, and Advances in Polymer Nanocomposites - Types and Applications, Fengge Gao, Woodhead Publishing, 2012; buried PVC is not susceptible to thermal, UV, or radiation related degradation. In addition, based on

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	the typical range of concrete environments PVC is not susceptible to chemical degradation.
VII.J.A-710	The staff reviewed: (a) Roff, W.J., *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Academic Press Inc., New York, 1956, Plastic Piping Institute, (b) Recommended Design Factors and Design Coefficients for Thermoplastic Pressure Pipe, TR-9/2002, October 2002, and (c) The Corrosion Resistant Materials Handbook, by D.J. De Renzo and Ibert Mellan, 4th Edition. The staff noted that fiberglass piping embedded in concrete is not exposed to environmental stressors such as ultraviolet light, high radiation, or ozone concentrations or temperatures above 93 °C [200 °F]. The staff also noted that GALL-SLR Report, AMR item AP-176 states that fiberglass components exposed to soil can experience cracking, blistering, or loss of material. However, the staff has concluded that unlike the soil environment where groundwater can be abundant, fiberglass components embedded in concrete will not be exposed to sufficient water to result in cracking, blistering, or loss of material. In addition, should water penetrate the concrete barrier and cause cracking or blistering of the fiberglass piping, the concrete encapsulating the fiberglass provides reasonable assurance that the pressure boundary function of the piping will still be met.
VII.J.A-711	Based on the staff's review of the following documents, there is reasonable assurance that the aging effects associated with copper alloy components exposed to concrete will not be significant enough to result in a loss of intended function. • Corrosion of Nonferrous Metals in Contact with Concrete, Portland Cement Association, Modern Concrete, February 1970, https://www.copper.org/applications/plumbing/techcorner/pdf/corrosion_nonferrous_metals_contact_concrete.pdf, accessed on October 31, 2016. • "Corrosion of Embedded Material Other than Reinforcing Steel," Research and Development Laboratories of the Portland Cement Association, Research Department Bulletin 198, Hubert Woods/Significance of Tests and Properties of Concrete and Concrete-Making Materials STP No.169A, published by ASTM 1967. • ASM Handbook Volume 13B, "Corrosion: Materials," 2005. This document states that copper alloys are corrosion resistant or corrode at negligible rates except when exposed to oxidizing acids, oxidizing heavy-metal salts, sulfur, ammonia, and some sulfur and ammonia compounds. Concrete, which is primarily composed of calcium, silicon, and oxide compounds, is not a corrosive environment for copper alloys. The staff noted that the reference to SCC of copper piping exposed to concrete is in reference to copper alloys with greater than 15% zinc, not the copper alloys that are cited in this item.
VII.J.A-712	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The staff concluded that there are no aging effects requiring management and no recommended AMP for zinc components exposed to indoor air based on a review of ASM Handbook, Volume 13B, (page 404) which states that the corrosion rate of zinc in an indoor atmosphere is "very low, typically below 0.1 μm/yr (0.004 mil/yr)…" and "pitting is not a common form of corrosion in zinc

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	applications." In addition, the ASM Handbook states that "stress-corrosion cracking is generally not encountered by zinc products that are normally used for nonstructural applications." The staff did not include outdoor air in the list of environments based on the following. The following is an excerpt from the above reference: Atmospheric corrosion is a complex process involving a large number of interacting and constantly varying factors, such as weather conditions, air pollutants, and material conditions. The combined effect of these factors results in a great variation in corrosion rates, as shown in Fig. 2. The corrosion rate of zinc in atmospheric environments may vary from approximately 0.1 mm/yr (0.004 mil/yr) in indoor environments to as high as more than10 mm/yr (0.4 mil/yr) in industrial or marine environments [outside the splash zone] —2 orders of magnitude. The corrosion rate is lowest in dry, clean atmospheres and highest in wet, industrial atmospheres. Sea-coast atmospheres, not in direct contact with salt spray, are mildly corrosive to zinc.
VII.I.A-714a VII.I.A-714b VII.I.A-714c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items." The items citing Tables C1, C2, C3, D, E1, E4, F1, F2, F3, F4, G, H1, and H2, were editorially consolidated into a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.I.A-716	AMR items for heat exchanger tubes exposed to air or condensation were added in recognition of air to water heat exchangers that are within the scope of license renewal. This category of heat exchangers is included in GL 89-13, which permits visual inspections on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. Not all in-scope heat exchangers are also within the scope of GL 89-13; however, the above provides a basis for visual inspections on the air side of the heat exchangers cited in this item. Periodic visual inspections conducted by AMP XI.M36 can be capable of detecting this aging effect. The condensation environment was included because depending on the humidity level and internal tube temperature, condensation may be present on the tubes.
VII.I.A-719	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Consistent with the use of the term "wear" in GALL-SLR Report, Chapter IX.F, wear can occur in fiberglass exposed to air due to erosion due to hard abrasive particles (outdoor air) or loss of clamping force resulting in relative motion.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.I.A-720	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The matrix of fiberglass piping can be constructed of different materials (e.g., epoxy resin, reinforced vinyl ester resin). These materials are influenced differently when exposed to an air environment. *Fibres, Plastics, and Rubbers: A Handbook of Common Polymers*, Roff, W.J., Academic Press Inc., New York, 1956, Plastic Piping Institute, Recommended Design Factors and Design Coefficients for Thermoplastic Pressure Pipe, TR-9/2002, October 2002) states that stressors for fiberglass reinforced piping and piping components include light, high radiation, or ozone concentrations. The periodic visual inspections recommended by AMP XI.M36 can detect cracking, blistering, or loss of material.
VII.E5.A-721	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Managing cracking due to stress corrosion cracking for stainless steel materials exposed to waste water greater than 60°C [140 °F] is consistent with the GALL-SLR Report, Chapter IX.D., temperature threshold of 60°C [140°F] for SCC in stainless steel. The periodic visual inspections recommended by AMP XI.M38 can detect cracking in this material and environment combination.
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	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Consistent with the definition for air-outdoor in GALL-SLR Report, Section IX.D., outdoor air has sufficient moisture to result in loss of material in steel components. The periodic visual examinations recommended by AMP XI.M27 and AMP XI.38 can detect loss of material for this material and environment combination.
VII.E5.A-724	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of ASM Handbook, Volume 13B, Corrosion: Materials, Corrosion of Copper and Copper Alloys, ASM International, 2006, pages 129–133, the staff has concluded that copper alloy (>15% Zn or >8% Al) components exposed to waste water are susceptible to selective leaching. The staff has concluded that loss of material due to selective leaching should be managed for ductile iron components exposed to soil or waste water. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090). Loss of material due to selective leaching is consistent with existing GALL Report Revision 2, item A-51 because the staff concluded that waste water or the groundwater potentially present in the soil environment would be at least as aggressive as the raw water environment cited in item A-51. AMP XI.M33 contains specific recommendations for managing loss of material due to selective leaching for these material types.
VII.C1.A-727	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however,

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	applicants have many other components exposed to water environments that are not within the scope of GL 89-13. The cited aging effect requiring management in this new AMR item is consistent with GALL Report Revision 2, AMR items AP-55, AP-183, and AP-196; however, the staff added flow blockage due to fouling. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel and copper alloy piping exposed to raw water are subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M38. This item was originally cited as items VII.C1.A-408 (steel and copper alloy) and VII.C1.A-409 (SS) as issued in LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation"; however, these duplicated line numbers issued in LR-ISG-2012-01, "Wall Thinning Due to Erosion Mechanisms," line numbers A-408 and A-409 were retained as originally issued in LR-ISG-2012-01, "Wall Thinning Due to Erosion Mechanisms."
VII.E5.A-728	GALL-SLR Report AMR items citing elastomeric piping, piping components, and seals exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. As discussed in GALL-SLR Report, Chapter IX.D, hardening or loss of strength of elastomers can be induced by thermal aging, oxidation, and radiation. Temperature and radiation effects could occur in the waste water environment. Depending on the presence of deleterious compounds in waste water, oxidation could also occur. Flow blockage can occur due to potential intrusion of fouling products from the waste water source. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination. The periodic visual inspections recommended by AMP XI.M38 are capable of detecting flow blockage.
VII.D.A-729 VII.G.A-729	GALL-SLR Report AMR items citing elastomeric seals and components exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. As discussed in GALL-SLR Report, Chapter IX.D, hardening or loss of strength of elastomers can be induced by thermal aging, oxidation, and radiation. Depending on the locations of the components, radiation as well as thermal effects could occur due to the internal gas or external environment. Plant-specific evaluation is necessary. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination.
VII.B.A-730	Structural bolting AMR items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The environment was designated as "air" because cranes can be located throughout the plant in different air environments. The basis for using visual

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	inspections to detect the aging effects for these components derives from ASME B30.2-2011, “Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist),” as cited in AMP XI.M23. Section 2-2.1.5, “Periodic Inspections,” cites a visual inspection for loose or missing fasteners, such as, but not limited to, bolts, nuts, pins, or rivets. Depending on the moisture content in the vicinity of the crane, loss of material can also occur. Cracking of crane structural bolting can occur based on the composition of the bolting and potential local environmental factors (e.g., presence of halogens in the atmosphere or due to flange or packing leakage from a source containing halogens).
VII.I.A-734a VII.I.A-734b VII.I.A-734c VII.I.A-734d	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff’s position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff’s response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VII.C1.A-736	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report AMP XI.M20 is focused on components within the scope of the applicant’s response to GL 89-13, “Service Water System Problems Affecting Safety-Related Equipment.” These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Fouling is known to occur in raw water environments due to the potential for the accumulation of deposits on surfaces. These deposits occur due to mechanisms such as biofouling and particulate from sediment. See GALL-SLR Report, Chapter IX.F, “Fouling,” for further details. The basis for conducting a visual inspection in accordance with AMP XI.M38 is GL 89-13, “Service Water System Problems Affecting Safety-Related Equipment,” which states that it may not be possible to obtain enough heat load to conduct an efficiency test. As an alternative, GL 89-13 recommends that a visual inspection be conducted on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting reduction of heat transfer for these types of heat exchangers.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.C1.A-737	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. GALL-SLR Report AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. The aging effects and mechanisms were developed from: • Sections 21, "Cracking," and 2.2, "Distress," in American Concrete Institute (ACI) 201.1R-08, "Guide for Conducting a Visual Inspection of Concrete in Service." • Section 1.3, "Cracking of Hardened Concrete," in ACI 224.1R-07, "Causes, Evaluation, and Repair of Cracks in Concrete Structures." Regardless of their function, for the same material and environment, the aging effect would be the same. The periodic visual inspections of AMP XI.M38 are capable of detecting these aging effects. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Cementitious piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M38.
VII.C1.A-739	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Cracking and blistering are appropriate aging effects, consistent with GALL Report Revision 2, item AP-239. Change in color was not included as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. HDPE piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. These aging effects can be detected by the internal visual inspections recommended in AMP XI.M38.
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	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of ASM Handbook, Volume 13B, Corrosion: Materials, Corrosion of Copper and Copper Alloys, ASM International, 2006, pages 129–133, the staff has concluded that copper alloy (>15% Zn or >8% Al) components exposed to potential ground water in the soil environment are susceptible to selective leaching.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.H2.A-743	AMP XI.M33 contains specific recommendations for managing loss of material due to selective leaching for buried copper alloy (>15% Zn or >8% Al) components.
VII.G.A-744	An AMR item for aluminum fire water storage tanks was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other aluminum components exposed to air and condensation cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, for fire water storage tanks, the further evaluation section is not cited because AMP XI.M27 recommends periodic inspections of the internal and external surfaces of these tanks to detect loss of material.
VII.G.A-745	An AMR item for stainless steel fire water storage tanks was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other stainless steel components exposed to air and condensation cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential cracking, for fire water storage tanks, the further evaluation section is not cited because AMP XI.M27 recommends periodic inspections of the internal and external surfaces of these tanks to detect cracking. Although AMP XI.M27 does not cite surface examinations to detect cracking for these tanks, the more frequent inspections (i.e., external surfaces annually or refueling outage interval, internally noncoated surfaces every 3 years, internally coated surfaces every 5 years) will reasonably suffice to detect cracking that is growing prior to the point where a loss of intended function would occur. In addition, the tank bottoms exposed to soil or concrete are volumetrically inspected.
VII.G.A-747	An AMR item for stainless steel fire water storage tanks was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other stainless steel components exposed to air and condensation cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, for fire water storage tanks, the further evaluation section is not cited because AMP XI.M27 recommends periodic inspections of the internal and external surfaces of these tanks to detect loss of material. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M27 cites AMP XI.M29 for external surface tank bottom inspections, which recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
VII.F1.A-748 VII.F2.A-748 VII.F3.A-748 VII.F4.A-748	This AMR item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The aging effect and recommended AMP are consistent with GALL Revision 2, SP-98.
VII.I.A-751b-e	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.I.A-752a VII.I.A-752b VII.I.A-752c	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.I.A-755	GALL-SLR Report, AMR item A-755 was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other aluminum components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material. The items citing Tables C3, E5, and H1 were editorially consolidated into a single item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
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	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.C3.A-758 VII.E5.A-758 VII.H1.A-758	This item was added to address the tank interface surface with a soil or concrete environment. Although other stainless steel components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
VII.C3.A-759 VII.E5.A-759 VII.H1.A-759	These AMR items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other stainless steel components cite an SRP-SLR further evaluation (e.g., Section 3.3.2.2.3) to determine whether one-time or periodic inspections are conducted to detect potential cracking, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
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	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.I.A-761a VII.I.A-761b VII.I.A-761c VII.I.A-761d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary–Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.I.A-762a VII.I.A-762b VII.I.A-762c VII.I.A-762d	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The air and condensation environments were cited because either of these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.3.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.A4.A-763a VII.A4.A-763b VII.A4.A-763c VII.A4.A-763d VII.C1.A-763a	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.C1.A-763b VII.C1.A-763c VII.C1.A-763d VII.C3.A-763a VII.C3.A-763b VII.C3.A-763c VII.C3.A-763d VII.E5.A-763a VII.E5.A-763b VII.E5.A-763c VII.E5.A-763d VII.F1.A-763a VII.F1.A-763b VII.F1.A-763c VII.F1.A-763d VII.F2.A-763a VII.F2.A-763b VII.F2.A-763c VII.F2.A-763d VII.F3.A-763a VII.F3.A-763b VII.F3.A-763c VII.F3.A-763d VII.F4.A-763a VII.F4.A-763b VII.F4.A-763c VII.F4.A-763d VII.H1.A-763a VII.H1.A-763b VII.H1.A-763c VII.H1.A-763d VII.H2.A-763a VII.H2.A-763b VII.H2.A-763c VII.H2.A-763d	corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items." The items citing GALL-SLR Report, Table J, "Common Miscellaneous Material/ Environment Combinations," were deleted because there are no applicable aging effects.
VII.D.A-764	The staff does not anticipate loss of material due to general, pitting, or crevice corrosion for metallic components exposed to dry air. However, over long periods of operation, some water could accumulate within instrument air systems downstream of air dryers and cause localized corrosion. As a result, AMP XI.M24 recommends opportunistic inspections for this material, environment, and aging effect combination. This new item establishes the link between this material, environment, and aging effect combination and AMP XI.M24.
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	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5, are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2, items AP-139, EP-74, SP-96, and SP-100.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.J.A-766	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Grade 9 was added based on the staff's review of "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217.
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	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5, are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2 items such as SP-41, where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
VII.J.A-768	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Grade 9 was added based on the staff's review of "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217.
VII.E5.A-769a VII.E5.A-769b VII.E5.A-769c VII.E5.A-769d	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur in water environments that could potentially contain deleterious materials (e.g., raw water, ground water, waste water). The staff determined that the most accurate and practical method for determining the susceptibility materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.F4.A-770a VII.F4.A-770b VII.F4.A-770c VII.F4.A-770d	are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.E3.A-773 VII.E4.A-773	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. This material, environment, aging effect, and AMP combination is consistent with existing GALL Report Revision 2, item AP-112.
VII.I.A-774a VII.I.A-774b VII.I.A-774c VII.I.A-774d	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.I.A-775a VII.I.A-775b VII.I.A-775c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary–Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur in water environments that could potentially contain deleterious materials (e.g., raw water, ground water, waste water). The staff determined that the most accurate and practical method for determining the susceptibility materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.J.A-777	The staff has concluded that aluminum is not susceptible to loss of material in an air with borated water leakage. Uhlig's Corrosion Handbook, 3rd Edition, Chapter B11, "Chemicals," states that, "[b]oric acid solutions in all concentrations up to saturated have negligible actions on aluminum alloys."
VII.C1.A-778 VII.F1.A-778 VII.F2.A-778 VII.F3.A-778 VII.F4.A-778	The staff added these new AMR items to address managing aging effects on external surfaces of components that are located internal to a component (e.g., air-to-water heat exchanger in a duct). The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting loss of material for these types of components.
VII.E5.A-780	The staff added this new AMR item to address flow blockage due to fouling in waste water systems. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Piping exposed to waste water is subject to this aging effect due to the potential aggressiveness of the environment on the components for some materials (e.g., steel), resulting in generation of corrosion products, and intrusion of fouling products from the waste water source for all materials.
VII.F1.A-781a VII.F1.A-781b VII.F1.A-781c VII.F2.A-781a VII.F2.A-781b VII.F2.A-781c VII.F3.A-781a VII.F3.A-781b	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.F3.A-781c VII.F4.A-781a VII.F4.A-781b VII.F4.A-781c	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.E5.A-785	Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water) and a review of general rates of corrosion for steel piping, the staff has concluded that a one-time inspection for loss of material is appropriate. Details of the staff's review of general rates of corrosion for steel piping are documented in the response to comment No. 015-003. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some existing GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program element to not conduct a one-time inspection if a representative sample of wall thickness measurements had been conducted within the 50 to 60 year time frame. The staff concluded that wall thickness measurements conducted within this time period would provide sufficient data to project loss of material rates through 80 years of operation.
VII.C1.A-787a VII.C1.A-787c VII.G.A-787b VII.E5.A-787d	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Loss of material due to wear can occur due to potential abrasive particles in the raw water and waste water environments and flow velocity changes (for all water environments) where the configuration of the piping system causes perturbations in flow velocity. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. PVC piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20, AMP XI.M27, and AMP XI.M38. The staff concluded that there is reasonable assurance that there would not be enough fouling products from raw water (potable) or treated water sources to result in flow blockage due to fouling. The AMPs are aligned to the appropriate system (e.g., AMP XI.M27 for fire water components, AMP XI.M38 for waste water components).
VII.F1.A-788a VII.F2.A-788b VII.F3.A-788c VII.F4.A-788d	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The air and condensation environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR. Section 3.3.2.2.8. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.G.A-789	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The metallic and elastomeric portions of fire protection barriers are potentially subject to the cited aging effects. For example, steel materials would not be subject to SCC; however, stainless steel materials would be. The periodic inspections recommended by AMP XI.M26 are capable of detecting these aging effects.
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	This item was added to address reduction of heat transfer in heat exchanger tubes exposed to lubricating oil. The material, environment, aging effect, and AMP is consistent with other items such as EP-75, EP-78, and EP-79.
VII.A3.A-793 VII.A4.A-793 VII.C1.A-793a VII.C1.A-793b VII.C2.A-793 VII.C3.A-793 VII.E1.A-793 VII.E2.A-793 VII.E3.A-793 VII.E4.A-793 VII.F1.A-793 VII.F2.A-793 VII.F3.A-793 VII.F4.A-793 VII.H1.A-793 VII.H2.A-793	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Aluminum piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. These aging effects can be detected by the internal visual inspections recommended in AMP XI.M20 or AMP XI.M38.

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
VII.F1.A-794 VII.F2.A-794 VII.F3.A-794 VII.F4.A-794	The staff recognizes that it would be difficult to use leakage as an indication for potential degradation of heating, ventilation, and air conditioning (HVAC) closure bolting exposed to air or condensation, as recommended in AMP XI.M18 for closure bolting. The air in HVAC ducts is only slightly pressurized. As a result, the staff has cited AMP XI.M36 to manage aging effects associated with HVAC closure bolting. HVAC leaks will typically be evident by changes in the capability of the system to cool or heat a room or enclosure, which if they are severe enough will be addressed in the corrective action program. This is in contrast to an instrument air system (another system that is air-filled) where although air compressor run times could be trended, it would be difficult to pin point the relative location of leaking flanges. In addition, most HVAC closure bolting is relatively short and thus the potential for significant undetected corrosion to be occurring along the hidden portions of the shank is less. Most ducts have a significantly larger number of closure bolts than typical flanges and thus the joint is more tolerant of undetected aging effects occurring at a joint. As a result, the staff has concluded that the normal visual inspections conducted during personnel walkdowns as recommended by AMP XI.M36 can be capable of detecting loss of material, cracking, or loss of preload sufficient to provide reasonable assurance that the HVAC system can meet its intended function.
VII.C1.A-795a VII.C2.A-795b VII.C3.A-795a VII.E4.A-795a VII.H2.A-795a	Based on its review of: (a) "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217; (b) "Metals Handbook—Failure Analysis," 9th Edition, Volume 11, ASM International, p. 415. 1980; (c) http://www.azom.com/article.aspx?ArticleID=1547 (accessed on April 24, 2017); and (d) http://www.arcam.com/wp-content/uploads/Arcam-Ti6Al4V-Titanium-Alloy.pdf (accessed on April 24, 2017), the staff has concluded that: • Grades 3 and 4 are susceptible to cracking in water environments. • Grade 5 has an aluminum content ranging from 5.5 to 6.76% and is therefore susceptible to cracking in a water environment. Subsequent to issuance of the GALL-SLR Report, the staff recognized that to be consistent with item A-767, A-795a and A-795b should have also cited reduction of heat transfer due to fouling. This is consistent with GALL Report Revision 2, item SP-41 where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
VII.C1.A-796a VII.C2.A-796b VII.C3.A-796a VII.E2.A-796c VII.E3.A-796c VII.E4.A-796a VII.H2.A-796a	This item was added to address instances where the specific grade of titanium could not be identified. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. A review of Uhlig's Corrosion Handbook, 3rd Edition, page 866 states "Excellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 °C [482 °F]. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such as metal ions, sulfides, sulfates, and carbonates." As a result, the staff has concluded that titanium is not

Table 2-6 New AMR Items Added in GALL-SLR Report, Chapter VII, Auxiliary Systems	
New AMR Item No.	**Technical Bases for Changes**
	susceptible to loss of material in a closed-cycle cooling water of treated water environment.
VII.C1.A-797b VII.C2.A-797b VII.C3.A-797b VII.D.A-797b VII.E5.A-797b VII.F1.A-797b VII.F2.A-797b VII.F3.A-797b VII.F4.A-797b VII.G.A-797b VII.H1.A-797b VII.H2.A-797b VII.I.A-797a	This item was added as an informal request from the industry as discussed during a public meeting on April 13, 2017 (ADAMS Accession No. ML17108A491). These items would be used when the specific type of polymeric material has not been identified. As a result of the specific material type not being known, the staff included all applicable AERM. GALL-SLR Report, Chapter IX.C, "various polymeric materials," describes the intent of the term. For item A-797a, flow blockage due to fouling is not an applicable AERM because it is not an applicable AERM for the external environment of polymeric components
VII.F4.AP-205	An item citing in GALL-SLR Report, Table F4, "Diesel Generator Building Ventilation Systems," was added
VII.G.AP-162	The staff added this new AMR item in order to include this material, environment, aging effect, and AMP within the fire protection table as well as the emergency diesel generator system (i.e., VII.H2.AP-162).
VII.F1.AP-99a VII.F1.AP-99b VII.F1.AP-99c VII.F2.AP-99a VII.F2.AP-99b VII.F2.AP-99c VII.F3.AP-99a VII.F3.AP-99b VII.F3.AP-99c VII.F4.AP-99a VII.F4.AP-99b VII.F4.AP-99c VII.H1.AP-105a VII.H2.AP-105a VII.G.AP-129 VII.G.AP-129a VII.G.AP-132a VII.C2.AP-130 VII.H2.AP-130 VII.H1.AP-132a VII.H2.AP-132a VII.G.AP-136a VII.H1.AP-136a VII.H2.AP-136a VII.G.AP-234a VII.G.AP-75	The technical basis for these AMR items can be found in Table 2-20.

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
VIII.H.S-418	Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, aging management review (AMR) items citing bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The periodic visual inspections recommended in aging management program (AMP) XI.M18 are sufficient to detect loss of material for these material and environment combinations. In addition, AMP XI.M18, was revised to include recommendations for managing loss of material for bolting that is submerged (e.g., bolted components in a drainage sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage.
VIII.G.S-420 VIII.H.S-420	GALL-SLR Report AMR items citing piping, piping components, and tanks exposed to soil or concrete were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M41 includes recommendations addressing cracking for these material and environment combinations. Potential cracking of steel materials was addressed in License Renewal Interim Staff Guidance (LR-ISG-2015-01, “Changes to Buried and Underground Piping and Tank Recommendations.” The term, “steel in carbonate/bicarbonate environment only” was added to clarify that cracking of steel components would only occur in these two environments. The staff concluded this based on a review of National Association of Corrosion Engineers (NACE) SP0169-2013, “Control of External Corrosion on Underground or Submerged Metallic Piping Systems,” Figure 2, “SCC Range of Pipe Steel in Carbonate/Bicarbonate Environments”. Although other stainless steel and aluminum components cite a Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) further evaluation to determine whether one-time or periodic inspections are conducted to detect potential cracking, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting cracking. The item citing Table G was editorially consolidated into a single item citing GALL-SLR Report, Table H, “External Surfaces of Components and Miscellaneous Bolting.”
VIII.E.S-421 VIII.G.S-421 VIII.H.S-421	GALL-SLR Report AMR items citing closure bolting exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Due to the potential presence of halides in any of the cited environments, stress corrosion cracking (SCC) is an applicable aging effect for stainless steel (SS) closure bolting. The periodic visual inspections recommended in AMP XI.M18 are sufficient to detect cracking for this material and environment combination. The items citing Tables E and G were editorially consolidated into a single item citing GALL-SLR Report, Table H, “External Surfaces of Components and Miscellaneous Bolting”.

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
VIII.H.S-425a VIII.H.S-425b VIII.H.S-425c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation (e.g., underground). The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-426	AMR items for heat exchanger tubes exposed to air or condensation were added in recognition of air to water heat exchangers that are within the scope of license renewal. This category of heat exchangers is included in Generic Letter (GL) 89-13, which permits visual inspections on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. Not all in-scope heat exchangers are also within the scope of GL 89-13; however, the above provides a basis for visual inspections on the air side of these heat exchangers. Periodic visual inspections conducted by AMP XI.M36 can be capable of detecting this aging effect. The condensation environment was included because depending on the humidity level and internal tube temperature, condensation may be present on the tubes.
VIII.H.S-428	GALL-SLR Report AMR items citing elastomeric seals and components exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The environment was cited as air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report, Chapter IX.E. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M36 are sufficient to detect hardening and loss of strength due to elastomer degradation for this material and environment combination.
VIII.D1.S-429 VIII.D2.S-429 VIII.E.S-429 VIII.G.S-429	GALL-SLR Report AMR items citing elastomeric seals and components exposed to various environments were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The environment was cited as air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report, Chapter IX.E. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect hardening and loss of strength due to elastomer degradation for this material and environment combination.

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
VIII.A.S-432 VIII.D1.S-432 VIII.D2.S-432 VIII.E.S-432 VIII.F.S-432 VIII.G.S-432	Based on a review of the GALL-SLR Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water) and a review of general rates of corrosion for steel piping, the staff has concluded that a one-time inspection for loss of material is appropriate. Details of the staff's review of general rates of corrosion for steel piping are documented in the response to comment No. 015-003. Original plant designs should have included at least a 40-year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that loss of material has been progressing at a rate that will not challenge the structural integrity of these systems throughout an 80-year span of operation. The staff acknowledges that some existing GALL-SLR Report programs (e.g., AMP XI.M27) recommend volumetric wall thickness measurements. In addition, based on the staff's review of aging management programs during AMP audits, many licensees have initiated wall thickness measurements for steel piping exposed to raw water. As a result of these observations, the staff included a provision in the Scope of Program program element to not conduct a one-time inspection if a representative sample of wall thickness measurements had been conducted within the 50 to 60 year time frame. The staff concluded that wall thickness measurements conducted within this time period would provide sufficient data to project loss of material rates through 80 years of operation.
VIII.E.S-433 VIII.G.S-433	The staff added these new AMR items to address air to water side heat exchangers located within ducts. Fouling is known to occur in air environments due to the potential for the accumulation of deposits on surfaces. These deposits occur due to particles in the air surrounding the component (e.g., dust, maintenance debris). The deposits can result in a reduction in heat transfer because they act as insulators. The basis for conducting a visual inspection in accordance with AMP XI.M38 is GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment," which states that it may not be possible to obtain enough heat load to conduct an efficiency test. As an alternative, GL 89-13 recommends that a visual inspection be conducted on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting reduction of heat transfer for these types of heat exchangers because the deposits would be visible on the surface of the tubes. The condensation environment was added to the AMR item after the issuance of the GALL-SLR Report for public comment because depending on the humidity level and internal tube temperature, condensation may be present on the tubes.
VIII.A.S-436 VIII.E.S-436 VIII.F.S-436 VIII.G.S-436	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20 is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13.

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
	The cited aging effect requiring management in this new AMR item is consistent with GALL Report Revision 2, AMR items AP-55, AP-183, and AP-196; however, the staff added flow blockage due to fouling. Flow blockage due to fouling was added as an aging effect requiring management (AERM) based on the staff's review of industry operating experience (OE). Stainless steel and copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source or corrosion from upstream piping that is subject to loss of material due to general corrosion. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. These aging effects can be detected by the internal visual inspections recommended in AMP XI.M38.
VIII.E.S-437 VIII.F.S-437 VIII.G.S-437	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20, is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. Based on the review of several license renewal applications (LRAs) the staff recognized that applicants often have many air to water side heat exchangers. In regard to managing reduction of heat transfer due to fouling, GL 89-13 states that it may not be possible to obtain enough heat load to conduct an efficiency test. As an alternative, GL 89-13 recommends that a visual inspection be conducted on the air (condensation) and water side of the heat exchanger to ensure cleanliness of the heat exchanger. Not all in-scope heat exchangers are also within the scope of GL 89-13; however, the above provides a basis for visual inspections on the air side of these heat exchangers. The staff has concluded that the periodic visual inspections conducted by AMP XI.M38 can be capable of detecting this aging effect.
VIII.E.S-438 VIII.F.S-438 VIII.G.S-438	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. AMP XI.M20, is focused on components within the scope of the applicant's response to GL 89-13, "Service Water System Problems Affecting Safety-Related Equipment." These components are typically exposed to raw water; however, applicants have many other components exposed to raw water environments that are not within the scope of GL 89-13. The cited aging effect requiring management in this new AMR item is consistent with GALL Report Revision 2, AMR items AP-55, AP-183, and AP-196; however, the staff added flow blockage due to fouling. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel and copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source or corrosion from upstream piping that is subject to loss of material due to general corrosion. Steel piping exposed to

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	raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. These aging effects can be detected by the internal visual inspections recommended in AMP XI.M38.
VIII.D1.S-439 VIII.D2.S-439 VIII.E.S-439 VIII.F.S-439 VIII.G.S-439	These items were added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, pages 129–133, the staff has concluded that copper alloy (>15% Zn or >8% Al) components exposed to potential ground water in the soil environment are susceptible to selective leaching. AMP XI.M33 contains specific recommendations for managing loss of material due to selective leaching for buried copper alloy (>15% Zn or >8% Al) components.
VIII.H.S-442a VIII.H.S-442b VIII.H.S-442c	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment (e.g., underground) could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.4.2.2.9 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-443a VIII.H.S-443b VIII.H.S-443c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation (e.g., underground). The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of Electric Power Research Institute (EPRI) 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels.

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	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VIII.E.S-444 VIII.G.S-444	These items were generated as a result of the evolution of the changes to address aluminum tanks exposed to soil, concrete, and air. Item SP-139 was revised to include air environments. However, the staff concluded that aging effects associated with aluminum components exposed to air should be managed by a further evaluation. As a result, SP-139 was deleted and item S-444 was generated to address aluminum tanks exposed to soil or concrete. The staff recognizes that SP-139 could have been revised back to its original configuration; however, S-444 was retained and SP-139 was deleted. Although other aluminum components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material.
VIII.E.S-445a VIII.E.S-445b VIII.E.S-445c VIII.G.S-445a VIII.G.S-445b VIII.G.S-445c	This item was added based on the staff’s review of “Corrosion of Aluminum and Aluminum Alloys,” J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.4.2.2.9 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VIII.E.S-446a VIII.E.S-446b VIII.E.S-446c VIII.G.S-446a VIII.G.S-446b VIII.G.S-446c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff’s position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff’s response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff’s review of EPRI 1010639, Table 4-1, “Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys.” This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels.

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New AMR Item No.	**Technical Bases for Changes**
	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.E.S-447 VIII.G.S-447	This item was added to address the tank interface surface with a soil or concrete environment. Although other stainless steel components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M29 recommends periodic volumetric inspections of the bottom of tanks. These inspections are capable of detecting loss of material. Microbiologically influenced corrosion (MIC) was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
VIII.E.S-448a VIII.E.S-448b VIII.E.S-448c VIII.G.S-448a VIII.G.S-448b VIII.G.S-448c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.E.S-449 VIII.G.S-449	GALL-SLR Report, AMR item S-449 was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. Although other stainless steel components cite an SRP-SLR further evaluation (e.g., Section 3.4.2.2.2) to determine whether one-time or periodic inspections are conducted to detect potential cracking, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting cracking.
VIII.E.S-450a VIII.E.S-450b VIII.E.S-450c VIII.G.S-450a VIII.G.S-450b VIII.G.S-450c	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. These environments were cited because any of these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
	tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.4.2.2.7. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-451a VIII.H.S-451b VIII.H.S-451c VIII.H.S-451d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-452a VIII.H.S-452b VIII.H.S-452c VIII.H.S-452d	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 015-004, 015-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-453a VIII.H.S-453b VIII.H.S-453c VIII.H.S-453d	Based on its review of "Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The air and condensation environments were cited because these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not

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	readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.4.2.2.7. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VIII.H.S-454	Based on a review of ASM Handbook, Volume 13B, “Corrosion: Materials, Corrosion of Copper and Copper Alloys,” ASM International, 2006, pages 129–133, the staff concluded that copper alloy (>15% Zn or >8% Al) is susceptible to cracking due to SCC in air or condensation environments depending on the presence of ammonia-based compounds. In addition to being present in the outdoor air environment, they could be conveyed to the surface of a copper alloy (>15% Zn or >8% Al) component via leakage through the insulation from bolted connections (e.g., flange joints, valve packing).
VIII.H.S-455	Based on a review of ASM Handbook, Volume 13B, “Corrosion: Materials, Corrosion of Copper and Copper Alloys,” ASM International, 2006, pages 129–133, the staff concluded that copper alloy (>15% Zn) is susceptible to cracking due to SCC in air or condensation environments depending on the presence of ammonia-based compounds. In addition to being present in the outdoor air environment, they could be conveyed to the surface of a copper alloy (>15% Zn) component via leakage through the insulation from bolted connections (e.g., flange joints, valve packing).
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	Based on its review of “Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys,” B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The four environments were cited because any of these could cause SCC. For example, leakage from bolted or flanged connections could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.4.2.2.7. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VIII.H.S-460a VIII.H.S-460b VIII.H.S-460c	Based on its review of “Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys,” B.F. Brown, Naval Research Laboratory, 1972; and “Corrosion of Aluminum and Aluminum Alloys,” J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC; however, others are. In addition, certain environments can contain sufficient halogens to cause SCC if the aluminum alloy is susceptible to SCC. The underground environment was cited because it could cause SCC. For example, leakage from bolted or flanged connections

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	could result in halides being on the surface of the component if the leakage passed through insulation with high levels of halides. Finally, the sustained tensile stress is a contributing factor to SCC; however, in regard to tensile stress, it is necessary to understand both the applied and residual stress level in the material. The information necessary to eliminate the aging effect of SCC based on the sustained service stress is often not readily available. The staff developed a further evaluation section that will be used to document the determination on whether the specific alloy and environment will promote SCC. Further detail is provided in SRP-SLR, Section 3.4.2.2.7. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.E.S-462 VIII.F.S-462 VIII.G.S-462	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2, items AP-139, EP-74, SP-96, and SP-100.
VIII.I.S-463	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Grade 9 was added based on the staff's review of "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217.
VIII.A.S-464 VIII.E.S-464 VIII.F.S-464 VIII.G.S-464	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2, item SP-41, where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
VIII.I.S-465	These items were added as a result of the staff's evaluation of public comments. Details of the staff's review of are documented in the response to comment No. 015-020.

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	Grade 9 was added based on the staff's review of "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217.
VIII.H.S-466	This item was added to provide more components for which an applicant can cite a consistent AMR item. This item is consistent with GALL Report Revision 2, item AP-173 for managing loss of material for aluminum components exposed to soil.
VIII.H.S-468a VIII.H.S-468b VIII.H.S-468c VIII.H.S-468d	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999. The staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.3.2.2.10 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.E.S-469a VIII.E.S-469b VIII.E.S-469c VIII.E.S-469d VIII.E.S-469e	This item was added based on the staff's review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur in water environments that could potentially contain deleterious materials (e.g., raw water, ground water, waste water). The staff determined that the most accurate and practical method for determining the susceptibility materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.4.2.2.9 for further details. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VIII.H.S-471	Although the GALL AMR item is new, the material, environment, and aging effect is the same as GALL AMR, item AP-113. Piping and piping components were added to ensure that components such as flex hoses are included. The environment is cited as air because the aging effect can occur regardless of the specific air environment. The aging effect occurs due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report, Chapter IX.D. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect loss of material due to wear for this material and environment combination.
VIII.D1.S-472 VIII.D2.S-472 VIII.E.S-472	Although the GALL AMR item is new, the material, environment, and aging effect is the same as GALL AMR item AP-103. Piping and piping components were added to ensure that components such as flex hoses are included. The

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
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VIII.G.S-472	environment is cited as air because the aging effect can occur regardless of the specific air environment. The aging effect occurs due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report Chapter IX.D. The periodic visual inspections, accompanied by physical manipulation, recommended in AMP XI.M38 are sufficient to detect loss of material due to wear for this material and environment combination.
VIII.I.S-473	Based on a review of "PVC Degradation and Stabilization," George Wypych, Chem Tec Publishing, 2008, and "Advances in Polymer Nanocomposites - Types and Applications," Fengge Gao, Woodhead Publishing, 2012; buried polyvinyl chloride (PVC) is not susceptible to thermal, ultraviolet (UV), or radiation related degradation. In addition, based on the typical range of concrete environments PVC is not susceptible to chemical degradation.
VIII.H.S-474	Based on a review of "PVC Degradation and Stabilization," George Wypych, Chem Tec Publishing, 2008, and "Advances in Polymer Nanocomposites - Types and Applications," Fengge Gao, Woodhead Publishing, 2012; buried PVC is not susceptible to thermal, UV, or radiation related degradation. In addition, based on the typical range of environments within the pipe and the soil composition, PVC is not susceptible to chemical degradation. However, PVC is susceptible to mechanical wear due to ground movement of deleterious materials in the backfill.
VIII.I.S-475	The staff has concluded that aluminum is not susceptible to loss of material in an air with borated water leakage. Uhlig's Corrosion Handbook, 3rd Edition, Chapter B11, "Chemicals," states that, "[b]oric acid solutions in all concentrations up to saturated have negligible actions on aluminum alloys."
VIII.I.S-476	Based on the staff's review of the following documents, there is reasonable assurance that the aging effects associated with copper alloy components exposed to concrete will not be significant enough to result in a loss of intended function. • Corrosion of Nonferrous Metals in Contact with Concrete, Portland Cement Association, "Modern Concrete," February 1970, https://www.copper.org/applications/plumbing/techcorner/pdf/corrosion_nonferrous_metals_contact_concrete.pdf, accessed on October 31, 2016. • "Corrosion of Embedded Material Other than Reinforcing Steel," Research and Development Laboratories of the Portland Cement Association, Research Department Bulletin 198, Hubert Woods/Significance of Tests and Properties of Concrete and Concrete-Making Materials STP No.169A, published by ASTM, 1967. • ASM Handbook Volume 13B, "Corrosion: Materials," 2005. This document states that copper alloys are corrosion resistant or corrode at negligible rates except when exposed to oxidizing acids, oxidizing heavy-metal salts, sulfur, ammonia, and some sulfur and ammonia compounds. Concrete, which is primarily composed of calcium, silicon, and oxide compounds, is not a corrosive environment for copper alloys. The staff noted that the reference to SCC of copper piping exposed to concrete is in reference to copper alloys with greater than 15% zinc, not the copper alloys that are cited in this item.

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New AMR Item No.	**Technical Bases for Changes**
VIII.H.S-477	The staff concluded that copper alloys are not susceptible to loss of material unless exposed to a water environment. See the basis for EP-10 for further information. The staff recognizes that underground vaults can experience in-leakage from groundwater and rain. In addition, the soil environment is subject to groundwater. As a result, loss of material for copper alloy components is managed for the soil and underground environments.
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	Based on the staff's review of industry OE, the staff concluded that titanium components exposed to raw water are susceptible to flow blockage due to fouling. Titanium piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. The internal visual inspections cited in AMP XI.M20 and AMP XI.M38 are capable of detecting flow blockage due to fouling. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12, are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. ASM Handbook Volume 13B, "Corrosion: Materials," 2005, page 256, states: "because of its protective oxide film, titanium exhibits anodic pitting potentials, Eb, that are very high (»1 V); thus, pitting corrosion is generally not of concern for titanium alloys." The staff also reviewed Uhlig's Corrosion Handbook, 3rd Edition, page 866 which states "[e]xcellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 ° C. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such as metal ions, sulfides, sulfates, and carbonates." As a result, the staff did not identify loss of material as an aging effect for titanium components exposed to raw water.
VIII.H.S-479	Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
VIII.I.S-480	This item was added to reduce the number of material, environment, and aging effects that were not identified in the GALL-SLR Report. The material, environment, and aging effect is consistent with other GALL-SLR Report items such as AP-18 and EP-19.
VIII.D1.S-481 VIII.D2.S-481 VIII.E.S-481 VIII.F.S-481 VIII.G.S-481	This item was added to address flow blockage due to fouling based on the staff's review of industry OE. Aluminum piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. This aging effect can be detected by the internal visual inspections recommended in AMP XI.M38.
VIII.D1.S-482 VIII.D2.S-482 VIII.E.S-482 VIII.F.S-482	Based on its review of: (a) "Materials Properties Handbook: Titanium Alloys," Gerhard Welsch, Rodney Boyer, E.W. Collings, ASM International, 1993, page 217; (b) "Metals Handbook—Failure Analysis," 9th Edition. Volume 11. ASM International, p. 415. 1980; (c) http://www.azom.com/article.aspx?ArticleID=1547 (accessed on April 24,

Table 2-7 New AMR Items Added in GALL-SLR Report, Chapter VIII, Steam and Power Conversion System	
New AMR Item No.	**Technical Bases for Changes**
	2017); and (d) http://www.arcam.com/wp-content/uploads/Arcam-Ti6Al4V-Titanium-Alloy.pdf (accessed on April 24, 2017), the staff has concluded that: • Grades 3 and 4 are susceptible to cracking in a raw water environment. • Grade 5 has an aluminum content ranging from 5.5 to 6.76% and is, therefore, susceptible to cracking in a raw water environment. Subsequent to issuance of the GALL-SLR Report, the staff recognized that to be consistent with other GALL-SLR Report items associated with heat exchanger tubes, S-482 should have also cited reduction of heat transfer due to fouling. This is consistent with GALL Report, Revision 2, item SP-41 where a material (i.e., stainless steel) that is not susceptible to loss of material (a potential source of fouling products), is susceptible to reduction of heat transfer due to fouling.
VIII.D1.S-483b VIII.D2.S-483b VIII.E.S-483b VIII.F.S-483b VIII.G.S-483b VIII.H1.S-483a	This item was added as an informal request from the industry as discussed during a public meeting on April 13, 2017 (ADAMS Accession No. ML17108A491). These items would be used when the specific type of polymeric material has not been identified. As a result of the specific material type not being known, the staff included all applicable AERM. GALL-SLR Report, Chapter IX.C, "Various Polymeric Materials," describes the intent of the term. For item S-483a, flow blockage due to fouling is not an applicable AERM because it is not an applicable AERM for the external environment of polymeric components
VIII.E.SP-162 VIII.G.SP-162	Based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because it has the same AERM and is cited in the further evaluation section. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys." See the basis for EP-63 for additional detail.
VIII.A.S-408 VIII.B1.S-408 VIII.B2.S-408 VIII.C.S-408 VIII.E.SP-113 VIII.E.SP-59 VIII.G.SP-59	The technical basis for these items is available in Table 2-21.

Table 2-8 Deleted AMR Items, Chapter II, Containment Structures	
AMR Item No.	**Technical Bases for Changes**
No AMR items were deleted from Chapter II of the GALL-SLR Report.	

Table 2-9 Deleted AMR Items, Chapter III, Structures and Component Supports	
AMR Item No.	**Technical Bases for Changes**
III.A1.TP-300 III.A2.TP-300 III.A3.TP-300 III.A4.TP-300 III.A5.TP-300 III.A7.TP-300 III.A8.TP-300 III.A9.TP-300 III.B2.TP-300 III.B3.TP-300 III.B4.TP-300 III.B5.TP-300	These items have been deleted from the scope of the NUREG–2191. TP-300 items referenced Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, aging management program (AMP) XI.S6, "Structures Monitoring," to manage cracking due to stress corrosion cracking (SCC) in high-strength structural bolting that are fabricated from low-alloy steel with actual measured yield strength ≥ 150 ksi (1,034 MPa) and exposed to air-indoor uncontrolled OR air-outdoor environment. In addition, these items included a note stating that American Society for Testing and Materials (ASTM) A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts. Note: ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. Thus, the SCC potential need not be evaluated for these bolts. TP-300 was replaced by the new aging management review (AMR) items T-36a, T-36-b, and T-36c and T-37a, T-37b, and T-37c (see Table 2-2). These new AMR items are more generic and address "support members; welds; bolted connections; support anchorage to building structure" fabricated from aluminum or stainless steel. The reference to components made from low-alloy steel has been removed from GALL-SLR Report, Chapter III.

Table 2-10 Deleted AMR Items, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
AMR Item No.	**Technical Bases for Changes**
IV.A1.R-411	The deleted aging management review (AMR) item referenced a plant-specific aging management program (AMP) to manage cracking due to cyclic loading in boiling water reactor (BWR) steel (with or without stainless steel cladding) nozzles and nozzle-to-vessel welds: control rod drive return line (BWR-2 designs) exposed to reactor coolant. This was a new line in draft Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report that is not being retained for final version of the GALL-SLR Report.
IV.A1.R-67 IV.A2.R-81	These items have been deleted from NUREG–2191. They both referenced a time-limited aging analysis (TLAA) to manage loss of fracture toughness due to neutron irradiation embrittlement in steel (with stainless steel or nickel alloy cladding) nozzles exposed to reactor coolant and neutron flux. Refer to the technical basis discussion of GALL-SLR Report, AMR items IV.A1.R-62 and IV.A2.R-84 in Table 2-17 of this NUREG report for a full explanation of the basis for deleting AMR items IV.A1.R-67 and IV.A2.R-81 from the GALL-SLR Report.
IV.A2.RP-228	This AMR item has been deleted from NUREG–2191. It referenced AMP XI.M31, “Reactor Vessel Surveillance” to manage loss of fracture toughness due to neutron irradiation embrittlement in steel (with or without cladding) in inlet, outlet, or safety injection nozzles exposed to reactor coolant and neutron flux. Refer to the technical basis discussion of GALL-SLR, AMR items IV.A1.RP-227 and IV.A2.RP-229 in Table 2-17 of this NUREG report for a full explanation of the basis for deleting AMR item IV.A2.RP-228 from the scope of the GALL-SLR Report.
IV.B4.RP-375 IV.B4.RP-375a	The AMR item IV.B4.RP-375, as previously provided in License Renewal Interim Staff Guidance Document (LR-ISG)-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors,” was deleted from Table IV.B4 in NUREG–2191. The staff’s basis for managing cracking in Babcock and Wilcox (B&W)-designed internal baffle-to-baffle bolts is adequately addressed in the staff’s retention and update of the AMR basis in AMR item IV.B4.RP-244, as given in GALL-SLR Report, Table IV.B4. Similarly, the AMR item IV.B4.RP-375a, as previously updated in LR-ISG-2011-04, was deleted from Table IV.B4 in NUREG–2191. The staff’s basis for managing loss of preload, loss of materials due to wear, and loss of fracture toughness in B&W-designed internal baffle-to-baffle bolts is adequately addressed in the staff’s retention and update of the AMR basis in AMR item IV.B4.RP-243, as given in the GALL-SLR Report, Table IV.B4.

Table 2-10 Deleted AMR Items, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
AMR Item No.	**Technical Bases for Changes**
IV.C2.R-448 IV.D1.R-448 IV.D2.R-448	Initially, these AMR items were included the draft version of NUREG–2191 as new AMRs that may be used to manage long term loss of material due to general corrosion in steel pressurized water reactor (PWR) reactor coolant system piping and steam generator components that are exposed to a treated water environment. However, the staff concluded that these items were not appropriate to warrant inclusion of the AMR items in the final version of NUREG–2191. Specifically, the staff determined that these items for steel PWR piping and steam generator components would not be necessary for the final issuance of the NUREG–2191 report because the RCS in PWR would have few (in any) steel RCS components where the steel materials would be in direct contact with a treated water environment (including reactor coolant). Instead, the steel components would normally be clad with either stainless steel or nickel alloy materials where the stainless steel or nickel alloy surfaces are the surfaces that would be exposed to the treated water environment. Since stainless steel and nickel alloy materials are designed to be resistant to general corrosion mechanisms (even under exposure to treated water) and since the treated water environments for RCS components in PWRs would typically include corrosion inhibitors or oxygen scavengers, the staff determined that there was no need to include these AMR items in the final version of the NUREG–2191.
IV.C1.R-429 IV.C2.R-429	The staff deleted AMR items IV.C1.R-429 and IV.C2.R-429 from the GALL-SLR Report and AMR item No. 122 from Table 3.1-1 in the SRP-SLR. The staff determined that copper alloy materials would be protected from corrosion in these environments due to the presence of metallic oxides that would render corrosion resistance in the materials. Therefore, the reactor coolant system (RCS) piping and piping components that are made from copper alloy and are exposed to these environments are now addressed in a different AMR item, item IV.E.R-453, which identifies that copper alloy RCS piping and piping component are not subject to any aging effects requiring management (i.e., None-None for the aging effect-AMP combination). The staff also determined that general corrosion would not be an issue for stainless steel or nickel alloy components that are exposed to air or condensation but did not fully agree that nickel alloy components or stainless components would be impervious to loss of material due to pitting or crevice corrosion mechanisms under exposure to air or condensation environments. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) and the staff's responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. However, the staff addressed loss of material in BWR stainless steel or nickel alloy RCS piping and piping components exposed to air or condensation environments in its

Table 2-10 Deleted AMR Items, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
AMR Item No.	**Technical Bases for Changes**
	development of a new SRP-SLR further evaluation section (i.e., SRP-SLR Section 3.1.2.2.16), the development of AMR item No. 136 in Table 3.1-1 of the SRP-SLR and the development of four new AMR items in Table IV.C1 of the GALL-SLR Report (i.e., AMR items IV.C1.RP-452a – IV.C1.RP-452d), where the an applicant's selection of the specific line item is dependent on plant-specific operating experience in the components and the selection of one of four GALL-based AMPs that may be used for aging management of loss of material in the components. The staff also developed the corresponding case for PWR piping components made from stainless steel or nickel alloy materials in the staff's development of four new AMR items in Table IV.C2 of the GALL-SLR Report (i.e., AMR items IV.C2.RP-452a – IV.C2.RP-452d). The staff also determined that loss of material due to general, pitting and crevice corrosion in steel piping and piping components is adequately addressed by in new AMR items IV.C1.R-431 and IV.C2.R-431 of the GALL-SLR Report and new AMR item No. 124 in Table 3.1-1 of the SRP-SLR Report. Therefore, AMR items IV.C1.R-429 and IV.C2.R-429 have not been retained in the final versions of Tables IV.C1 and IV.C2 in the GALL-SLR Report and are deleted. Similarly, AMR item No. 122 in Table 3.1-1 of the draft SRP-SLR has not been retained for the final version of Table 3.1-1 in the SRP-SLR and is deleted.
IV.C1.R-451 IV.C2.R-451 IV.C1.R-452 IV.C2.R-452	The staff deleted these AMR items, which initially (in the draft version of NUREG–2191) referenced a plant-specific AMP to manage loss of material due to pitting or crevice corrosion in stainless steel or nickel alloy piping or piping components exposed to any air environment (except air-dry internal) or condensation. The full basis for initially developing these items in the draft version of NUREG–2191 and deleting these items from the scope of the final version of the GALL-SLR Report is given in the technical basis write up for AMR items IV.C1.R-451, IV.C2.R-451, IV.C1.R-452, IV.C2.R-452, IV.C1.R-452a, IV.C2.R-452a, IV.C1.R-452b, IV.C2.R-452b, IV.C1.R-452c, IV.C2.R-452c, IV.C1.R-452d, and IV.C2.R-452c, as given in Table 2-3 of this NUREG–2221 report.
IV.C2.R-30	The staff deleted AMR item IV.C2.R-30 from the scope of GALL-SLR Table IV.C2 and AMR item No. 33 from the scope of SRP-SLR Table 3.1-1. The staff determined that AMR item IV.C2.R-30 in the GALL Revision 2 report did not need to be retained in Table IV.C2 of the NUREG–2191 report , because the AMR basis in the line item is bounded by the AMR basis in AMR item IV.C2.RP-344, which is being retained as the basis for managing cracking to stress corrosion cracking (SCC) in PWR Class 1 piping and piping components that are made from stainless steel or steel with internal stainless steel cladding, where the stainless steel surfaces are exposed to reactor coolant. Thus, AMR item IV.C2.RP-344 may be used lieu of AMR item IV.C2.R-30 to manage cracking due to SCC in RCS PWR reactor coolant hot leg piping, cold leg piping, surge line piping, or spray line piping that is exposed to a PWR reactor coolant environment. The AMPs in GALL-SLR AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and GALL-SLR AMP XI.M2, "Water Chemistry," may be used to manage any cracking in the components that is induced by a SCC mechanism, without any need for further evaluation of the program element activities that are described for aging management in the programs.

Table 2-10 Deleted AMR Items, Chapter IV, Reactor Vessel, Internals, and Reactor Coolant System	
AMR Item No.	**Technical Bases for Changes**
IV.D1.R-48 IV.D2.R-48	In the draft version of NUREG–2191 (draft GALL-SLR report), these AMR items referenced AMP XI.M19, “Steam Generators,” and AMP XI.M2, “Water Chemistry” to manage cracking due to intergranular attack in nickel alloy tubes and sleeves exposed to secondary feedwater or steam. The staff deleted AMR item IV.D1.R-48 from the final version of GALL-SLR Table IV.D1 based on consolidation of the line item into AMR item IV.D1.R-47 in the same GALL-SLR Table. Similarly, the staff deleted AMR item IV.D2.R-48 from the final version of GALL-SLR Table IV.D2 based on consolidation of the line item into AMR item IV.D2.R-47 in the same GALL-SLR Table. For further explanations, see technical basis discussions for AMR items IV.D1.R-47, IV.D1.R-48, and IV.D1.R-437 and for AMR items IV.D2.R-47, IV.D2.R-48, and IV.D2.R-442 in Table 2-17 of this report.
IV.E.RP-03 IV.E.RP-04	In the original versions of these items in NUREG–1801, Revision 2 (i.e., the GALL-LR report), the staff identified that there are not any aging effects that need to be managed for nickel alloy or stainless steel components that are exposed to an air–indoor, uncontrolled environment or any AMPs that are needed for these material-environment combinations. For subsequent license renewal applications, the staff determined that AMR items IV.E.RP-03 and IV.E.RP-04 should be deleted from the scope of Table IV.E in NUREG–2191 (i.e., GALL-SLR report). Specifically, the staff confirmed that other AMR items in Chapter IV of the GALL-SLR Report identify that cracking due to SCC, intergranular stress corrosion cracking (IGSCC) may occur in nickel alloy or stainless steel components that are subjected to an air–indoor uncontrolled environment. Therefore, AMR items IV.E.RP-03 and IV.E.RP-04 have been withdrawn (i.e., deleted) from the scope of Table IV.E in the GALL-SLR Report. Based on the deletion of item IV.E.RP-03, AMR item No. 106 has been modified (in part) to delete the air–indoor uncontrolled environment as an applicable environment for the line item and to delete reference to AMR item IV.E.RP-03 as a referenced line for item No. 106. Similarly, based on the deletion of item IV.E.RP-04, AMR item No. 107 has been modified (in part) to delete the air–indoor uncontrolled environment as an applicable environment for the line item and to delete reference to AMR item IV.E.RP-04 as a referenced line for item No. 107.

Table 2-11 Deleted AMR Items, Chapter V, Engineered Safety Features	
AMR Item No.	**Technical Bases for Changes**
V.D1.E-01	Aging management program (AMP) XI.M29 was revised to address sealants and caulking for partially encased tanks. The staff concluded that periodic inspections of the caulking or sealant coupled with periodic wall thickness measurements when the soil is corrosive or cathodic protection is not provided (otherwise one-time wall thickness measurements are conducted) is sufficient to provide reasonable assurance that potential pitting or crevice corrosion will not result in a loss of intended function of the partially-encased tanks.
V.D1.E-24a	This item is shown as deleted in NUREG–2191 in error. This item was not included in the GALL Report Revision 2 or the draft NUREG–2191 version issued for public comment. It was incorporated during the staff's review of the SLR documents subsequent to the issuance of the draft NUREG–2191 and then removed by the staff prior to final issuance of the document.
V.A.E-26 V.B.E-26 V.D2.E-26	These items were deleted because they are enveloped by E-44.
V.A.E-28 V.D1.E-28	These items were editorially consolidated to cite a single Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, Table E, "External Surfaces of Components and Miscellaneous Bolting."
V.C.E-30	This item was deleted because it was enveloped by changes to E-44.
V.C.E-35	This item was deleted because it was enveloped by E-44.
V.D1.E-38	This item was deleted because the staff has concluded that there is a low likelihood that a pressurized water reactor (PWR) plant will have a safety injection tank (accumulator) exposed to temperatures above 60 °Celsius(C) [140 °F]. Containment structures are normally at a lower temperature. In case there is a plant where the containment temperatures exceed the threshold or long-term in-leakage from the reactor coolant system results in elevated temperatures, item E-12 was revised to include steel (with stainless steel or nickel alloy cladding). An applicant could cite E-12 as a consistent item.
V.B.E-40	This item was deleted because it was enveloped by E-44 and changes to AMP XI.M18 and AMP XI.M36 to manage aging effects associated with ducting closure bolting by AMP XI.M36.
V.E.E-41	This item was deleted because it is enveloped by E-28.
V.E.E-45	This item was deleted because it was enveloped by changes to E-44.
V.E.E-46	This item was deleted because it was enveloped by changes to E-44.
V.A.E-403 V.B.E-403 V.C.E-403 V.D1.E-403 V.D2.E-403	These items were editorially consolidated to cite a single GALL-SLR Report Table E, "External Surfaces of Components and Miscellaneous Bolting." However, the items were re-designated as E-403a and E-403b. See the technical basis for the revised items addressing changes to the material and environment.
V.A.E-406 V.B.E-406 V.C.E-406 V.D1.E-406 V.D2.E-406	These items were editorially consolidated to cite a single GALL-SLR Report Table E, "External Surfaces of Components and Miscellaneous Bolting." See the technical basis for the revised item addressing changes to the material and environment.
V.E.E-416	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to EP-116.
V.E.E-417	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to EP-116.

Table 2-11 Deleted AMR Items, Chapter V, Engineered Safety Features	
AMR Item No.	**Technical Bases for Changes**
V.E.E-419	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to E-418 for the lubricating oil environment and A-423 for the fuel oil environment.
V.A.E-421 V.D1.E-421 V.D2.E-421	These items were incorporated into the draft GALL-SLR Report. However, they were deleted prior to issuance of the final document because they were consolidated to cite a single GALL-SLR Report, Table E, "External Surfaces of Components and Miscellaneous. In addition, the staff recognized that cracking due to stress corrosion cracking (SCC) for buried bolting is not managed by AMP XI.M41, but rather AMP XI.M18.
V.E.E-426	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to EP-59.
V.E.E-429	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to E-418.
V.E.E-430	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to E-418.
V.E.E-431	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to E-418.
V.E.E-433	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because the staff concluded that loss of material should be addressed by a further evaluation for stainless steel, nickel alloy, and aluminum components. See the basis for items E-442 and EP-114. In addition, the staff concluded that copper alloys are not susceptible to loss of material unless exposed to a water environment. See the basis for item EP-10. Steel exposed to condensation is addressed by changes to E-44.
V.A.E-435 V.B.E-435 V.D1.E-435 V.D2.E-435	These items were originally proposed to address cooler banks internal to a component, typically duct coolers. The staff concluded that GALL-SLR Report, Chapter VII AMR items for the same component and material, environment, aging effect, and AMP, A-419, citing the ventilation system tables (i.e., F1, F2, F3, F4) and the open-cycle cooling water system (i.e., C1) were sufficient for providing recommendations related to managing aging effects for these components.
V.F.E-438	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to EP-12.
V.A.E-443a V.B.E-443a V.D1.E-443a V.D2.E-443a	These items were incorporated into the draft GALL-SLR Report. However, prior to issuance of the final document, E-443 was split into items citing four AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, E-443a, because the tanks cited in the item are not within the scope of AMP XI.M29.
V.E.E-444a	This item was incorporated into the draft GALL-SLR Report. However, prior to issuance of the final document, E-444 was split into items citing four AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, and AMP XI.M42. The staff deleted the item citing AMP XI.M29, E-444a, because the tanks cited in the item are not within the scope of AMP XI.M29.
V.E.E-456	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to E-455.

Table 2-11 Deleted AMR Items, Chapter V, Engineered Safety Features	
AMR Item No.	**Technical Bases for Changes**
V.A.EP-3a V.D1.EP-3a V.D2.EP-3a V.F.EP-3a V.F.EP-3b V.F.EP-3c V.F.EP-3d	These items were deleted because the staff has concluded that: either (a) loss of material can occur when aluminum components are exposed to air or condensation when contaminants are present; or (b) tanks within the scope of AMP XI.M29 are addressed in other AMR items (see the E-448 AMR items. See the discussion related to the changes to items EP-3 citing Tables A, D1, and D2.
V.F.EP-9	This item was deleted because it was enveloped by changes to EP-10.
V.F.EP-17	This item was deleted because the staff concluded that loss of material should be addressed by a further evaluation for nickel alloy components. See the basis for item E-442.
V.F.EP-18	This item was deleted because the staff concluded that loss of material should be addressed by a further evaluation for stainless steel components. See the basis for item E-442.
V.D1.EP-49	The staff determined that the industry has moved away from using the component of concern (steel with stainless steel clad charging pump casings) and as of August 2014, the original applicability of this issue is now limited to only two pumps at one plant. As a result, the staff concluded that this issue is no longer of generic concern and the further evaluation section was deleted. Loss of material due to exposure to treated borated water for piping components (inclusive of pumps) is managed by items EP-41 and EP-63.
V.E.EP-64	This item was deleted because it was enveloped by changes to E-02.
V.E.EP-69	This item was deleted because it was enveloped by changes to EP-116.
V.E.EP-70	This item was deleted because it was enveloped by changes to E-02.
V.F.EP-82	This item was deleted because the staff concluded that loss of material and cracking for stainless steel components should be addressed by a further evaluation for stainless steel components. See the basis for items E-442 and E-446.
V.F.EP-87	This item was deleted because it was enveloped by changes to EP-15.
V.D1.EP-101	This item was deleted because the staff concluded that there are no aging effects for aluminum components exposed to air with borated water leakage. See the basis for new item E-467.
V.A.EP-103a V.B.EP-103a V.C.EP-103a V.D1.EP-103a V.D2.EP-103a	These items were split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, EP-103a, because the tanks cited in the item are not within the scope of AMP XI.M29.
V.D2.EP-72 V.B.EP-107c V.C.EP-107c V.D1.EP-107c V.D2.EP-107c V.A.E-420 V.D1.E-420 V.D2.E-420	The technical basis for these items is available in Table 2-18.
V.E.EP-114a	This item was split into items citing four AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, EP-114a, because the tanks cited in the item are not within the scope of AMP XI.M29.
V.E.EP-117	This item was deleted because it was enveloped by changes to EP-116.
V.E.EP-118 V.E.EP-119 V.E.EP-120	These items were deleted because they were enveloped by changes to EP-116.

Table 2-11 Deleted AMR Items, Chapter V, Engineered Safety Features	
AMR Item No.	**Technical Bases for Changes**
V.E.EP-121 V.E.EP-122	

Table 2-12 Deleted AMR Items, Chapter VI, Electrical Components	
AMR Item No.	**Technical Bases for Changes**
No AMR items were deleted from Chapter VI of the GALL-SLR Report.	

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.B.A-05	This item was deleted because it is enveloped by changes to A-07.
VII.F1.A-10 VII.F2.A-10 VII.F3.A-10 VII.F4.A-10	These items were deleted because they are enveloped by changes to A-77.
VII.G.A-20	This item was deleted because it is enveloped by changes to A-19.
VII.G.A-22	This item was deleted because it is enveloped by changes to A-21.
VII.G.A-23 VII.H2.A-23	Item VII.G.A-23 was deleted by relocating steel material and the condensation environment to AP-143, which cites aging management program (AMP) XI.M27. The term "moist air" was deleted from Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. Condensation is an appropriate substitute for moist air. Item VII.H2.A-23 was deleted because it was enveloped by changes to A-26.
VII.H1.A-24	This item was editorially relocated to GALL-SLR Report, Chapter VII, Table I, "External Surfaces of Components and Miscellaneous Bolting," because AMP XI.M36 is the cited AMP. See item VII.I.A-24 in Table 2-20.
VII.C1.A-72	This item was deleted because it is enveloped by changes to AP-187.
VII.I.A-78	This item was deleted because it is enveloped by changes to A-77.
VII.A3.A-79 VII.E1.A-79	These items were editorially consolidated to cite a single item in GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.D.A-80	This item was deleted because it is enveloped by changes to A-77.
VII.I.A-81	This item was deleted because it is enveloped by changes to A-77.
VII.E1.A-88	This item was deleted because it is enveloped by AP-79. AP-79 cited AMP XI.M32 while A-88 did not. The basis for citing AMP XI.M32 is documented in the response to comment No. 015-007.
VII.G.A-91	This item was deleted because it is enveloped by changes to A-90.
VII.G.A-92	This item was deleted because it is enveloped by changes to A-90.
VII.G.A-93	This item was deleted because it is enveloped by changes to A-90.
VII.G.A-95 VII.H1.A-95	GALL-SLR Report, AMR item VII.G.A-95, added by License Renewal Interim Staff Guidance (LR-ISG) -2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," was deleted. Managing loss of material for fire water storage tanks is addressed in new GALL-SLR Report, AMR items G.A-412 and G.A-623. GALL-SLR Report, AMR item VII.H1.A-95, also added by LR-ISG-2012-02, was deleted because it is enveloped by changes to A-401.
VII.I.A-102	This AMR item was deleted because it is enveloped by changes to A-79.
VII.E1.A-102	Item VII.E1.A-102 was deleted because with the original issuance of LR-ISG-2011-01, "Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1" this material, environment, aging effect, and AMP combination was assigned as VII.E1.A-102. Item A-102 had already been assigned to a different material, environment, aging effect, and AMP combination. The material, environment, aging effect, and AMP combination described in VII.E1.A-102 is appropriately cited as AP-79 as described in Revision 1 of LR-ISG-2011-01.
VII.F1.A-105 VII.F2.A-105 VII.F3.A-105 VII.F4.A-105	These items were deleted because they are enveloped by changes to A-77.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.I.A-105	
VII.A2.A-400 VII.A3.A-400 VII.A4.A-400 VII.C2.A-400 VII.D.A-400 VII.E1.A-400 VII.E2.A-400 VII.E3.A-400 VII.E4.A-400 VII.F1.A-400 VII.F2.A-400 VII.F3.A-400 VII.F4.A-400 VII.H1.A-400 VII.H2.A-400	These items were deleted based on the staff's review of industry operating experience. It is not anticipate that recurring internal corrosion will occur in these systems. Item A-400 was retained for open-cycle cooling water, ultimate heat sink, waste water, and fire water systems.
VII.G.A-402 VII.H1.A-402	GALL-SLR Report, item VII.G.A-402, added by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation" was deleted. Fire water storage tanks (FWST) have been excluded from the scope of AMP XI.M29 and incorporated into AMP XI.M27, with the exception of managing aging effects on the external surfaces of tank bottoms exposed to periodically wetted concrete or soil environments. Loss of material for FWST exposed to air-indoor uncontrolled, air-outdoor, condensation, moist air, raw water, treated water, soil, concrete is managed by AMP XI.M27 as cited in GALL-SLR Report, AMR item VII.G.A-412. For tanks that are not FWSTs, item VII.H1.A-402, this item is enveloped by A-401.
VII.A2.A-405 VII.A3.A-405 VII.A4.A-405 VII.C1.A-405 VII.C2.A-405 VII.C3.A-405 VII.D.A-405 VII.E1.A-405 VII.E2.A-405 VII.E3.A-405 VII.E4.A-405 VII.E5.A-405 VII.F1.A-405 VII.F2.A-405 VII.F3.A-405 VII.F4.A-405 VII.G.A-405 VII.H1.A-405 VII.H2.A-405	These items were editorially consolidated to cite a single item in GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting." Stainless steel was deleted because the staff has concluded that loss of material for stainless steel components exposed to air and condensation should be addressed as a further evaluation. See item A-761. Copper alloy was deleted because the staff has concluded that there are no aging effects associated with copper alloy components exposed to air and condensation. See the staff's basis for item AP-144.
VII.A2.A-414 VII.A3.A-414 VII.A4.A-414 VII.D.A-414 VII.E1.A-414 VII.E2.A-414	These items were deleted based on the staff's review of license renewal applications (LRAs). It is not expected that coatings or lining would have been used in these systems. In the off chance that these an applicant has internal coatings/linings in these systems, they can cite the remaining A-414 items and remain consistent with the GALL-SLR Report.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.E3.A-414	
VII.D.A-415 VII.E1.A-415 VII.F1.A-415 VII.F2.A-415 VII.F3.A-415 VII.F4.A-415	These items were deleted based on the staff's review of LRAs. It is not expected that coatings or lining would have been used in these systems. In the off chance that these an applicant has internal coatings/linings in these systems, they can cite the remaining A-415 items and remain consistent with the GALL-SLR Report.
VII.A2.A-416 VII.A3.A-416 VII.A4.A-416 VII.D.A-416 VII.E1.A-416 VII.E2.A-416 VII.E3.A-416	These items were deleted based on the staff's review of LRAs. It is not expected that coatings or lining would have been used in these systems. In the off chance that these an applicant has internal coatings/linings in these systems, they can cite the remaining A-416 items and remain consistent with the GALL-SLR Report.
VII.C1.A-418 VII.F1.A-418 VII.F2.A-418 VII.F3.A-418 VII.F4.A-418	This item was incorporated into the draft GALL-SLR Report. However, the staff has concluded that managing loss of material for stainless steel and aluminum components exposed to condensation environments should be addressed as a further evaluation. New GALL-SLR AMR items were developed that cite the further evaluation section for this material, environment, aging effect, and AMP. See items A-770 and A-771.
VII.I.A-421	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped changes to AP 124.
VII.I.A-422	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped changes to AP 124.
VII.I.A-424	This aging management review (AMR) item was deleted because it is enveloped by changes to A-423.
VII.C3.A-425 VII.E5.A-425 VII.G.A-425 VII.H1.A-425 VII.H2.A-425	These items were editorially consolidated to cite a single item in GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting." See the technical basis for VII.I.A-425 in Table 2-6.
VII.I.A-427	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped changes to AP-102.
VII.I.A-452	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because the staff concluded that aluminum components exposed to these environments should be managed by a further evaluation item. It was enveloped by changes to A-451.
VII.C2.A-454	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because Table C2 includes closed-cycle cooling water systems that would not normally include raw water as an environment.
VII.I.A-455	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because this item is redundant to steel AMR lines in the same environments that are managed by the same AMPs. GALL-SLR Report, Chapter IX. C, "Use of Terms for Materials," combines gray cast iron with steel except for loss of material due to selective leaching.
VII.C1.A-456 VII.C2.A-456 VII.C3.A-456	These items were incorporated into the draft GALL-SLR Report. However, they were deleted prior to issuance of the final document because this item is redundant to steel AMR lines in the same environments that are managed by

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.D.A-456 VII.E5.A-456 VII.G.A-456 VII.H1.A-456 VII.H2.A-456	the same AMPs. GALL-SLR Report, Chapter IX. C, "Use of Terms for Materials," combines gray cast iron with steel except for loss of material due to selective leaching.
VII.C1.A-457	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to AP-75.
VII.C1.A-459	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to AP-76.
VII.E5.A-462 VII.G.A-462	These items were editorially consolidated into a single item citing in GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting." See the technical basis for VII.I.A-462 in Table 2-6.
VII.C1.A-469 VII.E5.A-469	The Table C1 entry was deleted because the staff concluded that citing components exposed to waste water in the open-cycle cooling water system (service water system) table was not necessary. The Table E5 was enveloped by A-785.
VII.C2.A-477	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to AP-101.
VII.D.A-498	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by A-504.
VII.E5.A-537	This item was consolidated to an item citing GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting.". See the technical basis for VII.I.A-537 in Table 2-6.
VII.E5.A-548	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by item A-728.
VII.H1.A-565	This item was incorporated into the draft GALL-SLR Report. However, the staff concluded that there would be limited applicability to this material, environment, aging effect, and AMP combination in GALL-SLR Report, Chapter VII, Table H1, and "Diesel Fuel Oil System."
VII.G.A-627	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped) by changes to item A-626.
VII.G.A-637	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to items A-722 (steel) and AP-221 (stainless steel). The staff has concluded that there are no aging effects associated with copper alloy components exposed to air. See the staff's basis for item AP-144.
VII.G.A-641	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to item AP-75.
VII.G.A-651 VII.H2.A-651	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped items A-439 and A-532.
VII.G.A-654 VII.H1.A-654	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped items A-762.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.H1.A-667 VII.H2.A-667	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by item A-660.
VII.I.A-700	This item was incorporated into the draft GALL-SLR Report. However, the staff has concluded that managing loss of material for stainless steel components exposed to condensation environments should be addressed as a further evaluation. New GALL-SLR Report AMR items were developed that cite the further evaluation section for this material, environment, aging effect, and AMP. See item AP-221.
VII.I.A-701	This item was incorporated into the draft GALL-SLR Report. However, the staff has concluded that managing loss of material for nickel alloy components exposed to condensation environments should be addressed as a further evaluation. New GALL-SLR Report AMR items were developed that cite the further evaluation section for this material, environment, aging effect, and AMP. See item AP-221.
VII.I.A-702	This item was incorporated into the draft GALL-SLR Report. However, the staff has concluded that managing loss of material for aluminum components exposed to condensation environments should be addressed as a further evaluation. New GALL-SLR Report AMR items were developed that cite the further evaluation section for this material, environment, aging effect, and AMP. See item A-756.
VII.I.A-707	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was replaced by changes to A-425.
VII.I.A-708	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped item AP-102.
VII.C1.A-714b VII.C2.A-714b VII.C3.A-714b VII.D.A-714b VII.E1.A-714b VII.E4.A-714b VII.F1.A-714b VII.F2.A-714b VII.F4.A-714b VII.G.A-714b VII.H1.A-714b VII.H2.A-714b VII.C1.A-714c VII.C2.A-714c VII.C3.A-714c VII.D.A-714c VII.E1.A-714c VII.E4.A-714c VII.F1.A-714c VII.F2.A-714c VII.F4.A-714c VII.G.A-714c VII.H1.A-714c VII.H2.A-714c	These items were editorially consolidated to cite a single item in GALL-SLR Report, Table I, “External Surfaces of Components and Miscellaneous Bolting.” See the technical basis for VII.I.A-714a, VII.I.A-714b, and VII.I.A-714c in Table 2-6.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.I.A-723	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped (or duplicated) by changes A-423.
VII.I.A-725	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped (or duplicated) by changes A-423.
VII.I.A-726	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped (or duplicated) by changes A-423.
VII.B.A-731	All bolted connections are visually inspected for cracking as part of the inspections performed under the American Society of Mechanical Engineers (ASME) B30 series of standards cited in AMP XI.M23. Given that the inspections for cracking are conducted for all structural bolting, this item was deleted because it is enveloped by A-730.
VII.C1.A-733 VII.C2.A-733 VII.D.A-733 VII.F1.A-733 VII.F2.A-733 VII.F3.A-733 VII.F4.A-733 VII.H2.A-733	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by A-419.
VII.J.A-735	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to AP-11.
VII.C1.A-738	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by A-460.
VII.C1.A-740	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to A-737, which encompassed all aging effects for cementitious type mechanical components.
VII.C1.A-741	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to A-737, which encompassed all aging effects for cementitious type mechanical components.
VII.C1.A-742	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to A-737, which encompassed all aging effects for cementitious type mechanical components.
VII.G.A-746	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to A-747.
VII.A2.A-749 VII.A3.A-749 VII.A4.A-749 VII.C1.A-749 VII.C2.A-749 VII.C3.A-749 VII.D.A-749 VII.E1.A-749 VII.E2.A-749 VII.E3.A-749	These items were incorporated into the draft GALL-SLR Report. However, the items were deleted prior to issuance of the final document because they were enveloped by A-677.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.E4.A-749 VII.E5.A-749 VII.F1.A-749 VII.F2.A-749 VII.F3.A-749 VII.F4.A-749 VII.G.A-749 VII.H1.A-749 VII.H2.A-749	
VII.C1.A-750 VII.C2.A-750 VII.C3.A-750 VII.D.A-750 VII.E1.A-750 VII.E4.A-750 VII.F1.A-750 VII.F2.A-750 VII.F4.A-750 VII.G.A-750 VII.H1.A-750 VII.H2.A-750	These items were not included in the GALL Report Revision 2 or the draft NUREG–2191 version issued for public comment. They were incorporated during the staff's review of the SLR documents subsequent to the issuance of the draft NUREG–2191 and then removed by the staff prior to final issuance of the document.
VII.I.A-751a	Item A-751 was incorporated into the draft GALL-SLR Report. However, prior to issuance of the final document, A-751 was split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, A-751a, because the tanks cited in the item are not within the scope of AMP XI.M29.
VII.I.A-753	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to item A-451.
VII.C3.A-755 VII.E5.A-755 VII.H1.A-755	These items were editorially consolidated to cite a single item in GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting."
VII.J.A-763a VII.J.A-763b VII.J.A-763c VII.J.A-763d VII.J.AP-4 VII.J.AP-8 VII.J.AP-152a VII.J.AP-152b VII.J.AP-161a VII.J.AP-161b	The Table J entries, "Common Miscellaneous Material/ Environment Combinations," were deleted because there are no applicable aging effects.
VII.A3.AP-1 VII.E1.AP-1	These item were deleted. The staff has concluded that aluminum is not susceptible to loss of material in an air with borated water leakage. Uhlig's Corrosion Handbook, 3rd Edition, Chapter B11, "Chemicals," states that, "[b]oric acid solutions in all concentrations up to saturated have negligible actions on aluminum alloys." A new item, VII.J.A-777, was developed citing no aging effect requiring management (AERM) and no recommended AMP for aluminum components exposed to air with borated water leakage.
VII.J.AP-16	The staff has concluded that managing loss of material for nickel alloy component exposed to air environments should be addressed as a further evaluation. See item AP-221.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.J.AP-17	The staff has concluded that managing loss of material and cracking due to stress corrosion cracking (SCC) for stainless steel exposed to air environments should be addressed as a further evaluation. See items AP-221 and AP-209.
VII.J.AP-20	The use of the term "air-dry in GALL-SLR Report, Chapter IX.D, was revised to cite only internal air environments located downstream of the compressed air system air dryers. The staff does not anticipate loss of material due to general, pitting, or crevice corrosion for metallic components exposed to dry air. However, over long periods of operation some water could accumulate within instrument air systems downstream of air dryers and cause localized corrosion. As a result, AMP XI.M24 recommends opportunistic inspections for this material, environment, and aging effect combination. GALL-SLR Report, item A-764 establishes the link between this MEA combination and AMP XI.M24, and therefore, AP-20 was deleted.
VII.J.AP-36	The staff has concluded that cracking and loss of material could occur in aluminum components exposed to air environments. See items A-451 and A-763.
VII.G.AP-40 VII.H2.AP-40	These items were deleted to consolidate items in a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables. See item VII.I.AP-40 in Table 2-20 for the technical basis.
VII.F1.AP-41 VII.F2.AP-41 VII.F3.AP-41 VII.F4.AP-41 VII.G.AP-41 VII.H2.AP-41	These items were deleted to consolidate items in a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables. See item VII.I.AP-41 in Table 2-20 for the technical basis.
VII.D.AP-81	This item was deleted because the staff concluded that loss of material for stainless steel components exposed to condensation should be subject to further evaluation. This material, environment, and aging effect combination is now addressed in item AP-221.
VII.E1.AP-85	The staff deleted this item and the associated further evaluation in SRP-LR, Revision 2, Section 3.3.2.2.4, because of limited fleet-wide applicability. The staff will evaluate the individual plants with this configuration rather than having the entire PWR fleet address this material, environment, and aging effect combination. In addition, existing items (e.g., AP-79) address loss of material for this material and environment combination, recommending AMP XI.M2 and AMP XI.M32 to manage the aging effect.
VII.F1.AP-102 VII.F2.AP-102 VII.F3.AP-102 VII.F4.AP-102	These items were deleted to consolidate items in a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables. See item VII.I.AP-102 in Table 2-20 for the technical basis.
VII.F1.AP-109 VII.F2.AP-109 VII.F3.AP-109 VII.F4.AP-109 VII.I.AP-109	The staff concluded that copper alloys are not susceptible to loss of material unless exposed to a water environment. See item AP-144.
VII.F1.AP-113 VII.F2.AP-113 VII.F3.AP-113 VII.F4.AP-113	These items were deleted to consolidate items in a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables. See item VII.I.AP-113 in Table 2-20 for the technical basis.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.D.AP-121	This AMR item was deleted because it is enveloped by changes to A-03.
VII.E1.AP-122	This AMR item was deleted because it is enveloped by changes to A-04.
VII.J.AP-123	The staff has concluded that cracking and loss of material could occur in stainless steel components exposed to air environments. See items AP-209 and AP-221
VII.I.AP-125	This AMR item was deleted because it is enveloped by changes to A-03.
VII.I.AP-126	This AMR item was deleted because it is enveloped by changes to A-03.
VII.J.AP-134	The use of the term “air-dry in GALL-SLR Report, Chapter IX.D, was revised to cite only internal air environments located downstream of the compressed air system air dryers. The staff does not anticipate loss of material due to general, pitting, or crevice corrosion for metallic components exposed to dry air. However over long periods of operation, some water could accumulate within instrument air systems downstream of air dryers and cause localized corrosion. As a result, AMP XI.M24 recommends opportunistic inspections for this material, environment, and aging effect combination. GALL-SLR Report, item A-764 establishes the link between this material, environment, and aging effect combination and AMP XI.M24; therefore, AP-134 was deleted.
VII.J.AP-135	The staff has concluded that cracking and loss of material could occur in aluminum components exposed to air environments. See items A-451 and A-776.
VII.C1.AP-137 VII.C3.AP-137 VII.G.AP-137	These items were editorially replaced by the new AMR item VII.I.AP-137. See item VII.I.A-137 in Table 2-20 for the technical basis.
VII.F1.AP-142 VII.F2.AP-142 VII.F3.AP-142 VII.F4.AP-142	The staff has concluded that cracking and loss of material could occur in aluminum components exposed to condensation environments. See items A-451 and A-776.
VII.C1.AP-153	This item was deleted because it is enveloped by changes to AP-187.
VII.C1.AP-155	This AMR item was deleted because it is enveloped by changes to AP-250.
VII.C1.AP-156	This AMR item was deleted because it is enveloped by changes to AP-253.
VII.I.AP-159	The staff has concluded that copper alloy components exposed to air-outdoor are no subject to AERM. See item AP-144.
VII.J.AP-167	This AMR item was deleted because it is enveloped by changes to AP-48.
VII.I.AP-177	This AMR item was deleted because it is enveloped by changes to AP-157.
VII.C1.AP-178	This AMR item was deleted because it is enveloped by changes to AP-157.
VII.C1.AP-198 VII.C3.AP-198 VII.G.AP-198 VII.H1.AP-198	These items were editorially replaced by the new AMR item VII.I.AP-198.
VII.C1.AP-209e VII.C2.AP-209e VII.C3.AP-209e VII.E4.AP-209e VII.G.AP-209e VII.H1.AP-209e	Item AP 209 was incorporated into the draft GALL–SLR Report. However, prior to issuance of the final document, A-751 was split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, AP-209e, because the tanks cited in the item are not within the scope of AMP XI.M29.
VII.C1.AP-237	This AMR item was deleted because it is enveloped by changes to AP-157.
VII.D.AP-240	The staff has concluded that copper alloy components exposed to air-outdoor are no subject to AERM. See item AP-144.
VII.I.AP-242	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-244	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.C1.AP-248	This AMR item was deleted because it is enveloped by changes to AP-250.
VII.C1.AP-249	This AMR item was deleted because it is enveloped by changes to AP-250.
VII.C1.AP-251	This AMR item was deleted because it is enveloped by changes to AP-253.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.C1.AP-252	This AMR item was deleted because it is enveloped by changes to AP-253.
VII.I.AP-256	The staff has concluded that loss of material and cracking could occur in aluminum components exposed to air environments. See A-763 and A-451.
VII.C2.AP-257	This AMR item was deleted because it is enveloped by AP-130
VII.H2.AP-258	This AMR item was deleted because it is enveloped by AP-130
VII.I.AP-261	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-262	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-263	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-264	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-265	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-266	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.I.AP-267	This AMR item was deleted because it is enveloped by changes to AP-124.
VII.E5.AP-273	This item was incorporated into the draft GALL-SLR Report. However, the staff has concluded that managing loss of material for stainless steel components exposed to condensation environments should be addressed as a further evaluation. See AMR item AP-221.
VII.E5.AP-274	The staff has concluded that loss of material should be managed for nickel alloy components exposed to condensation by a further evaluation AMR item. See AMR item AP-221.
VII.E5.AP-280	This AMR item was deleted because it is enveloped by changes to A-26.
VII.I.A-750a VII.I.A-750b VII.I.A-750c VII.I.A-750d VII.C3.A-754a VII.E5.A-754b VII.H1.A-754c VII.I.A-754a VII.I.A-754b VII.I.A-754c VII.C1.A-771a VII.C1.A-771b VII.C1.A-771c VII.C1.A-771d VII.C1.A-772a VII.F1.A-772a VII.F2.A-772a VII.F3.A-772a VII.F4.A-772a VII.C1.A-772b VII.F1.A-772b VII.F2.A-772b VII.F3.A-772b VII.F4.A-772b VII.C1.A-772c VII.F1.A-772c VII.F2.A-772c VII.F3.A-772c VII.F4.A-772c VII.C1.A-772d VII.F1.A-772d VII.F2.A-772d VII.F3.A-772d	These items are marked as deleted in NUREG–2191. They were new items that were incorporated during the staff’s review of the SLR documents and then removed by the staff prior to final issuance of the document. They should not have appeared in NUREG–2191.

Table 2-13 Deleted AMR Items, Chapter VII, Auxiliary Systems	
AMR Item No.	**Technical Bases for Changes**
VII.F4.A-772d VII.G.A-786 VII.A3.A-790a VII.A4.A-790a VII.C1.A-790a VII.C2.A-790a VII.C3.A-790a VII.E1.A-790a VII.E3.A-790a VII.E4.A-790a VII.F1.A-790a VII.F2.A-790a VII.F3.A-790a VII.F4.A-790a VII.G.A-790a VII.H2.A-790a VII.A3.A-790b VII.A4.A-790b VII.C1.A-790b VII.C2.A-790b VII.C3.A-790b VII.E1.A-790b VII.E3.A-790b VII.E4.A-790b VII.F1.A-790b VII.F2.A-790b VII.F3.A-790b VII.F4.A-790b VII.G.A-790b VII.H2.A-790b	

Table 2-14 Deleted AMR Items, Chapter VIII, Steam and Power Conversion System	
AMR Item No.	**Technical Bases for Changes**
VIII.E.S-31 VIII.G.S-31	These items were deleted because they are enveloped by SP-115 and SP-116.
VIII.H.S-40	This item was deleted because it is enveloped by S-30.
VIII.H.S-41	This item was deleted because it is enveloped by changes to S-29.
VIII.H.S-42	This item was deleted because it is enveloped by changes to S-29.
VIII.B1.S-400 VIII.B2.S-400 VIII.C.S-400	These items were deleted because the staff concluded that there was a reasonable basis that recurring internal corrosion would not be occurring in the main steam and extraction steam systems outside of loss of material due to erosion or flow-accelerated corrosion managed by aging management program (AMP) XI.M17.
VIII.A.S-401 VIII.B1.S-401 VIII.B2.S-401 VIII.C.S-401 VIII.D1.S-401 VIII.D2.S-401	These items were deleted because the staff concluded that there was a reasonable basis that internal coatings would not be used in the steam turbine, main steam, extraction steam, and feedwater systems.
VIII.A.S-402 VIII.B1.S-402 VIII.B2.S-402 VIII.C.S-402 VIII.D1.S-402 VIII.D2.S-402 VIII.E.S-402 VIII.F.S-402 VIII.G.S-402	These items were editorially consolidated to cite Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, Table H, “External Surfaces of Components and Miscellaneous Bolting.”
VIII.I.S-404	This item was deleted it is enveloped by changes to S-403.
VIII.A.S-414 VIII.B1.S-414 VIII.B2.S-414 VIII.C.S-414 VIII.D1.S-414 VIII.D2.S-414	These items were deleted because the staff concluded that there was a reasonable basis that internal coatings would not be used in the steam turbine, main steam, extraction steam, and feedwater systems.
VIII.A.S-415 VIII.B1.S-415 VIII.B2.S-415 VIII.C.S-415 VIII.D1.S-415 VIII.D2.S-415	These items were deleted because the staff concluded that there was a reasonable basis that internal coatings would not be used in the steam turbine, main steam, extraction steam, and feedwater systems.
VIII.H.S-416	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to SP-142.
VIII.H.S-417	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to SP-142.
VIII.H.S-419	This item was deleted because is enveloped by S-418.

Table 2-14 Deleted AMR Items, Chapter VIII, Steam and Power Conversion System	
AMR Item No.	**Technical Bases for Changes**
VIII.H.S-431	Subsequent to issuance of the GALL-SLR Report, the staff concluded the following: • Steel materials exposed to condensation are enveloped by S-29. • Stainless steel, aluminum, and nickel alloy materials exposed to condensation should be addressed by a further evaluation. See items SP-127 and SP-147. • Copper alloy was removed based on the staff concluding that copper alloys are not susceptible to loss of material unless exposed to a water environment. The staff reviewed: (a) "Atmospheric Corrosion of Copper Alloys Exposed for 15 to 20 Years," L. P. Costos, ASTM International, 1982, which tested copper alloys in marine, industrial and rural environments; and (b) "General Localized and Stress Corrosion Resistance of Copper Alloys in Natural Atmospheres," A. P. Castillo, ASTM International, 1982, which tested copper alloys in urban industrial (with some sea salt and road salt) and heavy industrial (with ammonia and sulfur dioxide) environments. The general loss of material rates (pitting was not a factor) ranged from 0.009 mils per year (mpy) to 0.09 mpy and 0.12 mpy to 0.14 mpy (in the latter study). These environments envelope what would be expected in a nuclear power plant air environments and the loss of material rates would not be expected to challenge the intended function of a copper alloy component. See item SP-6.
VIII.B1.S-432 VIII.B2.S-432 VIII.C.S-432	These items were deleted because the staff concluded that there was reasonable assurance that this material, environment, and aging effect combination was not likely to be applicable for main steam and extraction steam systems.
VIII.I.S-435	This item was deleted because it is enveloped by changes to SP-104.
VIII.E.S-440 VIII.F.S-440 VIII.G.S-440	AMR item S-31 was deleted because it is enveloped by S-439.
VIII.A.S-441 VIII.B1.S-441 VIII.B2.S-441 VIII.C.S-441 VIII.D1.S-441 VIII.D2.S-441 VIII.E.S-441 VIII.F.S-441 VIII.G.S-441	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to item S-448.
VIII.H.S-456	This item was incorporated into the draft GALL-SLR Report. However, it was deleted prior to issuance of the final document because it was enveloped by changes to item SP-118.
VIII.D1.S-457a VIII.D2.S-457a VIII.E.S-457a VIII.F.S-457a VIII.G.S-457a	These items were incorporated into the draft GALL-SLR. However, prior to issuance of the final document, S-457 was split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, E-457a, because the tanks cited in the item are not within the scope of AMP XI.M29.

Table 2-14 Deleted AMR Items, Chapter VIII, Steam and Power Conversion System	
AMR Item No.	**Technical Bases for Changes**
VIII.D1.S-458a VIII.D1.S-458b VIII.D1.S-458c VIII.D1.S-458d VIII.D2.S-458a VIII.D2.S-458b VIII.D2.S-458c VIII.D2.S-458d VIII.E.S-458a VIII.E.S-458b VIII.E.S-458c VIII.E.S-458d VIII.F.S-458a VIII.F.S-458b VIII.F.S-458c VIII.F.S-458d VIII.G.S-458a VIII.G.S-458b VIII.G.S-458c VIII.G.S-458d	These items were incorporated into the draft GALL-SLR Report. However, they were deleted because it was enveloped by changes to S-457.
VIII.D1.S-459a VIII.D1.S-459b VIII.D1.S-459c VIII.D2.S-459a VIII.D2.S-459b VIII.D2.S-459c VIII.E.S-459a VIII.E.S-459b VIII.E.S-459c VIII.F.S-459a VIII.F.S-459b VIII.F.S-459c VIII.G.S-459a VIII.G.S-459b VIII.G.S-459c	These items were incorporated into the draft GALL-SLR Report. However, they were deleted because it was enveloped by changes to S-457.
VIII.I.S-461	This item was incorporated into the draft GALL-SLR Report. However, it was deleted because it was enveloped by changes to SP-147.
VIII.I.SP-5	This item was deleted because it is enveloped by SP-6.
VIII.I.SP-9	Item SP-111 was editorially deleted because it is enveloped by SP-33.

Table 2-14 Deleted AMR Items, Chapter VIII, Steam and Power Conversion System	
AMR Item No.	**Technical Bases for Changes**
VIII.I.SP-11	This item was deleted because the staff has concluded that nickel alloys are susceptible to pitting and crevice corrosion when exposed to contaminants. Electric Power Research Institute (EPRI) 1010639, Table 4-1, "Aging Effects Summary – External Surfaces." Footnote 1 of this table states, "[p]rolonged or frequent wetting (e.g., from condensation, leakage, ponding/pooling) or alternate wetting and drying can concentrate contaminants from the atmosphere and they can thereby become aggressive species for metals. Infrequent or intermittent wetting (e.g., limited time periods with condensation) are not expected to concentrate contaminants sufficiently to become aggressive for metals." As discussed in the GALL-SLR Report and Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Supplemental Staff Guidance document, sources of moisture in plant areas include condensation and leakage from mechanical connections such as bolted flanges and valve packing. Insulation can contain sufficient levels of halogens to promote pitting and crevice corrosion. The staff has concluded that nickel alloy materials are no more susceptible to loss of material due to pitting and crevice corrosion in air environments where moisture is possible than are stainless steel components. As a result, the staff has revised the further evaluation sections with stainless steel components exposed to air or condensation to include nickel alloys. See SP-127.
VIII.I.SP-12	This item was deleted because the staff has concluded that managing loss of material and cracking due to stress corrosion cracking (SCC) for stainless steel exposed to air environments should be addressed as a further evaluation. See SP-127 and SP-118.
VIII.F.SP-56	This item was deleted because reduction of heat transfer due to fouling is not applicable to heat exchanger components, but rather, heat exchanger tubes. The staff did not replace this item with one that cites the same material, environment, aging effect, and AMP because it is not expected that steam generator blowdown systems (Table F) would not have a safety-related heat rejection intended function.
VIII.E.SP-78 VIII.F.SP-78	These items were deleted because they are enveloped by SP-77. There is no need to uniquely identify pressurized water reactor (PWR) heat exchanger components when SP-77 covers boiling water reactors (BWR) and PWR heat exchanger components.
VIII.E.SP-81 VIII.F.SP-81	When the draft GALL-SLR Report was issued for public comment, item SP-81 was revised to cite a further evaluation. At that time, the staff had concluded that stainless steel components exposed to treated water should be subject to a further evaluation. As a result of the staff's review of a public comment they concluded that a further evaluation was not necessary. The staff's basis for this change is documented in the response to comment No. 015-007. Nevertheless, SP-81 remained as deleted because this material, environment, aging effect, and AMP combination was enveloped by SP-80.
VIII.H.SP-82	This item was deleted because it is enveloped by changes to S-02.
VIII.H.SP-83	This item was deleted because it is enveloped by changes to SP-142.
VIII.H.SP-84	This item was deleted because it is enveloped by changes to S-02.
VIII.I.SP-86	This item was deleted because the staff has concluded that loss of material and cracking due to SCC for stainless steel components exposed to air environments should be addressed as a further evaluation. See SP-127 and SP-118.

Table 2-14 Deleted AMR Items, Chapter VIII, Steam and Power Conversion System	
AMR Item No.	**Technical Bases for Changes**
VIII.I.SP-93	This item was deleted because the staff has concluded that loss of material and cracking due to SCC for aluminum components exposed to air environments should be addressed as a further evaluation. See SP-147 and S-457.
VIII.E.SP-94 VIII.G.SP-94	This item was deleted because it was enveloped by SP-145.
VIII.I.SP-108	This item was editorially deleted because it is enveloped by SP-33.
VIII.B1.SP-110 VIII.B2.SP-110	These items were deleted because the staff has concluded that loss of material for stainless steel components exposed to condensation should be addressed as a further evaluation. See SP-127.
VIII.I.SP-111	Item SP-111 was editorially deleted because it is enveloped by SP-33.
VIII.A.SP-127e VIII.B1.SP-127e VIII.B2.SP-127e VIII.C.SP-127e VIII.D1.SP-127e VIII.D2.SP-127e VIII.E.SP-127e VIII.F.SP-127e VIII.G.SP-127e	Prior to issuance of the final document, SP-127 was split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, SP-127e, because the tanks cited in the item are not within the scope of AMP XI.M29.
VIII.E.SP-137	This item was deleted because it is enveloped by S-447.
VIII.E.SP-138	This item was deleted because the staff has concluded that loss of material for stainless steel components exposed to air environments should be addressed as a further evaluation. See S-446.
VIII.E.SP-139	This item was deleted because the staff has concluded that loss of material for aluminum components exposed to air environments should be addressed as a further evaluation. See S-445.
VIII.E.SP-140	This item was deleted because the staff has concluded that loss of material for aluminum components exposed to air environments should be addressed as a further evaluation. See S-445.
VIII.H.SP-144	This item was deleted because it is enveloped by changes to SP-142.
VIII.E.SP-147e VIII.G.SP-147e	Prior to issuance of the final document, SP-147 was split into items citing five AMPs, AMP XI.M29, AMP XI.M32, AMP XI.M36, AMP XI.M38, and AMP XI.M42. The staff deleted the items citing AMP XI.M29, SP-427e, because the tanks cited in the item are not within the scope of AMP XI.M29.
VIII.H.SP-149	This item was deleted because it is enveloped by changes to SP-142.
VIII.H.SP-150	This item was deleted because it is enveloped by changes to SP-142.
VIII.H.SP-151	This item was deleted because it is enveloped by changes to SP-142.
VIII.E.S-421 VIII.G.S-420 VIII.G.S-421	The technical basis for these items is available in Table 2-7.
VIII.E.SP-145 VIII.G.SP-145	The technical basis for these items is available in Table 2-21.
VIII.E.S-467 VIII.G.S-466 VIII.G.S-467 VIII.H.S-470	These items are shown as deleted in NUREG–2191 as an error. These items were not included in the draft NUREG–2191 copy issued for public comment and the staff recognizes that they should have been deleted.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.A3.C-13 II.B4.C-13	The entry in the Structure and/or Component column was expanded to add “Metal liner, metal plate, personnel airlock, equipment hatch, CRD hatch” to the original “penetration sleeves; penetration bellows.” This change was made to ensure the line item addressed all the components that could be impacted by the aging effect. The descriptor in the aging management program (AMP) column “Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation” was deleted to remove unnecessary verbiage, because the information was captured elsewhere. For consistency among TLAA items; the “Further Evaluation” column was simplified to “yes.”
II.A3.CP-37 II.B4.CP-37	The entry in the Structure and/or Component column was expanded to add “Metal liner, metal plate, airlock, equipment hatch, CRD hatch” to the original “penetration sleeves; penetration bellows.” These structures are also potentially susceptible to cracking due to cyclic loading [and the current licensing basis (CLB) fatigue analysis does not apply].
II.B3.1.CP-113	Editorial changes as follows: The entry in the Structure and/or Component column “Steel elements (inaccessible areas): drywell shell; drywell head; and drywell shell” repeated drywell shell two times. The second mention was deleted. For consistency and to remove unnecessary verbiage, the “Further Evaluation” column was simplified to “yes.” The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.
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	The entry in the Material column was revised from “Concrete, steel” to “Concrete.” There was no need to include steel because concrete is assumed to include reinforcing steel.
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	The entry in the Material column was revised from “Concrete, steel” to “Concrete.” There was no need to include steel because concrete is assumed to include reinforcing steel. For the concrete in inaccessible areas, the entry in the Environment column was revised from “Air–indoor uncontrolled or Air–outdoor” to “Any” since the aging effects could occur in any environment.
II.A3.CP-150 II.B4.CP-150	The entry in the Material column was revised from “Any” to “Steel.” The structure of concern, containment “Pressure-retaining bolting” would only be constructed of steel. For consistency between AMR chapters and to remove unnecessary verbiage, the entry in the Environment column was simplified from “Any environment” to “Any.”

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.B2.1.C-45	The environment of treated water was added to account for the internal surfaces of the suppression pool. . The descriptor in the AMP column "Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation" was deleted to remove unnecessary verbiage, because the information was captured elsewhere. For consistency among TLAA items; the "Further Evaluation" column was simplified to "yes."
II.B1.2.CP-106 II.B2.2.CP-106	The entry in the Environment column was expanded from "Air–indoor uncontrolled, air–outdoor," to "Air–indoor uncontrolled, air–outdoor, groundwater/soil" to better describe where the AMP is applicable. The noted aging effects/mechanisms of "Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack" could occur in concrete exposed to groundwater.
II.A3.CP-152 II.B4.CP-152	The entry in the Environment column was expanded from "Air–indoor uncontrolled" to "Air–indoor uncontrolled, treated water" to better describe where the AMP is applicable. The aging effect was expanded from "Loss of coating integrity…" to "Loss of coating or lining integrity…" to better capture the utility of the AMP XI.S8.
II.A3.CP-39 II.B4.CP-39	The entry in the aging effects/mechanism column removed "of locks, hinges, and closure mechanisms" because the information was unnecessary and is captured in the component column. .
II.A2.CP-58	The AMP column was changed to add "or AMP XI.S6, Structures Monitoring" because sites with steel containments are not required to have an ASME Section XI, Subsection IWL program and may credit AMP XI.S6 for aging management of this aging effect.
II.A1.CP-33 II.B1.2.CP-59 II.B2.2.CP-59 II.B3.2.CP-60 II.B3.1.CP-66	Editorial changes as follows: For consistency between AMR chapters and to remove unnecessary verbiage, the entry in the Environment column was simplified from "Any environment" to "Any."
II.B1.1.C-23 II.B1.2.C-23 II.B2.1.C-23 II.B2.2.C-23	Editorial changes as follows: Clarification was made between the identities of aging effect versus aging mechanism. The entry in the Aging Effect/Mechanism column "Fretting or lockup due to mechanical wear" was replaced by the phrase "Loss of material due to mechanical wear, including fretting." A corresponding change was made to Chapter IX, the chapter on terminology.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.B1.1.C-21 II.B2.2.C-48	Editorial changes as follows: For consistency and to remove unnecessary verbiage among TLAA items. The descriptor in the AMP column was originally "Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)" which was simplified to state "SRP-SLR Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis." for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)." The "Further Evaluation" column was simplified from "yes, TLAA" to "yes."
II.A1.C-11 II.B2.2.C-11	To improve TLAA guidance pointers. The descriptor in the AMP column was originally "Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the SRP, Section 4.5, "Concrete Containment Tendon Prestress" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.S1 of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii). For periodic monitoring of prestress, see Chapter XI.S2." The TLAA reference was revised to state "TLAA, SRP-SLR Section 4.5, "Concrete Containment Tendon Prestress," and/or SRP-SLR Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." For consistency and to remove unnecessary verbiage, the "Further Evaluation" column was simplified to "yes."
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	Removed unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally "Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure." This was simplified to state "Plant-specific aging management program." The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.A1.CP-34 II.B1.2.CP-57 II.B2.2.CP-57 II.B3.1.CP-65 II.B3.2.CP-108	Editorial changes as follows: Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally "Plant-specific aging management program. 10 CFR 50.55a (rule) references Subsection IWE, "Requirements for Class MC and Metallic Liners of Class CC Concrete Components of Light-Water Cooled Power Plants," and Subsection IWL, "Requirements for Class CC Concrete Components of Light-Water Cooled Power Plants," of Section XI, Division 1, of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and modulus of elasticity due to elevated temperature. Thus, for any portions of concrete containment that exceed specified temperature limits, further evaluations are warranted. Subsection CC-3400 of ASME Section III, Division 2, specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150 °F except for local areas, such as around penetrations, which are not allowed to exceed 200 °F. If significant equipment loads are supported by concrete at temperatures exceeding 150 °F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations." This was simplified to state "Plant-specific aging management program to be evaluated if temperature limits exceeded." The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
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	Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally: "Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in inaccessible areas. A plant-specific aging management program is not required if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as "map" or "patterned" cracking or the presence of reaction byproducts (e.g., alkali-silica gel) as described in NUREG–1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function." This was simplified to state "Plant-specific aging management program." The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR. Subsequent to the issuance of the GALL-SLR report, the staff noted that the descriptor in the AMP column was not properly revised for AMR item II.B3.2.CP-121. The AMP column for this item should state "Plant-specific aging management program."

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
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	Editorial changes as follows: Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally: AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J." Additional plant-specific activities are warranted if loss of material due to corrosion is significant for inaccessible areas (embedded containment steel shell or liner). Loss of material due to corrosion is not significant if the following conditions are satisfied: (1) Concrete meeting the requirements of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. (2) The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. (3) The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. (4) Borated water spills and water ponding on the concrete floor are common and when detected are cleaned up or diverted to a sump in a timely manner. Operating experience has identified significant corrosion in some plants. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary." This was simplified to state "AMP XI.S1, "ASME Section XI, Subsection IWE," and AMP XI.S4, "10 CFR Part 50, Appendix J" The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.A1.CP-147 II.A2-CP-70 II.B3.2.CP-135	Editorial changes as follows: Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally: "Further evaluation is required for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG–1557) to determine if a plant-specific aging management program is needed. A plant-specific aging management program is not required if documented evidence confirms that the existing concrete had air entrainment content (as per Table CC-2231-2 of the ASME Section III Division 2), and subsequent inspections of accessible areas did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. If this condition is not satisfied, then a plant-specific aging management program is required to manage loss of material (spalling, scaling) and cracking due to freeze-thaw of concrete in inaccessible areas. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1." This was simplified to state "Plant-specific aging management program to be evaluated for plants in moderate to severe weathering conditions." The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.
II.B1.1.CP-109 II.B3.1.CP-158	Editorial changes as follows: Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally: AMP XI.S1, "ASME Section XI, Subsection IWE" Plant-specific aging management program is required if plant operating experience identified significant corrosion of the torus ring girders and downcomers. If protective coating is credited for preventing corrosion of the torus shell, the coating should be included in scope of license renewal and subject to aging management review." This was simplified to state "AMP XI.S1, ASME Section XI, Subsection IWE." The "Further Evaluation" column was simplified to "yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.B1.1.CP-48	Remove unnecessary verbiage from GALL tables. The descriptor in the AMP column was originally: “AMP XI.S1, “ASME Section XI, Subsection IWE,” and AMP XI.S4, “10 CFR Part 50, Appendix J.” Significant corrosion of the torus shell and degradation of its protective coating are identified in IN 88-82. Other industrywide operating indicates a number of incidences of torus corrosion. License renewal applicants are advised to address their plant-specific operating experience related to the torus shell corrosion. If the identified corrosion is significant, a plant-specific aging management is required. If protective coating is credited for preventing corrosion of the torus shell, the coating should be included in scope of license renewal and subject to aging management review. ” This was simplified to state “AMP XI.S1, ASME Section XI, Subsection IWE, and AMP XI.S4, 10 CFR Part 50, Appendix J.” The “Further Evaluation” column was simplified to “yes.” The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.
II.A2.CP-69 II.B3.1.CP-69 II.A1.CP-101 II.B1.2.CP-105 II.B2.2.CP-105 II.B3.2.CP-105	Editorial changes as follows: The descriptor in the AMP column for AMP XI.S6, “If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the subsequent period of extended operation” was deleted because the information was captured in the AMP XI.S6. For consistency and to remove unnecessary verbiage, the “Further Evaluation” column was simplified to “yes.” The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.
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	Editorial changes as follows: The descriptor in the AMP column for AMP XI.S6, “If a de-watering system is relied upon for control of erosion of cement from porous concrete subfoundations, then the licensee is to ensure proper functioning of the de-watering system through the subsequent period of extended operation” was deleted because the information was captured in the AMP XI.S6. For consistency and to remove unnecessary verbiage, the “Further Evaluation” column was simplified to “yes.” The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.
II.A3.CP-38 II.B4.CP-38	Editorial changes as follows: For consistency and to remove unnecessary verbiage, the Further Evaluation column was simplified to “yes.” The deleted information is captured in the associated Further Evaluation section of the SRP-SLR.

Table 2-15 Changes to Existing GALL Report Revision 2 Chapter II AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
II.B3.1.C-24 II.B3.2.C-24 II.B1.1.CP-50	The entry in the Further Evaluation column was changed from “no” to “yes.” Further evaluation, including consideration of SCC susceptibility and applicable operating experience (OE) related to detection, is recommended of additional appropriate examinations/evaluations implemented to detect this aging effect for these SS components and dissimilar metal welds (SRP-SLR 3.5.2.2.1.6).
II.A1.CP-35 II.A2.CP-35 II.B3.2.CP-35 II.A3.CP-36 II.B4.CP-36 II.B1.1.CP-43 II.B3.1.CP-43 II.B1.2.CP-46 II.B2.1.CP-46 II.B2.2.CP-46	The entry in the Further Evaluation column was changed from “no” to “yes.” Loss of material due to general, pitting, and crevice corrosion could occur in steel elements of accessible and inaccessible areas for all types of PWR and BWR containments. Further evaluation is recommended to augment the existing program AMP XI.S1 which relies on ASME Code Section XI, Subsection IWE, and 10 CFR Part 50, Appendix J. (SRP-SLR 3.5.2.2.1.3).

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
III.B1.1.TP-41	For consistency with the other aging management review (AMR) Tables, the entry in the Material column was revised from “Low-alloy steel, actual measured yield strength ≥ 150 ksi (1,034 MPa)” to “High-strength steel” The entry in the Environment column was revised from “Air–indoor uncontrolled” to “Air” since cracking due to stress corrosion cracking (SCC) in high strength structural bolting can occur in any air environment.
III.B1.1.TP-3 III.B1.2.TP-3 III.B1.3.TP-3 III.B2.TP-3 III.B3.TP-3 III.B4.TP-3 III.B5.TP-3	The entry in the Material column was revised from “Galvanized steel, aluminum” to just be “Galvanized steel” because in the specified environment of “Air with borated water leakage,” boric acid corrosion exerts little attack on aluminum (ASM Handbook of Corrosion Data, B.S. Craig and D.S. Anderson, Ed, 998 pp, 1994).
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	The entry in the Material column was revised from “stainless steel” to be “stainless steel, aluminum” because in the specified environment of “Air with borated water leakage,” boric acid corrosion exerts little attack on aluminum (ASM Handbook of Corrosion Data, B.S. Craig and D.S. Anderson, Ed, 998 pp, 1994). The aging effect/mechanism for these AMR lines is “none.”
III.B1.1.TP-8 III.B1.2.TP-8 III.B1.3.TP-8 III.B2.TP-6 III.B2.TP-8 III.B3.TP-8 III.B4.TP-6 III.B4.TP-8 III.B5.TP-8	Aluminum and stainless steel materials were removed from TP-6 and TP-8 because these materials were relocated to T-37. (Refer to Table 2-2, “New AMR Items Added in GALL-SLR, Chapter III” for the T-36 and T-37 basis). The staff has concluded that aluminum and stainless steel support members exposed to air or condensation should be managed for loss of material and cracking with a new Further Evaluation, Section 3.5.2.2.2.4 linked to T-36 and T-37. Galvanized steel was retained with TP-6 and TP-8 because there are no aging effects for galvanized materials exposed to indoor air or condensation.
III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A6.TP-110 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108	The entry in the Environment column was expanded from “Air-outdoor” to “Air-outdoor, groundwater/soil” to better represent the range that inaccessible areas of concrete structures and component supports may be subject to. The entry in the AMP column was simplified to “Plant-specific aging management program to be evaluated for plants in moderate to severe weathering conditions.” The previous AMP entry wording was deleted. “Further evaluation is recommended of programs to manage loss of material (spalling, scaling) and cracking due to freeze-thaw in below-grade inaccessible concrete areas of Groups 1–3, 5, and 7–9 structures. Structure monitoring programs may not be sufficient for plants located in moderate to severe weathering conditions. Further evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG–1557). The weathering index for the continental United States is shown in ASTM C33-90, Figure 1. A plant-specific program is not required if documented evidence confirms that the existing concrete had air content of 3 percent to 8 percent and subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The reviewer confirms that the applicant has satisfied these conditions. Otherwise, the reviewer reviews the applicant’s proposed AMP to

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	verify that, where appropriate, an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas for plants located in moderate to severe weathering conditions is adequately managed." For consistency, the entry for the Further Evaluation column was simplified to "Yes." The deleted information is captured in the associated Further Evaluation section in the SRP-SLR.
III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204 III.A5.TP-204 III.A6.TP-220 III.A7.TP-204 III.A8.TP-204 III.A9.TP-204	The entry in the Environment column was revised from "Any environment" to "Any" to remove unnecessary verbiage. The entry in the AMP column was simplified to "Plant-specific aging management program." The previous AMP entry wording was deleted: "Further evaluation is required to determine if a plant-specific aging management program is needed to manage cracking and expansion due to reaction with aggregate of concrete in inaccessible areas. A plant-specific aging management program is not required if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as "map" or "patterned" cracking or the presence of reaction byproducts (e.g., alkali-silica gel).as described in NUREG–1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295 and other ASTM reactivity tests, as required, can demonstrate that those aggregates do not adversely react within concrete, or (2) For potentially reactive aggregates, aggregate concrete reaction is not significant if it is demonstrated that the in-place concrete can perform its intended function." For consistency, the entry for the Further Evaluation column was simplified to "Yes." The deleted information is captured in the associated Further Evaluation section in the SRP-SLR, Section 3.5.3.2.1.8.
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.B1.1.TP-226 III.B1.2.TP-226 III.B1.3.TP-226 III.B2.TP-248 III.B3.TP-248 III.B4.TP-248 III.B5.TP-248	The entry in the Environment column was revised from "Air–indoor uncontrolled" to "Air–indoor uncontrolled or Air–outdoor" since loss of material in steel structural bolting due to general, pitting, and crevice corrosion can also occur in outdoor air.
III.A1.TP-31 III.A2.TP-31	Editorial changes as follows:

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
III.A3.TP-31 III.A5.TP-31 III.A6.TP-31 III.A7.TP-31 III.A8.TP-31 III.A9.TP-31	The entry in the Environment column was revised from “Water-flowing under foundation” to “Water-flowing” to reduce unnecessary verbiage since the context is apparent from the AMR item. The descriptor in the AMP column for AMP XI.S6, “If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the subsequent period of extended operation” was deleted because the information was captured in the AMP XI.S6 and also the associated Further Evaluation section of the SRP-SLR, Section 3.5.3.2.1.1. For consistency and to remove unnecessary verbiage, the “Further Evaluation” column was simplified to “yes.”
III.A4.TP-301	The entry in the Environment column was expanded from “Air–indoor uncontrolled” to “Air–indoor uncontrolled, treated water” to better describe where the AMP is applicable. The aging effect was expanded from “Loss of coating integrity…” to “Loss of coating or lining integrity…” to better capture the utility of the AMP XI.S8.
III.A6.TP-36 III.A6.TP-37 III.A6.TP-38	Editorial changes as follows: The entry in the Environment column was generalized to simply “Any” to better describe where the AMP is applicable. The entry in the AMP column was revised to reflect the change in the title of AMP XI.S7. Previously, including Regulatory Guide (RG) 1.127 in the AMP title was misleading to applicants because they believed that the AMP only applied if they were committed to RG 1.127.
III.A6.T-22	The entry in the Environment column was expanded from “water–flowing or standing” to “Air–outdoor, water–flowing or standing” to better describe where the AMP is applicable. The entry in the AMP column was revised to reflect the change in the title of AMP XI.S7. Previously, Including RG 1.127 in the AMP title was misleading to applicants because they believed that the AMP only applied if they were committed to RG 1.127.
III.A6.TP-7	In the “Environment” column, “various” is not an environment in the GALL. “Any” makes more sense and is consistent with the other items. Original input to the “Aging Effect/Mechanism” column was “Loss of sealing due to deterioration of seals, gaskets, moisture barriers (caulking, flashing, other sealants)” which does not clearly denote the aging mechanism leading to aging effect causality (deterioration is also an effect). The input has been corrected to “Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects” which more correctly denotes the effect and mechanisms.
III.A1.TP-25 III.A1.TP-261 III.A2.TP-25 III.A2.TP-261 III.A3.TP-25 III.A3.TP-261	Editorial changes as follows: The entry in the Environment column was revised from “Any environment” to “Any” to remove unnecessary verbiage.

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
III.A4.TP-25 III.A4.TP-261 III.A5.TP-25 III.A5.TP-261 III.A6.TP-261 III.A7.TP-25 III.A7.TP-261 III.A8.TP-25 III.A8.TP-261 III.A9.TP-25 III.A9.TP-261 III.B1.1.TP-229 III.B1.2.TP-229 III.B1.3.TP-229 III.B2.TP-261 III.B3.TP-261 III.B4.TP-261 III.B5.TP-261	
III.B1.1.TP-10	Editorial changes as follows: The entry in the Environment column was revised from “Treated water <60 °C (<140 °F)” to “Treated water” to reduce unnecessary verbiage. The entry in the “Aging Effect/Mechanism” column was revised from AMP XI.M2, “Water Chemistry,” for BWR water, and AMP XI.S3, “ASME Section XI, Subsection IWF” to AMP XI.M2, “Water Chemistry,” and AMP XI.S3, “ASME Section XI, Subsection IWF” thus removing the stipulation of BWR water.
III.A4.TP-35 III.B1.1.T-28 III.B1.1.TP-45 III.B1.2.T-28 III.B1.2.TP-45 III.B1.3.T-28 III.B1.3.TP-45 III.B2.TP-46 III.B2.TP-47 III.B4.TP-46 III.B4.TP-47	In each case, the aging effect/aging mechanism was slightly revised to uniformly state “Loss of mechanical function due to corrosion, distortion, dirt or debris accumulation, overload, wear.” The previous wording had incorrectly identified “dirt” as a cause of loss of mechanical function.
III.B1.1.T-26 III.B1.2.T-26 III.B1.3.T-26	Original input to the “Aging Effect/Mechanism” column was “Cumulative fatigue damage due to fatigue (Only if CLB fatigue analysis exists)” which does not clearly denote the aging mechanism leading to aging effect causality (fatigue was listed as both mechanism and effect). The input has been corrected to “Cumulative fatigue damage due to cyclic loading (Only if CLB fatigue analysis exists)” which more correctly denotes the effect and mechanisms. The input to the AMP/TLAA column was revised for consistency between GALL-SLR chapters and to remove unnecessary verbiage among TLAA items. The descriptor in the AMP column in GALL Revision 2 stated “Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	operation." See the SRP-SLR, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)." Another TLAA was added as an option and the input was simplified to state "SRP-SLR Section 4.3, Metal Fatigue," and/or Section 4.7 "Other Plant-Specific Time-Limited Aging Analyses"
III.B1.1.TP-235 III.B1.2.TP-235 III.B1.3.TP-235	Original input to the "Aging Effect/Mechanism" column was "Loss of material due to pitting, crevice corrosion" The input has been revised to "Loss of material due to general, pitting, crevice corrosion" which more correctly denotes the susceptibility of steel. Although galvanized steel is not susceptible to general corrosion, the materials of consideration are "steel, galvanized steel."
III.A7.T-23 III.A8.T-23	Editorial changes as follows: Original input to the "Aging Effect/Mechanism" column "A plant-specific aging management program is to be evaluated" was simplified to "Plant-specific aging management program." Further evaluation was simplified from "Yes, plant-specific" to "Yes."
III.A1.TP-67 III.A2.TP-67 III.A3.TP-67 III.A4.TP-305 III.A5.TP-67 III.A6.TP-109 III.A7.TP-67 III.A8.TP-67 III.A9.TP-67	The entry in the AMP/TLAA column was simplified to "Plant-specific aging management program." The previous AMP entry wording was deleted: "Further evaluation is required to determine if a plant-specific aging management program is needed to manage increase in porosity, and permeability due to leaching of calcium hydroxide and carbonation of concrete in Inaccessible Areas. A plant-specific aging management program is not required if (1) There is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) Evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure. For consistency with other AMR tables, the entry for the Further Evaluation column was simplified to "Yes." The deleted information is captured in the associated Further Evaluation section in the SRP-SLR, Section 3.5.3.2.1.9.
III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114 III.A5.TP-114	Editorial changes as follows: The entry in the AMP/TLAA column was simplified to "Plant-specific aging management program to be evaluated if temperature limits exceeded." The previous AMP entry wording was deleted: Plant-specific aging management program. Subsection CC-3400 of ASME Section III, Division 2, and Appendix A of ACI 349 specifies the concrete temperature limits for normal operation or any other long-term period. The temperatures shall not exceed 150 °F except for local areas, such as around penetrations, where the temperatures are not allowed to exceed 200 °F. If significant equipment loads are supported by concrete at temperatures exceeding 150 °F, an evaluation of the ability to withstand the postulated design loads is to be made. Higher temperatures than those given above may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and

Table 2-16 Changes to Existing GALL Report Revision 2 Chapter III AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	modulus of elasticity and these reductions are applied to the design calculations. For consistency with other AMR tables, the entry for the Further Evaluation column was simplified to "Yes." The deleted information is captured in the associated Further Evaluation section in the SRP-SLR, Section 3.5.3.2.1.2.
III.A1.TP-30 III.A2.TP-30 III.A3.TP-30 III.A4.TP-30 III.A5.TP-30 III.A6.TP-30 III.A7.TP-30 III.A8.TP-30 III.A9.TP-30	Editorial changes as follows: The descriptor in the AMP/TLAA column for AMP XI.S6, "If a de-watering system is relied upon for control of settlement, then the licensee is to ensure proper functioning of the de-watering system through the subsequent period of extended operation" was deleted because the information was captured in the AMP XI.S6. For consistency and to remove unnecessary verbiage, the "Further Evaluation" column was simplified to "Yes." The deleted information is captured in the associated Further Evaluation section of the SRP-SLR, 3.5.3.2.1.1.
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	Editorial changes as follows: The descriptor in the AMP/TLAA column for AMP XI.S6, "If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance" was deleted because the information was captured in the AMP XI.S6.
III.A5.T-14	Editorial changes as follows: The "AMP/TLAA" descriptor was revised to remove unnecessary, redundant, verbiage. For consistency and to remove unnecessary verbiage, the "Further Evaluation" column was simplified to "no." The deleted information "unless leakages have been detected through the SFP liner that cannot be accounted for from the leak chase channels" is captured elsewhere." The "Structure and/or Component" input was revised from "steel components: fuel pool liner" to more correctly and less redundantly state, "Stainless steel: fuel pool liner" because the liner will not be simply steel.
III.A6.T-20 III.A6.TP-221 III.A6.TP-223	Editorial changes as follows: The entry in the AMP/TLAA column was revised to reflect the change in the title of AMP XI.S7. Previously, including RG 1.127 in the AMP title was misleading to applicants because they believed that the AMP only applied if they were committed to RG 1.127.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
Page IV C1-1 Page IV C2-1	The following phrase was deleted from each of the cited GALL-SLR Report pages: "They are also subject to replacement based on qualified life or a specified time period." This phrase appears in a paragraph under Systems, Structures, and Components. The phrase was associated with pump and valve internals. During the development of the GALL-SLR Report, the industry submitted a comment that these items are not necessarily subject to replacement based on a qualified or specified time period. The staff agreed with this comment and deleted the phrase. The cited pages retain the phrase, "Pump and valve internals perform their intended functions with moving parts or with a change in configuration." This statement provides an adequate basis for not subjecting the parts to aging management review.
Page IV E-1	The introduction to the Common Miscellaneous Material/Environment Combinations Table was revised. The associated AMR line item table states that there are no aging effects requiring management and no recommended AMP. However, some of the components listed in the table could be within the scope of ASME Code Section XI, "Rules for Inspection and Testing of Components of Light Water Cooled Plants." The staff added, "With the exception of components within the scope of ASME Section XI," to the statement that no aging management programs are required for the components in the Common Miscellaneous Material/Environment Combinations Table. The aging effects associated with components within the scope of ASME Section XI are managed by aging management programs such as AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The introduction to this table could have mislead the user without this clarification.
IV.A1.R-04	The staff determined that the previous version of AMR item IV.A1.R-04 in GALL Report Revision 2 was acceptable for retention in Table IV.A1 of the GALL-SLR Report, with the exception that the staff edited the "Aging Effect/Mechanism" column entry for the line item to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to administratively reduce the language in the "Aging Management Program (AMP)/TLAA" column entry of the line item such that simply states "TLAA, SRP-SLR Section 4.3, and "Metal Fatigue." AMR item No. 007 in SRP-SLR Table 3.1-1, which references item IV.A1.R-04, was modified accordingly. The staff also deleted reactor vessel flange components from the scope of item No. 007 in SRP-SLR Table 3.1-1 and the scope of GALL-SLR AMR item IV.A1.R-04, as the retention of AMR item No. 001 in SRP-SLR Table 3.1-1 and AMR item IV.A1.RP-201 in GALL-SLR Table IV.A1 adequately covers management of cumulative fatigue damage or fatigue-induced cracking in BWR reactor vessel closure flange assembly components that are the subject of an applicable metal fatigue or cyclical loading TLAA (as defined in SRP-SLR Section 4.3). Therefore, the staff determined that there is no reason to maintain its inclusion of reactor vessel flange components in the scope of AMR item IV.A1.R-04 or in AMR item No. 007 in SRP-SLR, Table 3.1-1.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR, Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR, Section 3.1.3.2.1.
IV.A1.R-61a IV.A1.R-61b	The staff modified AMR item IV.A1.R-61 in GALL, Revision 2 to recommend specific programs for managing cracking due to SCC or IGSCC in BWR reactor closure flange leakage lines. Specifically, the staff determined that it was appropriate to modify AMR item IV.A1.R-61, and break the AMR item down into two different aging management cases: (a) a modified form of AMR item IV.A1.R-61 (i.e., AMR item IV.A1.R-61a), which may be used for those cases where past experience with cracking of the leakage lines has yet occur at the plant, such that a One-Time Inspection program could be proposed for aging management of the aging effect, and (b) a new AMR item, IV.A1.R-61b, which may be used for those cases where past experience with cracking of the leakage lines has occurred at the plant, such that a periodic condition monitoring program would be needed to manage the aging effect. The line item cites that a program corresponding to GALL-SLR AMP XI.M36, “External Surfaces Monitoring,” is one type of periodic condition monitoring program that may be used for cases where operating experience with cracking has been detected in the leakage lines. For cases where the item in IV.A1.R-61a is appropriate, the staff accepts that implementation of the program corresponding to GALL-SLR AMP XI.M32, “One-Time Inspection,” is appropriate because the plant has yet to experience incidences of SCC or IGSCC in it RPV leakage lines, and therefore a one-time inspection would be appropriate for confirming that this is not occurring RPV leakage or leak-off line during the subsequent period of extended operation. The further evaluation acceptance criteria in SRP-SLR Section 3.1.2.2.4.1 and review procedures in SRP-SLR Section 3.1.3.2.4.1 apply to these AMR items and were updated to call for applicant reviews of applicable operating experience with cracking of their reactor vessel flange leakage lines. AMR item No. 016 in SRP-SLR Table 3.1-1 was amended accordingly, include changes to delete reference of GALL-SLR item IV.A1.R-61 and to instead reference of items IV.A1.R-61a and IV.A1.R-61b. Changes resolve stakeholder comments, with the exception that the AMR items still retain both the “air indoor–uncontrolled, and reactor coolant leakage environments.
IV.A1.R-62 IV.A2.R-84	The staff determined that a modification of the previous version of AMR item IV.A1.R-62 in the GALL Revision 2 report was appropriate for incorporating this item into Table IV.A1 of NUREG–2191. The modified item applies generically to the management of loss of fracture toughness due to neutron irradiation embrittlement for all BWR reactor vessel shell and nozzle components (including associated welds) that are located in the beltline region of the reactor vessel and are subject to the applicable TLAAs. The scope of IV.A1.R-62 was modified to bound and include those BWR reactor vessel components (i.e., BWR reactor vessel low coolant injection or residual heat removal (RHR) injection nozzles) previously included in item IV.A1.R-67 of the GALL, Revision 2 report, and the scope of item IV.A2.R-84 was modified to bound and include those reactor vessel components (i.e., PWR reactor vessel inlet, outlet, and safety injection nozzles) previously included in item IV.A2.R-81 of the GALL, Revision 2 report. Therefore, the previous version of AMR item IV.A1.R-67 in

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	the GALL Revision 2 is no longer needed for retention in Table IV.A1 of the GALL-SLR Report, as it is redundant with the updated AMR and component list in AMR item IV.A1.R-62. Similarly, the previous version of AMR item IV.A2.R-81 in Table IV.A2 of GALL Revision 2 report is no longer needed for retention in Table IV.A2 of the GALL-SLR Report, as it is redundant with the updated AMR and component list for AMR item IV.A2.R-84. Therefore, AMR items IV.A1.R-67 and IV.A2.R-81 have been deleted from the scope of the GALL-SLR Report and AMR item No. 013 in SRP-SLR, Table 3.1-1 has been modified accordingly to delete any reference to items IV.A1.R-67 and IV.A2.R-81. AMR items IV.A1.R-62 in Table IV.A1 of the GALL-SLR Report, AMR item IV.A2.R-84 in Table IV.A2 of the GALL-SLR Report, and AMR item No. 013 in Table 3.1-1 of NUREG–2191 continue to reference the TLAAs in SRP-SLR, Section 4.2 as a basis for managing loss of facture toughness that may occur in these components as a result of a neutron irradiation embrittlement mechanism. These AMR items are subject to staff's further evaluation acceptance criteria guidelines defined in SRP-SLR Section 3.1.2.2.3.1 and the review procedures guidelines in SRP-SLR Section 3.1.3.2.3.1.
IV.A1.R-64	The staff determined that the previous versions of versions of this AMR item and the corresponding item in AMR item No. 094 of Table 3.1-1 in the SRP-LR Revision 2 report (NUREG–1800, Revision 2) were acceptable for retention in NUREG–2191 and NUREG–2192, with the exception that the staff amended the "aging effect/mechanism" column entries of the AMR items to add cyclical loading as an additional mechanism that may induce cracking in the RPV interior attachment welds. Components in BWR RPVs may be subject to vibrational and/or thermal fatigue loads. The amended AMRs account for this. The staff has determined that the augmented inspections performed in accordance with GALL-SLR Report, AMP XI.M4, "BWR ID Attachment Welds," and the guidelines in Electric Power Research Institute (EPRI) Report No. BWRVIP-48-A are still appropriate for the detection of cracking in the RPV interior attachment welds. However, use of AMP XI.M2, "Water Chemistry" is only appropriate for prevention or mitigation of cracking that is induced by SCC or IGSCC mechanisms. Therefore, the "AMP/TLAA" column entries of the items were administratively edited to reflect this. AMR item No. 094 in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
IV.A1.R-65	The staff determined that the previous versions of version of these AMR items were acceptable for retention in NUREG–2191 and NUREG–2192, with the exception that the staff amended the "AMP/TLAA" column entries of the AMR items to replace AMP XI.M5, "BWR Feedwater Nozzles," with AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWD, and IWD," as the basis for aging management. These components are required to be inspected in accordance with the inservice inspection requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, IWB B-2500 as incorporated by reference in 10 CFR 50.55a. Therefore, GALL AMP XI.M5, BWR Feedwater Nozzles," has been deleted from the scope of the GALL-SLR Report and the corresponding AMR items for the components (GALL-SLR Report, AMR item IV.A1.R-65 and AMR item No. 095 in SRP-SLR, Table 3.1-1) have been adjusted to recommend use of AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" as the condition monitoring basis for managing cracking in BWR feedwater nozzles induced by a cyclical loading mechanism. Reference to AMP XI.M5 is no longer included in these AMR items.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
IV.A1.R-66	The staff determined that the previous versions of this AMR item and the corresponding item in AMR item No. 096 of Table 3.1-1 in the SRP-LR Revision 2 report (NUREG–1800, Revision 2) should be amended for incorporation in NUREG–2191 and NUREG–2192 such that the “AMP/TLAA” column entries of the AMR items would be amended to replace AMP XI.M6, “BWR Control Rod Drive Return Line Nozzle,” with AMP XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWD, and IWD,” as the basis for aging management. For these types of BWR designs, the criteria for inspecting the nozzles using the NUREG–0619 methods (as referenced in AMP XI.M5) are no longer applicable to the plant designs because these nozzles were cut and capped such that the CRD return lines were re-routed to an inlet piping system that delivers the return line flow to the reactor pressure vessel (typically the feedwater piping or another system that feeds into the RPV) or the lines were capped on both ends. These types of design modifications were implemented to mitigate cyclical loads or fatigue loads on the CRD penetration nozzle components. In addition, the condition monitoring activities for BWR CRD penetration nozzles and their nozzle-to-vessel welds are already adequately addressed through regulatory improvements made in 10 CFR 50.55a(g) and current inservice inspection requirements for the components. These components are required to be inspected in accordance with the inservice inspection requirements in ASME Code Section XI, IWB B-2500 as incorporated by reference in 10 CFR 50.55a. These components are to be inspected in accordance with the volumetric examination requirements for the components in the ASME Code Section XI as incorporated in 10 CFR 50.55a. Therefore, the staff has determined that it is appropriate for AMR item IV.A1.R-66 in the GALL-SLR Report and AMR item No. 096 in Table 3.1-1 of the SRP-SLR report to reference GALL-SLR AMP X.M1 as the appropriate AMP for managing cracking due to cyclical loading in these components. AMP XI.M6 has been deleted from the scope of the GALL-SLR report and as a referenced AMP for these AMR items. The staff did implement an additional administrative change of the items to indicate that the nozzles components may be clad with nickel alloy materials (i.e., in addition to the existing referencing of stainless steel cladding).
IV.A1.R-68	The staff determined that it was appropriate to amend AMR item IV.A1.R-68 to delete control rod drive return line nozzle safe ends and welds from the scope of interfacing system nozzle safe ends listed in AMR item IV.A1.R-68. Instead, the staff has amended GALL-SLR Table IV.A1 to address cracking of CRD return line nozzle safe-ends and associated safe-end welds in the development of new AMR item IV.A1.R-412 in GALL-SLR Table IV.A1 and in an associated administrative adjustment of AMR item No. 097 in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR), such that it will now include the additional reference to AMR item IV.A1.R-412. Consistent with these changes, the staff developed a new AMR item (No. 128) for SRP-SLR Table 3.1-1 to cover reference to the amended version of GALL AMR item IV.A1.R-68, such that these items will now cover any RPV nozzle safe ends and associate safe end-to-nozzle welds, other than those in the CRD return line system. AMR item IV.A1.R-68 and AMR item No. 128 in SRP-SLR Table 3.1-1 appropriately reference GALL AMPs XI.M7, ‘BWR Stress Corrosion Cracking,” and XI.M2, “Water Chemistry,” as acceptable AMPs that may be sued to manage cracking due to SCC or IGSCC in the nozzle safe ends and safe end welds referenced in the items.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
IV.A1.R-70 IV.A2.R-70	The staff determined that the previous version of AMR items IV.A1.R-70 and IV.A2.R-70 were acceptable for retention in NUREG–2191, with the exception that the staff edited the “Aging Effect/Mechanism” column entry for the line item to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to administratively reduce the language in the “AMP/TLAA” column entry of the line item such that simply states “TLAA, SRP-SLR Section 4.3, and “Metal Fatigue.” AMR item No. 004 in SRP-SLR Table 3.1-1, which references items IV.A1.R-70and IV.A2.R-70, has been modified accordingly. These AMR items are subject to the further evaluation acceptance criteria in SRP-SLR Section 3.1.2.2.1 and the review procedures in SRP-SLR Section 3.1.3.2.1.
IV.A1.RP-165 IV.A1.RP-51	The staff determined that the previous versions of AMR items IV.A1.RP-165 and IV.A1.RP-51, and AMR item No. 091 in SRP-LR Table 3.1-1 were acceptable for retention in NUREG–2191 and NUREG–2192, with the exception that the staff aligned the component descriptions for the items to be consistent with each other and other AMR items for RPV closure flange components, with AMR item IV.A1.RP-165 being the applicable line item for managing loss of material in the BWR closure flange assembly components and AMR item IV.A1.RP-51 being the applicable line item for managing cracking in these components. Analogous changes were made to AMR item No. 091 in Table 3.1-1. Use of AMP XI.M2, “Reactor Head Closure Stud Bolting,” remains as an acceptable AMP basis for managing loss of material and cracking in these components.
IV.A1.RP-201 IV.A2.RP-54	The staff determined that the previous versions of AMR item IV.A1.RP-201 and IV.A2.RP-54 in GALL Revision 2 were acceptable for retention in NUREG–2191 (i.e., the GALL-SLR Report), with the exception that the staff edited the “Structure and/or Component” column entries for the items to be consistent with revised component descriptions for AMR items involving RPV closure flange components and the administrative change of the “Aging Effect/Mechanism” column entry for the line item to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to administratively reduce the language in the “AMP/TLAA” column entry of the line item such that simply states “TLAA, SRP-SLR, Section 4.3, “Metal Fatigue.” AMR item No. 001 in SRP-SLR, Table 3.1-1, which references item IV.A1.RP-201, has been modified accordingly. Reference to reactor vessel closure flange assembly components has been deleted from the scope of GALL-SLR AMR items IV.A1.R-04 and IV.A2.RP-219 because they are adequately addressed for fatigue or cyclical loading effects in the staff’s updates of AMR items IV.A1.RP-201 and IV.A2.RP-54. These AMR items are subject to the further evaluation acceptance criteria for fatigue management in SRP-SLR Section 3.1.2.2.1 and the review procedures in SRP-SLR Section 3.1.3.2.1.
IV.A1.RP-227 IV.A2.RP-229	The staff modified the version of AMR item IV.A1.RP-227 in NUREG–2191 to include BWR reactor vessel shell and nozzle components (including associated welds) that are located in the beltline regions of the BWR designed reactor vessels. The staff also amended the AMP/TLAA column entry of the line item to add in the newly developed Neutron Fluence Monitoring AMP (GALL-SLR Report, AMP X.M2) as part of the basis for aging management, in addition to

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	implementation of AMP XI.M31. The new AMP was developed by the staff to provide an acceptable basis for accepting reactor vessel neutron embrittlement TLAAs in accordance with 10 CFR 54.21(c)(1)(iii), when used in conjunction with implementation of GALL-SLR AMP XI.M31, "Reactor Vessel Surveillance" (Refer to SRP-SLR Chapter 4.2). AMR item No. 014 in Table 3.1-1 of NUREG–2192 and the corresponding item for PWR RPVs (i.e., AMR item IV.A2.RP-229) were amended accordingly. For the PWR vessel components, the staff amended the scope of components listed in AMR item IV.A2.RP-229, such that the line item now bounds and incorporates those specific PWR reactor vessel components previously listed in item IV.A2.RP-228 of the GALL Revision 2 report (i.e., PWR reactor vessel inlet, outlet, and safety injection nozzles and associated welds). As such, consistent with the technical basis entry in Table 2-10 of this report, AMR item IV.A2.RP-228 has been deleted from the scope of Table IV.A2 in the GALL-SLR Report and from reference in AMR item No. 014 in Table 3.1-1 of the SRP-SLR. The assessment of components in AMR item IV.A1.RP-227, IV.A2.RP-229, and AMR item No. 014 in SRP-SLR, Table 3.1-1 continue to be subject to further evaluation criteria, as updated in the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.3.2 and the analogous review procedures in SRP-SLR Section 3.1.3.2.3.2. These SRP-SLR further evaluation sections have been modified accordingly to reference the new guidance for implementing neutron fluence monitoring programs, as defined in GALL-SLR, AMP XI.M2, "Neutron Fluence Monitoring." This is in addition to implementation of the AMP that corresponds to GALL AMP XI.M31, "Reactor Vessel Surveillance," which was updated in Appendix B of the GALL-SLR Report in order to incorporate subsequent license renewal (SLR) reactor vessel surveillance capsule program implementation, withdrawal, and testing considerations for subsequent periods of extended operation.
IV.A1.RP-369 IV.A1.RP-371	The staff determined that the previous versions of these AMR items and AMR item Nos. 98 and 30 in Table 3.1-1 of the SRP-LR Revision 2 report were acceptable for retention in NUREG–2191 and NUREG–2192, with the exception that the "AMP/TLAA" entries for the items were modified to clarify that use of AMP XI.M2, "Water Chemistry," is only applicable to management of cracking that is induced by either SCC or IGSCC aging mechanisms. The Water Chemistry program is not appropriate for managing cracking that may be induced by mechanical mechanisms, such as metal fatigue and cyclical loading mechanisms.
IV.A2.R-17 IV.C2.R-17 IV.C2.RP-167 IV.D1.R-17 IV.D2.R-17	The relevant AMR items apply to the management of loss of material due to boric acid corrosion in the external surfaces of steel reactor pressure vessel (RPV) components, steel piping and piping components, steel closure bolting, and steel components in recirculating or once-though steam generators that may be exposed to an "air with borated water leakage" environment. The items reference GALL-SLR AMP XI.M10, "Boric Acid Corrosion," for aging management of the effect. The staff determined that some past PWR license renewal applicants have used this item analogously for steel exterior attachments to the reactor pressure vessel. Therefore, staff amended the Structure or Component column entry for the item IV.A2.R-17 in NUREG–2191 to make sure that it covers the external surfaces of any steel PWR reactor pressure vessel components (including

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	those in the RPV closure flange area) or associated steel RPV exterior attachments that may be exposed to an air with borated treated water leakage environment. The remainder of the AMR line item remains valid, without change. AMR items IV.C2.R-17, IV.C2.RP-167, IV.D1.R-17, and IV.D2.R-17 in the GALL-SLR Report and AMR item No. 049 in Table 3.1-1 of NUREG–2192 were amended accordingly.
IV.A2.R-219	The staff determined that the previous version of AMR item IV.A2.R-219 in GALL Revision 2 was acceptable for retention in Table IV.A2 of the GALL-SLR report, with the exception that the staff edited the "Aging Effect/Mechanism" column entry for the line item to add cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to administratively reduce the language in the "AMP/TLAA" column entry of the line item such that simply states TLAA, SRP-SLR Section 4.3, "Metal Fatigue." AMR item No. 010 in SRP-SLR Table 3.1-1, which references item IV.A2.R-219, was modified accordingly. The staff also deleted reactor vessel flange components from the scope of AMR item No. 010 in SRP-SLR Table 3.1-1 and the scope of GALL-SLR AMR item IV.A2.R-219, as the retention of AMR item No. 001 in SRP-SLR Table 3.1-1 and AMR item IV.A2.RP-54 in GALL-SLR Table IV.A2 adequately covers management of cumulative fatigue damage or fatigue-induced cracking in BWR reactor vessel closure flange assembly components that are the subject of an applicable metal fatigue or cyclical loading TLAA (as defined in SRP-SLR Section 4.3). Therefore, the staff determined that there is no reason to maintain its inclusion of reactor vessel flange components in the scope of AMR item IV.A2.R-219 or in AMR item No. 010 in SRP-SLR, Table 3.1-1. These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR, Section 3.1.2.2.1, and the analogous review procedures in SRP-SLR, Section 3.1.3.2.1.
IV.A2.R-74a IV.A2.R-74b	For the update of the guidance in NUREG–2191, the staff determined that it was appropriate to modify AMR item IV.A2.R-74, and break the AMR item down into two different aging management cases: (a) a modified form of AMR item IV.A2.R-74 (i.e., IV.A2.R-74a), which may be used for those cases where past experience with cracking of the leakage lines has yet occur at the plant, such that a One-Time Inspection Program could be proposed for aging management of the aging effect, and (b) a new AMR item, IV.A2.R-74b, which may be used for those cases where past experience with cracking of the leakage lines has occurred at the plant, such that a periodic condition monitoring program would be needed to manage the aging effect. For cases where the item in IV.A2.R-74a is appropriate, the staff accepts that implementation of the program corresponding to GALL-SLR AMP XI.M32, "One-Time Inspection," is appropriate because the plant has yet to experience incidences of SCC or IGSCC in it RPV leakage lines, and therefore a one-time inspection would be appropriate for confirming that this is not occurring RPV leakage or leak-off line during the subsequent period of extended operation. For cases where the new item in AMR item IV.A2.R-74b is needed, the staff accepts that the program corresponding to GALL-SLR Report, AMP XI.M36, "External Surfaces Monitoring," is one type of periodic condition monitoring AMP that may be used to manage cracking in the leakage line components.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	In addition, the staff made an administrative decision to break the previous further evaluation acceptance criteria for PWR leakage or leak-off line components in draft SRP-SLR Section 3.1.2.2.6.1 and review procedures for the components in SRP-SLR Section 3.1.3.2.6.1 out of those sections and into new SRP-SLR Sections 3.1.2.2.6.3 and 3.1.3.2.6.3. The new, updated SRP-SLR sections apply to these AMR items and call for applicants to perform reviews of applicable operating experience with cracking of their reactor vessel flange leakage or leak-off lines. However, based on the development of the new guidelines in SRP-SLR Sections 3.1.2.2.6.3 and 3.1.3.2.6.3, AMR items IV.A2.R-74a and IV.A2.R-74b are now cross referenced to a new AMR item, which is AMR item No. 139 in Table 3.1-1 of SRP-SLR report. AMR item No. 019 in SRP-SLR Table 3.1-1 was amended accordingly to delete reference to GALL-SLR item IV.A2.R-74. The AMR items still retain both the "air indoor–uncontrolled environment and reactor coolant leakage environment as the applicable environments for the items.
IV.A2.R-78	The staff determined that previous version of AMR item IV.A2.R-78 was acceptable for retention in the NUREG–2191, with the exception that the staff amended the "Environment" column entry for the line item to delete reactor coolant leakage as an applicable environment for inducing cracking of the components. Impacts of reactor coolant leakage is more appropriately identified as an aging environment for inducing loss of material in steel reactor coolant pressure boundary. This type of environment has yet to shown to be conducive for inducing SCC in these types of stainless steel bolting components. AMR item No. 062 in SRP-SLR Table 3.1-1 was amended accordingly.
IV.A2.R-79	The staff determined that the previous version of AMR item IV.A2.R-79 was acceptable for retention in NUREG–2191, with the exception that the staff amended the "Environment" column entry for the line item to delete reactor coolant leakage as an applicable environment condition for inducing loss of material due to wear of the components, thus changing the applicable environment to an air - indoor uncontrolled environment. Infrequent incidents of reactor coolant would not induce loss of material due to wear in these types of bolting components because the assessment of loss of material in the components is based the consideration of a mechanical wear mechanism and not on any consideration of potential corrosive impacts from a postulated reactor coolant leak onto the components. AMR item No. 065 in SRP-SLR Table 3.1-1 was amended accordingly. The program in GALL-SLR AMP XI.M18, "Bolting Integrity" remains as an acceptable basis for managing loss of material due to wear in these components.
IV.A2.R-80	The staff determined that the previous version of AMR item IV.A2.R-80 was acceptable for retention in NUREG–2191, with the exception that the staff amended the "Environment" column entry for the line item to delete reactor coolant leakage as an applicable environment condition for inducing loss of preload in the components, thus changing the applicable environment to an indoor uncontrolled air environment. Infrequent incidents of reactor coolant would not induce loss of preload in these types of bolting components because the assessment of loss of preload in the components is based the consideration of mechanical loosening mechanisms and not on any consideration of potential corrosive impacts from a postulated reactor coolant leak onto the components. AMR item No. 066 in SRP-SLR, Table 3.1-1 was amended accordingly. The

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	program in GALL-SLR AMP XI.M18, "Bolting Integrity" remains as an acceptable basis for managing loss of material due to wear in these components.
IV.A2.R-85	The staff determined that the previous "Component" column entry for the previous version of AMR IV.A2.R-85 in GALL Revision 2 was not entirely correct. Specifically, the previous component description for the line item improperly assumed that the underclad cracking TLAA would only apply if the reactor vessel shell forging is located in the beltline region of the vessel. However, the associated TLAA for the line item is based on an assessment of cumulative operating cycles and is not associated with any assessment of increasing neutron fluence in the components. Instead, the AMR item applies to any PWR RPV shell component made from a SA-508 Class 2 steel forging material where the forging-to-cladding weld was made using a high heat input welding process. Based on these criteria, the staff amended and simplified the "AMP/TLAA" column entry description for AMR IV.A2.R-85 to indicate that the components may be within the scope of a plant-specific TLAA, as defined in SRP-SLR Section 4.7. The staff also amended the component column entry to be consistent with those PWR reactor vessel forging components that are susceptible to an underclad cracking mechanism. AMR item No. 018 in SRP-SLR, Table 3.1-1 was amended accordingly. These AMR items are subjection to the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.5 and the review procedure guidance in SRP-SLR Section 3.1.3.2.5.
IV.A2.RP-186	The staff determined that the previous version of AMR item IV.A2.R-186 in Table IV.A2 of the GALL Revision 2 Report was acceptable for retention in NUREG–2191, with the exception that the staff made minor editorial changes of the "Component" and "AMP/TLAA" column entries for the line item to clarify that the applicable components are the CRD penetration nozzles and their associated pressure retaining welds. These changes do not impact the staff's previous basis for managing cracking in these components. Programs that are consistent with AMP criteria in GALL-SLR AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," GALL AMP XI.M2, "Water Chemistry," and for nickel alloy locations, GALL-SLR AMP XI.M11B, "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only)," remain as acceptable AMPs for managing PWSCC in the components. AMR item No. 045 in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) was amended accordingly.
IV.A2.RP-234	The staff amended the version of AMR item IV.A2.RP-234 in Table IV.A2 of the NUREG–2191 report to delete reactor inlet and safety injection nozzles from the scope of the component column entry for the line item because the line item is applicable to all large bore PWR reactor pressure vessel (RPV) penetration nozzles and nozzle safe ends that are made from either stainless steel or nickel alloy materials and any associated pressure retaining welds that are part of the reactor coolant pressure boundary, including those made from nickel alloy weld filler materials, regardless of their location in the vessel. The scope of the line item was also amended to include PWR control rod drive penetration housings made from these types of materials. Therefore, the component column entry for this AMR now reads as "Control rod drive penetration housings; reactor vessel nozzles, nozzle safe ends, and welds." AMR item No. 046 in Table 3.1-1 of NUREG–2192 was amended accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Programs that are consistent with the AMP criteria in GALL-SLR AMP XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD:; GALL-SLR AMP XI.M2, “Water Chemistry”, and for nickel alloy locations; GALL-SLR AMP XI.M11B, “Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in RCPB Components (PWRs Only);” remain as acceptable AMPs that may be used to manage cracking in the components, without any need for further evaluation of the AMP program element criteria for managing the aging effect.
IV.A2.RP-52 IV.A2.RP-53	The staff determined that the previous versions of these items were acceptable for retention in the GALL-SLR and SRP-SLR reports, with the exception that the staff aligned the component descriptions for the items to be consistent with each other. Analogous changes were made to AMR item No. 092 in Table 3.1-1 of NUREG–2192, which references the updated versions of AMR items IV.A2.RP-52 and IV.A2.RP-53 in NUREG–2191. GALL-SLR AMP XI.M3, “Reactor Vessel Closure Studs,” as updated in the GALL-SLR Report, remains as an acceptable basis for managing cracking or loss of material in these components, without any need for performing further evaluation of the program element criteria in the AMP for managing the aging effects.
IV.B1.R-100 IV.B1.R-92 IV.B1.R-93 IV.B1.R-94 IV.B1.R-95 IV.B1.R-96 IV.B1.R-97 IV.B1.R-98 IV.B1.R-99 IV.B1.R-105	The relevant AMR items apply to the management of cracking that may be induced in specific types BWR reactor vessel internal (RVI) components as a result of either a SCC, IGSCC, or irradiation-assisted stress corrosion cracking (IASCC) mechanism. The scope of the AMR items credit AMP XI.M9, BWR Vessel Internals, and AMP XI.M2, Water Chemistry, as the basis for aging management. This XI.M9 AMP invokes the use of specific technical reports developed by the EPRI BWRVIP for aging management of BWR RVI components. The program in GALL-SLR AMP XI.M9 invokes the use specific technical reports that have been developed by EPRI BWRVIP and approved by the staff for use by the industry. However, EPRI BWRVIP has not updated these reports to assess the impact that 80 years of operation and accumulated neutron irradiation effects may have on the structural integrity of these components during a license renewal period. Therefore, the staff has developed new further evaluation recommendations in SRP-SLR Section 3.1.2.2.12 to address this issue and modified the further evaluation recommendation for items IV.B1.R-100, IV.B1.R-92, IV.B1.R-93, IV.B1.R-94, IV.B1.R-95, IV.B1.R-96, IV.B1.R-97, IV.B1.R-98, IV.B1.R-99, and IV.B1.R-105 from “No” to “Yes.” For AMR item IV.B1.R-100, staff also made an administrative change to delete the term “for jet pump assembly” from the “AMP/TLAA” column entry in the AMR line item. A new, analogous AMR item was developed in item IV.B1.R-422 for any BWR RVI components that are susceptible to these aging mechanisms but are not within the scope of the other AMR items listed above. Applicable review procedures are given in SRP-SLR Section 3.1.3.2.12. Use of BWRVIP reports invoked by AMP XI.M9 may be subject to specific Applicant Action item criteria. AMR items No. 29, No. 41, and No. 103 in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) were amended accordingly. The staff’s perspective continues to be that it is important for the applicant to verify that the 80-year projected fluence levels for the BWR RVI components will still be bounded by those assumed and used to develop the relevant BWRVIP inspection and evaluation criteria for the components. Therefore, the further evaluation acceptance criteria in Section 3.1.2.2.12 of NUREG–2191

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	and the corresponding review procedures in SRP-SLR Section 3.1.3.2.12 will remain applicable to the basis for managing cracking due to SCC, IGSCC, or IASCC in BWR RVI components associated with these AMR items. Programs that correspond to GALL-SLR AMPs XI.M9, “BWR Vessel Internals,” and XI.M2, “Water Chemistry,” may continue to be used as the basis for managing cracking due to SCC, IGSCC, or IASCC in these components, but as subject to the new further evaluation acceptance criteria guidelines in Section 3.1.2.2.12 of the SRP-SLR report and the review procedures in Section 3.1.3.2.12 of the SRP-SLR report.
IV.B1.RP-182 IV.B1.RP-200 IV.B1.RP-219 IV.B1.RP-220	For subsequent license renewal applications, the staff modified AMR items IV.B1.RP-182, IV.B1.RP-200, IV.B1.RP-219, and IV.B1.RP-220 and developed three new AMR items (i.e., AMR items IV.B1.R-416, IV.B1.R-417, and IV.B1-R-419 in Table IV.B1 of NUREG–2191) in order to address aging management loss of fracture toughness that may occur in these types of BWR RVI components. The modified AMR items and new AMR items continue to credit AMP XI.M9, “BWR Vessel Internals,” as the basis for aging management. EPRI Report No. BWRVIP-234 addresses neutron embrittlement and thermal aging in BWR RVI components made from CASS; however, the EPRI has not updated the report to assess the impact that 80 years of operation will have on structural integrity of these components during a license renewal period. Therefore, the staff has developed new further evaluation acceptance criteria guidelines to verify that the 80-year projected fluences for the BWR RVI components will still be bounded by those assumed and used to develop the relevant BWRVIP inspection and evaluation report methodologies for the components. Therefore, the further evaluation acceptance criteria guidelines in Section 3.1.2.2.13 of NUREG–2192 (i.e., the SRP-SLR report) and the corresponding review procedures in SRP-SLR Section 3.1.2.2.13 address the basis for managing loss of fracture toughness for those BWR RVI components that are associated with GALL-SLR AMR items IV.B1.RP-182, IV.B1.RP-200, IV.B1.RP-219, IV.B1.RP-220, and new AMR items IV.B1.R-416, IV.B1.R-417, and IV.B1.R-419, and with AMR item No.99 in Table 3.1-1 of the SRP-SLR report, which references these GALL-SLR items.
IV.B1.R-53	The relevant AMR items apply to the management of cumulative fatigue damage or cracking induced by either fatigue or cyclical loading in BWR reactor vessel internal components that are within the scope of a metal fatigue or cyclical loading analysis. The AMR items recommend aging management of these components through use of a metal fatigue TLAA, as defined and discussed in SRP-SLR, Section 4.3. The staff determined that the previous versions of these AMR items in NUREG–1801, Revision 2 and NUREG–1800, Revision 2 were acceptable for reference in the SRP-SLR and GALL-SLR reports, with the exception that the staff edited the “Aging Effect/Mechanism” column entries for the items to add in cyclical loading as an additional mechanism that could lead cracking of the components (in addition for fatigue as a listed aging mechanism for cracking) and made administrative changes to the “AMP/TLAA” and “Further Evaluation” column entry descriptions for the line item. The other applicable aging effect for item IV.B1.R-53 continues to be listed as “cumulative fatigue damage.” AMR item No. 003 in SRP-SLR Table 3.1-1 was amended accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The items are subject to the further evaluation acceptance criteria in SRP-SLR, Section 3.1.2.2.1 and review procedures in SRP-SLR, Section 3.1.3.2.1 because they correlate to implementation of a metal fatigue TLAA for the components.
IV.B1.RP-155	The staff determined that the previous versions of these items in GALL Revision 2 and SRP-LR Revision 2 reports were acceptable for retention in Table IV.B1 of NUREG–2191 and Table 3.1-1 of NUREG–2192, with the exception that the staff amended the items to add SCC and IGSCC as additional potential cracking mechanisms that could include cracking of the components and added loss of material due to wear as a potential additional aging effect/mechanism combination. This is based on operating experience reported by the industry. In addition, the staff made an editorial deletion of the phrase “for steam dryer” from the “AMP/TLAA” column entries for the items. The program consistent with GALL-SLR AMP XI.M9, “BWR Vessel Internals,” and the methods in BWRVIP-139 remain as acceptable methods that may be used to manage cracking and loss of material in the steam dryer assembly components. The staff also administratively deleted the word “for steam dryer” from the “Aging Management Program (AMP)/TLAA column entries of the items. Note that on November 8, 2016, the staff issued its safety evaluation (SE) on the EPRI BWRVIP’s license renewal appendix for the BWRVIP-139 report (i.e., BWRVIP-139, Appendix B). The applicant’s basis for managing cracking and loss of material in their steam dryer assemblies may be subject to specific limitations, conditions, or applicant actions items identified in the staff’s November 8, 2016 SE for BWRVIP-139, Appendix B.
IV.B1.RP-381	The staff determined that the previous version of this line item in the GALL Revision 2 report and AMR item No. 104 in Table 3.1-1 of the SRP-LR, Revision 2 report were acceptable for retention in the GALL-SLR and the SRP-SLR reports, with the exception that the staff decided to amended the items to cite nickel alloy as the listed materials rather than limit the materials only to X-750 nickel alloy materials. Industry operating experience has demonstrated that nickel alloy materials are susceptible to stress corrosion cracking mechanisms. In addition, the staff made a minor editorial change to delete the phrase “for core plate” from the “AMP/TLAA” column entries for the items. The AMPs, as updated in GALL-SLR AMP XI.M9, “BWR Vessel Internals,” and GALL-SLR AMP XI.M2, “Water Chemistry,” remain as acceptable AMPs that may be used to manage cracking in nickel alloy BWR RVI components.
IV.B2.RP-265 IV.B3.RP-306 IV.B4.RP-236	The relevant AMR items apply to the management of aging in those Westinghouse-designed, Combustion Engineering-designed, and Babcock and Wilcox-designed PWR reactor vessel internal (RVI) components that are designated as MRP-227-A “No Additional Measures” components. The staff defines “No Additional Measures” components in Table IX.B of NUREG–2191. The staff determined that the previous versions of these AMR items could be retained in NUREG–2191 (i.e., the GALL-SLR Report), with the exception that the staff amended the “Further Evaluation” column entries for the AMR items from “No” to “Yes” in order to reflect that the assessment of aging for the components in the applicable line item will need to be subject to the further evaluation acceptance criteria guidance in Section 3.1.2.2.9 of NUREG–2192 and to a gap analysis, as defined and explained in the SRP-SLR Section 3.1.2.2.9. Corresponding review procedures are provided in SRP-SLR Section 3.1.3.2.9. AMR items No. 55a, 55b, and 55c in SRP-SLR Table 3.1-1 were modified accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff also amended AMP XI.M16A and SRP-SLR Section 3.1.2.2.9 in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation stipulation that an engineering gap analysis would need be performed and included as part of the SLRA. The purpose of the gap analysis would be to identify any potential changes of the MRP's augmented inspection and evaluation bases for RVI components evaluated in MRP-227-A if the assessments of aging of the components in MRP-227-A or its background reports were extended to an 80-year operating period; this includes identification of any changes to the augmented inspection criteria in the report for EPRI MRP-defined "No Additional Measures" RVI components in Westinghouse-designed, Combustion Engineering-designed, and Babcock and Wilcox-designed PWRs. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report.
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	These AMR items apply to those reactor vessel internal (RVI) components that have been defined as "primary" category RVI components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines" (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific Westinghouse-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as "primary" category components, the components are inspected during the applicable period of extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191 (i.e., the GALL-SLR Report), but with the exception that the "Further Evaluation" column entries for the AMR s would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's update of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented inspection and evaluation (I&E) activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 053a in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) was adjusted accordingly.
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	These AMR items apply to those RVI components that have been defined as "expansion" category RVI components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines" (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific Westinghouse-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as "expansion" category components, the components are inspected during applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion" category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, the inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A protocols for the components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR s could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 053b in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
IV.B2.RP-289 IV.B2.RP-301 IV.B2.RP-346 IV.B2.RP-355 IV.B2.RP-399	These AMR items apply to those RVI components that have been defined as RVI "existing program" components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines" (MRP-227-A report or TR MRP-227-A). The scope

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	of the AMR items includes specific Westinghouse-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as “existing program” category components, the components will be inspected during the applicable period of extended operation using the existing requirements in 10 CFR 50.55a, “Codes and Standards,” and Section XI of the ASME Boiler and Pressure Vessel Code, Division 1 (ASME Section XI). However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the “Further Evaluation” column entries for the AMR s would need to be changed from “No” to “Yes” in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff’s updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI’s augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff’s update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 053c in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) was adjusted accordingly.
IV.B2.RP-284	For initial license renewal applications, AMR item IV.B2.RP-284, as previously updated in Interim Staff Guidance LR-ISG-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors,” provided an AMR item that may be used to manage loss of material due to wear in Westinghouse-designed flux thimble tubes that are located in the RVI bottom mounted instrumentation system. The staff modified AMR item IV.B2.RP-284 to delete GALL AMP XI.M16A, PWR Vessel Internals, as one of the two AMPs used to manage loss of material due to wear in Westinghouse-design flux thimble tubes. The EPRI MRP did not update Report MRP-227-A (as referenced in AMP XI.M16A) to evaluate PWR internals for an 80-year life. In addition, the mentioning of GALL AMP XI.M16A in addition to GALL AMP XI.M37, “Flux Thimble Tube Inspection,” is redundant, as the methodology in MRP-227-A references AMP XI.M37 as the existing program for these components. Therefore, GALL AMP XI.M37 by itself is sufficient to manage loss of material due to wear in these components. As a results, the staff decided to keep but modify AMR item IV.B2.RP-284 to delete reference to AMP XI.M16A. AMP XI.M37, as updated in the GALL-SLR Report, remains as an acceptable basis for managing loss of material due to wear in

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Westinghouse-design PWR flux thimble tubes. The staff also deleted nickel alloy as a listed materials for the components, as the flux thimble tubes in Westinghouse PWR designs are typically fabricated from stainless steel materials. The corresponding AMR in NUREG–2192, which is AMR item No. 054 in Table 3.1-1 of SRP-SLR report, was adjusted accordingly. These AMR items are not subject to the further evaluation guidelines in SRP-SLR Section 3.1.2.2.9 or the corresponding review procedures in SRP-SLR Section 3.1.3.2.9, as the AMR items no longer include any reference to GALL-SLR AMP XI.M16A for managing loss of material due to wear in the thimble tubes; a plant program that corresponds to GALL-SLR AMP XI.M37, “Flux Thimble Tube Inspection,” is sufficient for managing loss of material due wear in the flux thimble tubes.
IV.B2.RP-270 IV.B2.RP-272 IV.B2.RP-296 IV.B2.RP-297 IV.B2.RP-300 IV.B2.RP-302a IV.B2.RP-354 IV.B2.RP-388	These AMR items apply to those RVI components that have been defined as “primary” category RVI components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific Westinghouse-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since the MRP report designates these components as “primary” category components, the components are inspected during the applicable period of extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the “Further Evaluation” column entries for the AMR items would need to be changed from “No” to “Yes” in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and to a gap analysis that is to be included in the SLRA. As defined in the staff’s updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI’s augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 059a in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) was adjusted accordingly.
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	These AMR items apply to those RVI components that have been defined as "expansion" category RVI components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines" (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific Westinghouse-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since the MRP report designates these components as "expansion" category components, the components are inspected during the applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, the inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A protocols for the components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191 item, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 059b in Table 3.1-1 of NUREG–2192 was adjusted accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
IV.B2.RP-285 IV.B2.RP-288 IV.B2.RP-299 IV.B2.RP-356	These AMR items apply to the management of non-cracking effects in those RVI components that have been defined as “existing program” category RVI components for Westinghouse-designed plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A).” The items apply to specific Westinghouse-designed plate, forging, tube, weld, bolting or fastener components that may be subject to one or more of the following non-cracking aging effect and mechanism combinations, as identified and defined in the MRP-227-A report: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since the MRP report designates these components as “existing program” category components, the components will be inspected during the applicable period of extended operation using the existing requirements in 10 CFR 50.55a, “Codes and Standards,” and Section XI of the ASME Boiler and Pressure Vessel Code, Division 1 (ASME Code, Section XI). However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the “Further Evaluation” column entries for the AMR items would need to be changed from “No” to “Yes” in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff’s updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI’s augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff’s update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 059c in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
IV.B2.RP-303	The AMRs in GALL-SLR AMR item IV.B2.RP-303 and AMR item No. 003 in SRP-SLR Table 3.1-1, as updated in Interim Staff Guidance Document LR-ISG-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors,” have been retained to provide the staff’s AMRs for managing cumulative damage or cracking induced by fatigue or cyclical loading in Westinghouse-designed reactor vessel internal (RVI) components. The items apply to those Westinghouse RVI components that have been analyzed in accordance with a metal fatigue or cyclical loading TLAA, as defined in SRP-SLR Section 4.3.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff administratively adjusted the AMR items to be consistent with those for other components with fatigue-related or cyclical loading-related TLAAs. These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR Section 3.1.3.2.1.
IV.B2.RP-382 IV.B3.RP-382 IV.B4.RP-382	The relevant AMR items apply to the management of cracking due to SCC, IASCC, or fatigue or loss of material due to wear in Westinghouse-designed, Combustion Engineering-designed, and Babcock and Wilcox-designed reactor vessel internal (RVI) components that are defined in the CLB as ASME Section XI, Examination Category B-N-3 components. The items apply to those RVI components that are defined as Examination Category B-N-3 components in the CLB but have not been designated as "existing program" components in the MRP-227-A report. The previous versions of the items used GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD," or GALL AMP XI.M16A, "PWR Vessel Internals," as the basis for managing the aging effects. The staff determined previous versions of AMR items IV.B2.RP-382, IV.B3.RP-382, and IV.B4.RP-382 in Interim Staff Guidance LR-ISG-2011-04 were acceptable for retention in NUREG–2191, with the exception of the following changes that were incorporated into the line item: (a) SCC, IASCC, and fatigue have been defined as the mechanisms that could potentially induce cracking in the components, (b) loss of material has been defined as the aging effect associated with a wear mechanism, (c) AMP XI.16A, "PWR Vessel Internals" was deleted as a referenced AMP for aging management, as any inspections for components aligned to item IV.B2.RP-382 would be performed in accordance with the applicant's ASME Code Section XI program (i.e., GALL-SLR AMP XI.M1). AMR item No. 032 in Table 3.1-1 of NUREG–2192, which references AMR items IV.B2.RP-382, IV.B3.RP-382, and IV.B4.RP-382, was modified accordingly.
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-338 IV.B3.RP-342 IV.B3.RP-343 IV.B3.RP-358 IV.B3.RP-362a IV.B3.RP-363	These AMR items apply to the management of cracking in those RVI components that have been defined as "primary" category RVI components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A)." The listed AMR line items apply to specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that are identified in MRP-227-A as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as "primary" category components, the components are inspected during the applicable period of extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 052a in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
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	These AMR items apply to the management of cracking in those RVI components that have been defined as "expansion" category RVI components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A)." The listed AMR items apply to specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that are identified in MRP-227-A as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as "expansion" category components, the components are inspected during the applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion" category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, the inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A protocols for the components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR s could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 052b in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
IV.B3.RP-320 IV.B3.RP-334	These AMR items apply to those RVI components that have been defined as RVI "existing program" components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since the MRP report designates these components as "existing program" category components, the components will be inspected during the applicable period of extended operation using the existing requirements in 10 CFR 50.55a, "Codes and Standards," and Section XI of the ASME Boiler and Pressure Vessel Code, Division 1 (ASME Section XI). However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 052c in Table 3.1-1 of NUREG–2192 was adjusted accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
IV.B3.RP-357 IV.B3.RP-400	The relevant AMR items apply to the management of loss of material due to wear in the incore instrumentation tubes of Combustion Engineering-designed (CE-designed) PWRs and cracking due to SCC and irradiation-assisted SCC and loss of material due to wear in thermal shield positioning pins of CE-designed PWRs. In EPRI Report MRP-227-A, the EPRI MRP defines these components as CE-designed RVI components that may be the subject of plant-specific aging programs or activities. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and to a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 028 in SRP-SLR Table 3.1-1 was modified accordingly.
IV.B3.RP-315 IV.B3.RP-318 IV.B3.RP-326 IV.B3.RP-359 IV.B3.RP-360 IV.B3.RP-362 IV.B3.RP-364 IV.B3.RP-366 IV.B3.RP-365	These AMR items apply to those RVI components that have been defined as "primary" category RVI components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a)loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since, the MRP report designates these components as "primary" category components, the components are inspected during the applicable period of extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 056a in Table 3.1-1 of the NUREG–2912 was adjusted accordingly.
IV.B3.RP-317 IV.B3.RP-331 IV.B3.RP-359a IV.B3.RP-361 IV.B3.RP-362b IV.B3.R-455	These AMR items apply to those RVI components that have been defined as "expansion" category RVI components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A)." The scope of the AMR items includes specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since the MRP report designates these components as "expansion" category components, the components are inspected during the applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion" category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, any inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A protocols for the components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented inspection and evaluation (I&E) activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 056b in Table 3.1-1 of NUREG–2912 was adjusted accordingly. In addition, the staff also added a new AMR item IV.B3.R-455 to Table IV.B3 in the GALL-SLR Report. This new AMR item was developed in order to be consistent with list of RVI "expansion" category components listed for CE-designed PWRs cited in the MRP-227-A report and addresses management of loss of fracture toughness due to neutron irradiation embrittlement in the upper cylinder of the core support barrel assembly. GALL-SLR AMR item IV.B3.R-455 states that the program GALL-SLR AMP XI.M16A, "PWR Vessel Internals," is an acceptable AMP that may be used to manage loss of fracture toughness in the core support barrel upper cylinder and its welds. Similar to the AMR criteria for GALL-SLR items IV.B3.RP-317, IV.B3.RP-331, IV.B3.RP-359a, IV.B3.RP-361, and IV.B3.RP-362b, AMR item IV.B3.R-455 is subject to the SRP-SLR further evaluation acceptance criteria guidelines in SRP-SLR Section 3.1.2.2.9 and will need to be within the scope of a gap analysis.
IV.B3.RP-319 IV.B3.RP-332 IV.B3.RP-334a IV.B3.RP-336	These AMR items apply to those RVI components that have been defined as RVI "existing program" components for Combustion Engineering-designed (CE-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The MRP-227-A report was approved for a 60-year licensing basis in a safety evaluation dated December 16, 2011 (ADAMS Accession No. ML11308A770). The scope of the AMR items includes specific CE-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since the MRP report designates these components as "existing program" category components, the components will be inspected during the applicable period of extended operation using the existing requirements in 10 CFR 50.55a, "Codes and Standards," and Section XI of the ASME Boiler and Pressure Vessel Code, Division 1 (ASME Section XI).

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the “Further Evaluation” column entries for the AMR items would need to be changed from “No” to “Yes” in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff’s updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI’s augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff’s update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 056c in Table 3.1-1 of NUREG–2912 was adjusted accordingly.
IV.B3.RP-339	The AMRs in GALL-SLR AMR item IV.B3.RP-339 and AMR item No. 003 in SRP-SLR Table 3.1-1, as updated from the versions of these items in Interim Staff Guidance Document LR-ISG-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors,” have been retained to provide the staff’s AMRs for managing cumulative damage or cracking induced by fatigue or cyclical loading in Combustion Engineering-designed (CE-designed) reactor vessel internal (RVI) components. The items apply to those CE-designed RVI components that have been analyzed in accordance with a metal fatigue or cyclical loading TLAA, as defined in SRP-SLR Section 4.3. The staff administratively adjusted the AMR items to be consistent with those for other components with fatigue-related or cyclical loading-related TLAAs. These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR Section 3.1.3.2.1.
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	These AMR items apply to those RVI components that have been defined as “primary” category RVI components for Babcock and Wilcox-designed (B&W-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, “Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific B&W-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since, the MRP report designates these components as “primary” category components, the components are inspected during the applicable period of

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
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IV.B4.RP-261 IV.B4.RP-400	extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items will need to be subject to further evaluation and to a gap analysis that is to be included in the SLRA. As defined in the staff's update of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 051a in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
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-250a IV.B4.RP-254 IV.B4.RP-254a IV.B4.RP-260a IV.B4.RP-262 IV.B4.RP-352 IV.B4.RP-375	These AMR items apply to those RVI components that have been defined as "expansion" category RVI components for Babcock and Wilcox-designed (B&W-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific B&W-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following cracking mechanisms: (a) SCC, (b) IASCC, or (c) fatigue or cyclical loading. Since, the MRP report designates these components as "expansion" category components, the components are inspected during the applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion" category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, any inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A protocols for the components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191 (i.e., the GALL-SLR Report), but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the items

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 051b in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
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	These AMR items apply to those RVI components that have been defined as "primary" category RVI components for Babcock and Wilcox-designed (B&W-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A). The scope of the AMR items includes specific B&W-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep Since, the MRP report designates these components as "primary" category components, the components are inspected during the applicable period of extended operation using the inspection protocols defined for the components in the MRP-227-A report and the AMP that was approved for the RVI components. However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the line items will need to be subject to the guidance in SRP-SLR Section 3.1.2.2.9 and to a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR items. Minimum criteria for performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 058a in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
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 IV.B4.RP-375a	These AMR items apply to those RVI components that have been defined as "expansion" category RVI components for Babcock and Wilcox-designed (B&W-designed) plants in Electric Power Research Institute (EPRI) Topical Report No. 1022863, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A report or TR MRP-227-A)." The scope of the AMR items includes specific B&W-designed RVI plate, forging, tube, weld, bolting or fastener components that that have been identified in the MRP-227-A report as being subject to one or more of the following non-cracking aging effect and mechanism combinations: (a) loss of material due to wear, (b) loss of fracture toughness due to neutron irradiation embrittlement or thermal embrittlement, (c) changes in component dimensions as a result of void swelling or distortion, or (d) for bolted or fastened connections, loss of preload due to irradiation-enhanced stress relaxation or irradiation-enhanced creep. Since, the MRP report designates these components as "expansion" category components, the components are inspected during the applicable period of extended operation only if aging is detected in one of the "primary" category components linked to a given "expansion" category component and the extent of degradation is determined by the licensee to be greater than that specified for the aging effect in Chapter 5 of the MRP-227-A report. If needed, inspections of "expansion" component locations are implemented in accordance with the AMP that was approved for the RVI components and the applicable TR MRP-227-A However, the methodology in TR MRP-227-A is based on an assessment of aging for a cumulative 60-year service life. Therefore, the staff determined that the previous versions of these AMR items could be retained in NUREG–2191, but with the exception that the "Further Evaluation" column entries for the AMR items would need to be changed from "No" to "Yes" in order to reflect that the assessment of aging for the components in the line items will need to be subject to further evaluation and a gap analysis that is to be included in the SLRA. As defined in the staff's updated version of SRP-SLR Section 3.1.2.2.9, a gap analysis should be performed and used for the purpose of defining any potential plant-specific changes that may need to be proposed to EPRI's augmented I&E activities for PWR RVI components in the MRP-227-A report, particularly if the scope and assessments of aging in the report or its background reports were extended to cover an 80-year cumulative service life. The staff also amended the criteria in GALL-SLR AMP XI.M16A in a manner that permits a subsequent renewal applicant to use the MRP-227-A report as a starting point for managing aging in its PWR RVI components, as subject to the additional further evaluation criteria for performing a gap analysis of the RVI components listed in the applicable AMR line items. Minimum criteria for

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	performing a gap analysis were factored into the staff's update of the AMP XI.M16A program elements. Corresponding review procedures for evaluating the gap analysis are given in Section 3.1.3.2.9 of the SRP-SLR Report. AMR item No. 058b in Table 3.1-1 of NUREG–2192 was adjusted accordingly.
IV.B4.R-53	The AMRs in GALL-SLR AMR item IV.B4.R-53 and AMR item No. 003 in SRP-SLR Table 3.1-1, as updated from the previous versions of these line items in Interim Staff Guidance Document LR-ISG-2011-04, have been retained to provide the staff's AMRs for managing cumulative damage or cracking induced by fatigue or cyclical loading in Babcock and Wilcox-designed (B&W-designed) reactor vessel internal (RVI) components. The line items apply to those B&W-designed RVI components that have been analyzed in accordance with a metal fatigue or cyclical loading TLAA, as defined in SRP-SLR Section 4.3. The staff administratively adjusted the AMR items to be consistent with those for other components with fatigue-related or cyclical loading-related TLAAs. These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR Section 3.1.3.2.1.
IV.C1.R-08 IV.C2.R-08 IV.C1.R-52 IV.C2.R-52	The relevant AMR items in items IV.C1.R-08 and IV.C2.R-08 apply to the management of loss of fracture toughness due to thermal aging embrittlement in BWR or PWR Class 1 pump casings and valve bodies and bonnets made from cast austenitic stainless steel (CASS) materials and are exposed to reactor coolant. Corresponding AMR items for managing loss of fracture toughness due to thermal aging embrittlement in BWR or PWR reactor coolant system CASS piping and piping components were given in AMR item No. 052 in Table 3.1-1 of the SRP-LR Revision 2 report and in AMR items IV.C1.R-52 and IV.C2.R-52 in the GALL Revision 2 report. The staff determined that the previous versions of AMR item No. 052 in Table 3.1-1 of the SRP-LR Revision 2 report and AMR items IV.C1.R-52 and IV.C2.R-52 in GALL Report, Revision 2 continue to be acceptable for managing loss of fracture toughness due to thermal aging embrittlement in the CASS piping and piping components using the updated program in GALL-SLR AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)." However, staff determined that some changes would need to be made to the prior line items for managing loss of fracture toughness due thermal aging embrittlement in Class 1 CASS valve bodies and pump casings (i.e., AMR item No. 038 in Table 3.1-1 of the SRP-LR Revision 2 Report and AMR items IV.C1.R-08 and IV.C2.R-08 in the GALL Revision 2 Report), which credited AMP XI.M1, "ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD," with management of the aging effect and mechanism, such that the components would not need to be within the scope of the augmented aging assessment criteria for components, as defined in GALL AMP XI.M12. Specifically, the staff determined that it was appropriate to delete CASS pump casings from the scope of AMR item No. 038 in Table 3.1-1 of NUREG–2192 and the scope of AMR items IV.C1.R-08 and IV.C2.R-08 in NUREG–2191), such that the CASS Class 1 pump casings would no longer be excluded from the list of Class 1 CASS components needing further evaluation regarding susceptibility to thermal aging embrittlement. The staff determined that loss of fracture toughness due to thermal aging embrittlement may have impact on the integrity of these pump casing components; therefore, the further evaluation is

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	warranted for these components by using the program element criteria in GALL-SLR AMP XI.M12. Accordingly, the staff added pump casings to the scope of AMR item No. 050 in Table 3.1-1 of the SRP-SLR report and the scope of AMR items IV.C1.R-52 and IV.C2.R-52 in the GALL-SLR Report, such that the components would be subject to the condition monitoring and flaw evaluation criteria in AMP XI.M12, "Thermal Aging of Cast Austenitic Stainless Steel," as updated in NUREG–2191. If applicants can demonstrate that the previous flaw tolerance evaluation used for the implementation of ASME Code Case N-481 as an alternative to inspection requirements remains bounding for 80 years, or if the previous flaw tolerance evaluation is revised to be applicable to an 80-year licensed service life, no further actions to inspect the CASS pump casings would be necessary for the subsequent period of extended operation beyond the inservice inspections of the components specified in AMP XI.M1, "ASME Section XI Inservice Inspection, Subsection IWB, IWC, or IWD." In addition, the "detection of aging effects" program element of AMP XI.M12 is revised to indicate that ASME Code Case N-824 may be used as an acceptable method of performing ultrasonic (UT) examination of CASS piping and piping components, with the conditions specified in 10 CFR 50.55a. This change is based on the recommendation of NRC staff experts in nondestructive evaluation and the fact that Code Case N-824 has been approved by the ASME Code. The final 10 CFR 50.55a rule incorporating the ASME Code Case N-824 was published on July 18, 2017 (82 FR 32934). Therefore, the staff continues to find it appropriate to delete Class 1 CASS pump casings from AMR items IV.C1.R-08 and IV.C2.R-08 in the GALL-SLR report, and from AMR item No. 038 in Table 3.1-1 of the SRP-SLR report. Instead, aging management of loss of fracture toughness due to thermal aging embrittlement in Class 1 pump casings is adequately addressed by the changes the staff has made to GALL AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)," and by the addition of pump casings to AMR item IV.C1.R-52 in Table IV.C1 of the GALL-SLR Report, AMR item IV.C2.R-52 in Table IV.C2 of the GALL-SLR Report, and AMR item No. 050 in Table 3.1-1 of the SRP-SLR report. Class 1 pump casings made from CASS are now be subject to the supplemental assessment criteria as described in the updated version of AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel," in NUREG–2191. In contrast, the bases for managing loss of fracture toughness in Class 1 valve bodies continues to be with the scope of the AMR items in GALL-SLR items IV.C1.R-08 and IV.C2.R-08 and AMR item No. 038 in Table 3.1-1 of the SRP-SLR report.
IV.C1.R-11 IV.C2.R-11 IV.D1.R-10 IV.D2.R-10	The staff determined that the previous versions of AMR items IV.C2.RP-11 and IV.D1.R-10 in the GALL Revision 2 report were acceptable for retention in NUREG–2191 report, with the exception that staff amended the "Environment" column entries of the line items to delete reactor coolant leakage as an applicable environment for inducing cracking of the components. Impacts of reactor coolant leakage is more appropriately identified as an aging environment for inducing loss of material due to boric acid corrosion in steel reactor coolant pressure boundary. This type of environment has yet to shown to be conducive for inducing SCC in stainless steel components. The staff also

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	editorially amended the "Material" column entries these line items to state "high strength steel; stainless steel" or "high strength steel. The old method of listing steel in these line items cited the material as "Low-alloy steel, > 150 ksi." The change in the terminology to "high strength steel" will make the material terminology consistent with the new definition for steel bolting that may be susceptible for SCC, as defined in Table IX.B of the GALL-SLR Report. AMR item 062 in Table 3.1-1 of NUREG–2192 was amended accordingly. In addition, in order to ensure consistency between the contents of Tables IV.C1 and IV.C2 in the GALL-SLR Report, the staff developed new AMR item IV.C1.R-11 which may be used to manage cracking due to SCC in BWR high strength steel closure bolting. The AMR item criteria in AMR item IV.C1.R-11 are analogous and identical to those cited for PWR RCS bolting in AMR item IV.C2.R-11. Similarly, in order to ensure consistency between the contents of Tables IV.D1 and IV.D2 in the GALL-SLR Report, the staff developed new AMR item IV.D2.R-10, which may be used to manage cracking due to SCC in high strength steel or stainless steel closure bolting that may be included in once-through steam generator systems. The AMR item criteria in AMR item IV.D2.R-10 are analogous and identical to the AMR in AMR item IV.D1.R-10 for bolting PWR recirculating steam generator systems, as given in Table IV.D1 of the GALL-SLR Report. The new AMRs in AMR items IV.C1.R-11 and IV.D2.R-10 state that the AMP in GALL AMP XI.M18, "Bolting Integrity," may be used to manage any cracking in the components that is induced by an SCC mechanism, without any need for further evaluation of the program element activities that are described for aging management in the programs. AMR item No. 062 in Table 3.1-1 of the SRP-SLR report was amended to cite AMR item IV.C1.R-11, IV.C2.R-11, IV.D1.R-10, and IV.D2.R-10 as referenced GALL AMR items in the line item.
IV.C1.R-20 IV.C1.R-21	The staff determined that the previous versions of AMR items IV.C1.R-20 and IV.C1.R-21 were acceptable as previously written, with the exception that the staff administratively deleted the words "and piping elements" from the "Component" column entries of the line items, and amended the line items to eliminate the need for further evaluation of the AMP basis for managing cracking in the components, as identified for these line items in Table IV.C1 of the draft NUREG–2191 report. As defined in Table IX.B of the GALL-SLR Report, the use of the terminology "piping elements" is limited only to piping components made from glass materials, and therefore, does not apply to item IV.C1.R-20 or IV.C1.R-21.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Based on the staff's updates to the program element criteria for manage SCC or IGSCC in AMP XI.M7, "BWR Stress Corrosion Cracking," in NUREG–2191, the staff's determined that further evaluation of the AMP program element criteria would no longer need to be addressed in a specific further evaluation subsection in Section 3.1.2.2 of the NUREG–2192 report . Therefore, the "Further Evaluation" column entries for theses line items in the final version of NUREG–2191 have been amended state "No" for further evaluation, which is consistent with the previous basis for theses line item in Table IV.C1 of the NUREG–1800, Revision 2. GALL-SLR AMPs XI.M7, "BWR Stress Corrosion Cracking," and XI.M2, "Water Chemistry," remain as acceptable bases for managing cracking in the components that may be induced by either SCC or IGSCC aging mechanisms, without any need for further evaluation of the program element criteria for managing aging in the AMPs. AMR item No. 097 in Table 3.1-1 of the NUREG–2192 report was amended accordingly.
IV.C1.R-220 IV.C2.R-223	For subsequent license renewal applications, the versions of AMR item IV.C1.R-220 in Table IV.C1 of NUREG–2191, AMR item IV.C2.R-223 in Table IV.C2 of the GALL-SLR report, and AMR items No. 6 and No. 9 in Table 3.1-1 of NUREG–2192 continue to provide the staff's AMRs for managing cumulative fatigue damage or cracking induced by fatigue or cyclical loading in either BWR or PWR RCS piping and piping components. However, the staff amended the "Component" column entries for these AMR items to add "other pressure retaining components" to the list of components in the column entries. These changes will allow the line items to be used for components in these systems that have applicable fatigue or cyclical loading TLAAs, but whose definition may fall outside of the definition for piping and piping components in Table IX.B of the GALL-SLR Report. The staff also amended the line items to add in cracking due to cyclical loading as an applicable aging effect/mechanism combination (i.e., in addition to cumulative fatigue damage and cracking due to fatigue) and to simplify the "AMP/TLAA" column entries for the lines to state "TLAA, SRP-SLR Section 4.3, "Metal Fatigue." These AMR items are subjection the further evaluation acceptance criteria guidance in SRP-SLR Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR Section 3.1.3.2.1.
IV.C1.R-406	The staff determined that the previous versions of AMR item IV.C1.R-406 in Table IV.C1 of NUREG–1801, Revision 2 and AMR item No. 110 in Table 3.1-1 of NUREG–1800, Revision 2 were acceptable for retention in the GALL-SLR and SRP-SLR reports, with the exception that the staff amended the AMR item to change the material from any material to "metallic" materials. The category "any materials" would include materials such as glass or polymeric materials, which are normally resistant to mechanical erosion mechanisms. In contrast, metallic materials may be subject of these types of mechanisms. Thus, it is appropriate to limit the scope of these AMR items only to BWR piping and piping components made from metallic materials. Use of GALL-SLR AMP XI.M17, "Flow-Accelerated Corrosion," continues to be a valid basis for managing loss of material due to erosion in these types of metallic components. The staff also administratively deleted the words "and piping elements" from the "Component" column entries of the line items. As defined in Table IX.B of the GALL-SLR Report, the use of the terminology "piping elements" is limited only to piping components made from glass materials, and therefore does not apply to these AMR line items. AMR item No. 110 in Table 3.1-1 of NUREG–2192 was amended accordingly.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
IV.C1.RP-230 IV.C2.RP-235	The staff determined that the previous versions of AMR items IV.C1.RP-230 and IV.C2.RP-235 were acceptable retention in NUREG–2191 with the exception of the following technical edits that the staff found appropriate for the line items: (a) the staff amended the "Component" column entry to specify that steel piping components could be designed with or without internal stainless steel or nickel alloy cladding materials and to include small bore nickel alloy components as well; (b) the staff amended the "Material" column entry for the line item to specify that the SCC and IGSCC mechanisms are only applicable to those nickel alloy or stainless steel component surfaces or cladding surfaces that are exposed to the reactor coolant, (c) the staff administratively edited the "AMP/TLAA" column entry to delete the words "for Class 1 components" from the column entry and opted to use the revised title of AMP XI.M35 per an agreement with an industry-made comment on the AMP's specific title. The staff's basis for incorporating these changes into the AMR line items is that steel materials are not normally susceptible to SCC or IGSCC; however, industry experience has demonstrated that stainless steel and nickel alloy materials may be susceptible to SCC or IGSCC mechanisms. Any changes to the "AMP/TLAA" column entries in these line items were strictly editorial. For the updated bases in GALL-SLR AMR items IV.C1.RP-230 and IV.C2.RP-235, the combination of AMPs in GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," XI.M32, GALL AMP XI.M2, "Water Chemistry," and GALL AMP XI.M35, "ASME Code Class 1 Small Bore Piping," remain as valid AMPs that may be used to manage cracking in these components without the need for further evaluation of the AMP condition monitoring techniques and program element criteria that are credited for management of the applicable aging effect. AMR item No. 039 in Table 3.1-1 of NUREG–2192 was amended accordingly.
IV.C1.RP-39	The staff determined that the previous version of AMR item IV.C1.RP-39 in Table IV.C1 of the GALL Revision 2 Report was acceptable retention in Table IV.C1 of NUREG–2191 with the exception that the staff administratively added "wear" as a potential mechanism that could induce loss of material in the components. Inservice inspections performed on these components in accordance with an applicant's ISI program are sufficient to detect any loss of material that may be induced in the components by a mechanical loss of material mechanism, including wear. AMR item No. 031 in Table 3.1-1 of NUREG–2192 was amended accordingly.
IV.C1.RP-42	The staff determined that the previous version of AMR item IV.C1.RP-42 in Table IV.C1 of the GALL Revision 2 report was acceptable for retention in Table IV.C1 of NUREG–2191 with the exception that the staff edited the applicable environment to be listed as "air–indoor uncontrolled" environment. The concern with RCS leakage manifesting itself on the outside surfaces of the components is associated with a flow-accelerated corrosion mechanism which is not listed as an applicable loss of material mechanism for these line items. Instead, the appropriate external environment for the components is an uncontrolled indoor air environment. AMR item No. 063 in Table 3.1-1 of NUREG–2192 was amended accordingly. AMP in GALL AMP XI.M18, "Bolting Integrity," remains as a valid basis for managing loss of material in the bolting components.
IV.C2.RP-166 IV.D1.RP-166 IV.D2.RP-166	The staff determined that the previous version of AMR item IV.C2.RP-166 in the GALL Revision 2 Report was acceptable for retention in Table IV.C2 of the NUREG–2191 report, with the with the exception of some administrative

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	changes that the staff made to the line item in order to make it consistent with those in the analogous AMR item for boiling water reactors, as given in AMR item IV.C1.RP-42 in Table IV.B1 of the GALL-SLR Report. The staff added stainless steel as a potential material of fabrication for the closure bolting (i.e., in addition to steel). The staff also modified the listed aging mechanisms to add wear as an additional mechanism that could potentially induce loss of material in the bolting and to clarify that any loss of material induced by a general corrosion mechanism would only apply to bolts made from steel (i.e., carbon steel or alloy steel materials). In general, stainless steel grades are designed to be resistant to general corrosion mechanisms. In addition, the staff developed new, analogous AMR line items (i.e., GALL-SLR AMR items IV.D1.RP-166 and IV.D2.-RP-166) that may be used to manage loss of material in high strength steel or stainless steel bolting that may be included in PWR recirculating steam generator designs or once-through steam generator designs. The staff developed these new items in in order to provide consistency between the AMR items for closure bolting in PWR piping and steam generator systems, as updated in Table IV.C2, IV.D1 and IV.D2 of the GALL-SLR Report. Like the AMR in AMR item IV.C2.R-166, the new items in IV.D1.RP-166 and IV.D2.RP-166 cite that the AMP in GALL-SLR AMP XI.M18, “Bolting Integrity” remains as an acceptable program for managing loss of material that may be induced in the components, without any need for further evaluation of the program element criteria in the AMP for managing loss of material in the bolting components. AMR item No. 064 in Table 3.1-1 of NUREG–2192 was amended accordingly.
IV.C1.RP-43 IV.C2.R-12	The staff determined that the previous versions of AMR items IV.C1.RP-43 and IV.C2.R-12 in the GALL Revision 2 Report were acceptable for retention in the NUREG–2191 report, with the exception that the staff administratively amended the environment in the “Environment” column entries of the line items to state that the applicable environment is “air–indoor uncontrolled” environment. Infrequent incidents of reactor coolant leakage would not induce loss of preload in these types of bolting components because the assessment of loss of preload in the components is based the consideration of mechanical loosening mechanisms and not on any consideration of potential corrosive impacts from a postulated reactor coolant leak onto the components. Implementation of the AMP in GALL AMP XI.M18, “Bolting Integrity,” remains as an acceptable basis for managing any loss of preload that may occur in these components. AMR items No. 066 and No. 067 in Table 3.1-1 of NUREG–2192 were amended accordingly.
IV.C1.RP-44 IV.C2.RP-44	For subsequent license renewal applications, the staff determined that the previous versions of AMR item IV.C1.RP-44 in Table IV.C1 of NUREG–2191 and AMR item No. 011 in Table 3.1-1 of NUREG–2192 continue to provide the staff’s AMRs for managing cumulative fatigue damage or cracking induced by fatigue or cyclical loading in the applicable BWR bolting components. The staff amended the line items to add in cracking due to cyclical loading as an applicable aging effect/mechanism combination (i.e., in addition to cumulative fatigue damage and cracking due to fatigue) and to simplify the “AMP/TLAA” column entries for the lines to state “TLAA, SRP-SLR Section 4.3, “Metal Fatigue.” In addition, the staff developed new AMR item IV.C2.RP-44 for the analogous PWR pump and valve closure bolting case in PWR RCS system in order to

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	provide consistent between the AMR item entries listed in Table IV.C1 and IV.C2 of the GALL-SLR Report. Like item IV.C1.RP-44, the new item in AMR item IV.C2.RP-44 identifies that, for PWR RCS pump and valve bolting that has been analyzed with a metal fatigue TLAA, the TLAA in in Section 4.3 of the SRP-LR Revision 2 report may be used as a basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the components. AMR item No. 011 in SRP-SLR Table 3.1-1 was amended accordingly. These AMR items are within the scope of the further evaluation acceptance criteria guidance for metal fatigue evaluations in SRP-SLR Section 3.1.2.2.1 and the analogous review procedures in SRP-SLR Section 3.1.3.2.1.
IV.C2.R-13 IV.C2.R-18 IV.D1.R-33 IV.D2.R-33	For subsequent license renewal applications, the staff determined that the previous versions of these AMR items were acceptable for retention in SRP-SLR and GALL-SLR reports, with the exception that the staff edited the "Aging Effect/Mechanism" column entries for the line items to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to administratively reduce the language in the "AMP/TLAA" column entry of the line item such that simply states "TLAA, SRP-SLR Section 4.3, and "Metal Fatigue." AMR item No. 005 in SRP-SLR Table 3.1-1 was amended accordingly. These AMRs are subject to the further evaluation acceptance criteria guidelines in SRP-SLR Section 3.1.2.2.1 and the corresponding review procedures in SRP-SLR Section 3.1.3.2.1.
IV.C2.R-19	For subsequent license renewal applications, the staff determined that the previous versions of AMR item IV.C2.R-19 in Table IV.C2 of the GALL Revision 2 report was acceptable for retention in Table IV.C2 of NUREG–2191 (i.e., the GALL-SLR Report), with the exception that the staff changed the applicable environment from "Air with metal temperatures up to 288 °C (550 °F)" to "Any air environment." Listing of an applicable temperature threshold for crack initiation does not apply to cracking that is induced by a cyclical loading mechanism. The staff also edited the "Aging Effect/Mechanism" column entry for the line item to delete the words "for Class 1 components" from the column entry. It is evident to members of the industry that the AMR item applies to AMSE Code Class supports in pressurizer design. AMR item No. 036 in Table 3.1-1 of NUREG–2192 (i.e., the SRP-SLR report) was amended accordingly. AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," remains as an acceptable AMP basis for managing cracking due to cyclical loading in these components.
IV.C2.R-58	The staff determined that AMR item IV.C2.R-58 in the GALL Revision 2 report was acceptable for retention in Table IV.C2 of the NUREG–2191 report, with the exception that the staff changed the referenced AMP to state only AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." Previously, it had referenced AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and AMP XI.M2, "Water Chemistry." Cracks in the pressurizer cladding could propagate from cyclic loading into the ferrite base metal and weld metal. However, because the weld metal between the surge nozzle and the vessel lower head is subjected to the maximum stress cycles and the area is

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	periodically inspected as part of the ISI program, the existing AMP is adequate for managing the effect of pressurizer clad cracking." Analogous editorial changes were made to AMR item No. 040 in SRP-SLR Table 3.1-1.
IV.C2.RP-12	The staff determined that the version of AMR item IV.C2.RP-12 in the GALL Revision 2 report was acceptable for retention in Table IV.C2 of the NUREG–2191 Report, with the exception that that staff added treated water as one of the listed environments for inducing loss of material in the components, with closed-cycle cooling water remaining as the other applicable environment. GALL-SLR AMP XI.M33, "Selective Leaching," remains as a valid AMP for managing loss of material in the components that may be induced by a selective leaching mechanism. The AMP includes treated water as an applicable environment and provides recommendations for managing loss of material due to selective leaching for this material and environment combination. AMR item No. 093 in Table 3.1-1 of NUREG–2192 was amended accordingly.
IV.C2.RP-23	The relevant AMR item apples to the management of loss of material due to pitting or crevice corrosion in PWR reactor coolant piping, piping components, flanges, heater sheaths and sleeves, penetrations, thermal sleeves, non-reactor vessel shells, heads, nozzles, nozzle safe ends and welds that are made from steel with nickel alloy or stainless steel cladding, stainless steel, or nickel all materials and are exposed to reactor. The previous version of the line item stated that the AMPs in GALL AMP XI.M2, "Water Chemistry," may be used to manage any loss of material in the components that are induced by these mechanisms, without any need for further evaluation of the program element activities that are described for aging management in the programs. The staff determined that the previous version of AMR item IV.C2.RP-23 in the GALL Revision 2 report was acceptable for retention in Table IV.C2 of the NUREG–2191 report, with the exception that that staff revised the structure and/or component entry by deleting piping elements and adding non-reactor vessel shells, and nozzles, and nozzle safe ends. However, the staff determined that AMR item No. 088 in SRP-SLR Table 3.1-1 did not need to be further amended based on the staff changes made to GALL-SLR AMR item IV.C2.RP-23.
IV.C2.RP-221	The staff determined that AMR item IV.C2.RP-221 in the GALL Revision 2 report was acceptable for retention in Table IV.C2 of the NUREG–2191 report, with the exception that that staff added MIC as one of the listed aging mechanisms for inducing loss of material in the components.
IV.C2.RP-222	The staff determined that AMR item IV.C2.RP-222 in the GALL Revision 2 Report was acceptable for retention in Table IV.C2 of NUREG–2191, with the exception that that staff deleted general corrosion and galvanic corrosion as listed aging mechanisms for inducing loss of material in the components, and added microbiologically-influenced corrosion (MIC) as an applicable aging mechanism. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to closed-cycle cooling water. The staff reviewed EPRI 1007820, "Closed Cooling Water Chemistry Guidelines." This document includes tables for each type of chemical treatment program showing parameters monitored, acceptable ranges, monitoring frequencies, and action level ranges. All chemical treatment programs monitor ph. Most cite pH levels greater than 8.5 and below 11.0. The only exceptions are "pure water" systems (which cites >5.5 and <8.0) and "blended glycol" (which cites >7.5 and <11). The staff also reviewed Oilfield Water Technology, NACE International, 2006, Section 6.5, "Copper Alloys," page 94, which states, "In aerated water, if

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	pH drops below about 5, copper alloys corrode. In deaerated water, even at low pH, corrosion resistance is good." Given the lower limit of a pH below 5, the chemistry controls for closed-cycle cooling water are sufficient to minimize the potential for general corrosion. In addition, galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Chapter IX.F for additional information. The addition of MIC as an additional aging mechanism is based on EPRI's definition for MIC in Section 3.1.7 of the EPRI Mechanical Tools document (EPRI 1010639), which identifies that MIC may be applicable to copper alloy components in specific types of aqueous environments. AMR item No. 090 in Table 3.1-1 of NUREG–2192 was amended accordingly.
IV.D1.R-221 IV.D2.R-222	For subsequent license renewal applications, the versions of AMR items IV.D1.R-221 and IV.D2.R-222 in NUREG–2191 and AMR item No. 008 in Table 3.1-1 of NUREG–2192 continue to provide the staff's AMRs for managing cumulative fatigue damage or cracking induced by fatigue or cyclical loading in these components. The staff determined that the previous versions of these AMR items were acceptable for retention in SRP-SLR and GALL-SLR reports, with the exception that the staff edited the "Aging Effect/Mechanism" column entries for the line items to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to reduce the language in the "AMP/TLAA" column entry of the line items to simply state "TLAA, SRP-SLR Section 4.3, "Metal Fatigue." These AMR items are subject to the further evaluation acceptance criteria in SRP-SLR Section 3.1.2.2.1 and the review procedures in SRP-SLR Section 3.1.3.2.1.
IV.D1.R-47 IV.D1.R-48 IV.D1.R-437	For initial license renewal applications, AMR items IV.D1.R-47 and IV.D1.R-48 in Table IV.D1 of NUREG–1801, Revision 2 and AMR item No. 069 in Table 3.1-1 of NUREG–1800, Revision 2 provided a set of AMR items that may be used to manage cracking in recirculating generator tubes or sleeves that is induced either by an outside diameter stress corrosion cracking mechanism or by intergranular attack. The AMR items stated that the AMPs in GALL AMP XI.M19, "Steam Generators," and GALL AMP XI.M2, "Water Chemistry," may be used to manage cracking in the tubes or tube sleeves that is induced by these mechanical aging mechanisms, without the need for performing further evaluation of the AMP program element criteria used to manage the effect. For these applications, AMR item IV.D1.R-47 was the line item that applied for cracking that is induced by an outside diameter stress corrosion cracking mechanism and AMR item IV.D1.R-48 was the line item that applied for cracking that is induced by an intergranular attack mechanism. For the update of the GALL-SLR and SRP-SLR guidance documents, the staff deleted AMR item VI.D1.R-48 from the scope of the final GALL-SLR Report because the staff found it appropriate to add intergranular attack as an additional aging mechanism for AMR item IV.D1.R-47. AMR item No.69 in Table 3.1-1 of the final SRP-SLR report was adjusted accordingly to delete reference of AMR item IV.D1.R-48.

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	However, the staff did not delete AMR item IV.D1.R-437 as an applicable AMR item in Table IV.D1 of the GALL-SLR Report. Specifically, the new AMR basis in IV.D1.R-437 applies to cracking that is induced by mechanical aging mechanisms, such as vibrational fatigue or flow-induced. Thus, AMP XI.M2, "Water Chemistry," cannot be applied to the AMR because it is only valid for aging effects that are induced by chemistry related or corrosive aging mechanisms and does not apply to aging effects that are induced by mechanical aging mechanisms. The program in GALL-SLR AMP XI.M19, "Steam Generators," is the proper AMP to reference for managing cracking due to flow-induced vibrations or vibrational fatigue in regions of recirculating steam generator tubes that are located at tube support locations. Thus, the staff did not find it appropriate to delete new AMR item IV.D1.R-437 from the scope of the final GALL-SLR Report or new AMR item No.125 from the scope of Table 3.1-1 in the final SRP-SLR report. Therefore, for the final issuance of NUREG–2191, AMR item IV.D1.R-437 has been as drafted in Table IV.D1 of the draft NUREG–2191 report. Similarly, for the final issuance of NUREG–2192, new AMR item No. 125 in Table 3.1-1 of NUREG–2192 has been retained as drafted in Table 3.1-1 of the draft NUREG–2192 report.
IV.D2.R-47 IV.D2.R-48 IV.D2.R-442	For initial license renewal applications, AMR items IV.D2.R-47 and IV.D2.R-48 in Table IV.D2 of NUREG–1801, Revision 2 and AMR item No. 069 in Table 3.1-1 of NUREG–1800, Revision 2 provided a set of AMR items that may be used to manage cracking in once-through generator tubes or sleeves that is induced either by an outside diameter stress corrosion cracking mechanism or by intergranular attack. The AMR items stated that the AMPs in GALL AMP XI.M19, "Steam Generators," and GALL AMP XI.M2, "Water Chemistry," may be used to manage cracking in the tubes or tube sleeves that is induced by these mechanical aging mechanisms, without the need for performing further evaluation of the AMP program element criteria used to manage the effect. For these applications, AMR item IV.D2.R-47 was the line item that applied for cracking that is induced by an outside diameter stress corrosion cracking mechanism and AMR item IV.D2.R-48 was the line item that applied for cracking that is induced by an intergranular attack mechanism. For the update of the GALL-SLR and SRP-SLR guidance documents, the staff deleted AMR item VI.D2.R-48 from the scope of the final GALL-SLR Report because the staff found it appropriate to add intergranular attack as an additional aging mechanism for AMR item IV.D2.R-47. AMR item No. 069 in Table 3.1-1 of the final SRP-SLR report was adjusted accordingly to delete reference of AMR item IV.D2.R-48. However, the staff did not delete AMR item IV.D2.R-442 as an applicable AMR item in Table IV.D2 of the GALL-SLR Report. Specifically, the new AMR basis in IV.D2.R-442 applies to cracking that is induced by mechanical aging mechanisms, such as vibrational fatigue or flow-induced. Thus, AMP XI.M2, "Water Chemistry," cannot be applied to the AMR because it is only valid for aging effects that are induced by chemistry related or corrosive aging mechanisms and does not apply to aging effects that are induced by mechanical aging mechanisms. The program in GALL-SLR AMP XI.M19, "Steam Generators," is the proper AMP to reference for managing cracking due to flow-induced vibrations or vibrational fatigue in regions of recirculating steam generator tubes that are located at tube support locations. Thus, the staff did not find it appropriate to delete new AMR items IV.D2.R-442 from the scope of the final GALL-SLR Report or new AMR item No.125 from the scope of

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Table 3.1-1 in the final SRP-SLR report. Therefore, for the final issuance of NUREG–2191, AMR item IV.D2.R-442 has been as drafted in Table IV.D2 of the draft NUREG–2191 report. Similarly, for the final issuance of NUREG–2192, new AMR item No. 125 in Table 3.1-1 of NUREG–2192 has been retained as drafted in Table 3.1-1 of the draft NUREG–2192 report.
IV.D1.R-46 IV.D2.R-46	For subsequent license renewal applications, the versions of AMR item IV.D1.R-46 in Table IV.D1 of NUREG–2191, AMR item IV.D2.R-46 in Table IV.D2 of the GALL-SLR Report, and AMR item No. 002 in Table 3.1-1 of NUREG–2192 continue to provide the staff's AMRs for managing cumulative fatigue damage or cracking induced by fatigue or cyclical loading in these once-through steam generator components, where the TLAA in SRP-SLR Section 4.3, "Metal Fatigue" is used to manage the aging effect. The staff determined that the previous versions of these AMR items were acceptable for retention in SRP-SLR and GALL-SLR reports, with the exception that the staff edited the "Aging Effect/Mechanism" column entries for the line items to add in cyclical loading as an additional mechanism (in addition to fatigue) that could induce cracking in the components. The other applicable aging effect for the line item continues to be listed as cumulative fatigue damage. Other administrative changes were made to reduce the language in the "AMP/TLAA" column entry of the line items. These AMR items are subject to the further evaluation acceptance criteria in SRP-SLR Section 3.1.2.2.1 and the review procedures in SRP-SLR Section 3.1.3.2.1.
IV.D1.R-50	The staff determined that the previous version of AMR item IV.D1.R-50 in the GALL Revision 2 report was acceptable for retention in Table IV.D1 of the NUREG–2191 report, with the exception that the staff administratively edited the line item to move reference of phosphate chemistry conditions out of the "Structure and/or Component" column of the line item and into the "Environment" column of the line item. Similarly, the staff determined that AMR item No. 073 in Table 3.1-1 of the SRP-LR Revision 2 report remains acceptable for retention in Table 3.1-1 of NUREG–2192 , without any need for modifying the contents of the line item. The AMPs in GALL AMP XI.M19, "Steam Generators," and GALL AMP XI.M2, "Water Chemistry," remain as a valid basis for managing any loss of material that may occur in these components as a result of these aging mechanisms, without any need for performing further evaluation of the program element criteria for managing the aging effect.
IV.D1.RP-161 IV.D2.RP-162	The staff determined that the previous version of AMR items IV.D1.RP-161 and IV.D2.RP-162 in the GALL Revision 2 report were acceptable for retention in Tables IV.D1 and IV.D2 of the NUREG–2191 report, with the exception that the staff administratively edited the "AMP/TLAA" column entries for the line items to indicate that use of the Water Chemistry Program applies only to loss of material that may be induced by corrosion-based aging mechanisms. Similarly, the staff determined that AMR item No. 072 in Table 3.1-1 of the SRP-LR Revision 2 report remains acceptable for retention in Table 3.1-1 of NUREG–2192, with similar types of administrative changes to the line item. The AMP in GALL AMP XI.M19, "Steam Generators," remains as a valid basis for managing any loss of material that may occur in these components as a result of corrosion-based or erosion-based aging mechanisms, without any need for performing further evaluation of the program element criteria for managing the aging effect. As stated above, use of AMP XI.M2, "Water Chemistry," applies only to the management of loss of material that is induced

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	by corrosion-based aging mechanisms. A water chemistry program would not be a valid program for managing loss of material effects that are induced solely by mechanical mechanisms, such as erosion, abrasion, or mechanical wear.
IV.D1.RP-225	The staff determined that the previous version of AMR item IV.D1.RP-225 in the GALL Revision 2 report was acceptable for retention in Table IV.D1 of the NUREG–2191 report, with the exception that the staff added wear as an additional mechanical aging mechanism for inducing loss of material in the components. AMR item No. 076 in Table 3.1-1 of NUREG–2192 was modified accordingly. Implementation of GALL-SLR AMP XI.M19, "Steam Generators," remains as an acceptable AMP basis for managing any loss of material that may occur in these components as a result of mechanical aging mechanisms, including wear or fretting.
IV.D1.RP-367 IV.D1.RP-385 IV.D2.RP-185	The previous line items stated that the AMP in GALL AMP XI.M2, "Water Chemistry," may be used to manage any cracking that may occur in the components as a result of these types of aging mechanisms, as assessed in conjunction with the further evaluation acceptance criteria and review procedure guidelines in Sections 3.1.2.2.11 and 3.1.3.2.1.11 of the SRP-LR Revision 2 report and their subsections. The further evaluation criteria basically recommended that the applicants perform an evaluation of these SG components to determine whether additional aging management activities or a plant-specific AMP would need to be implemented (i.e., in addition to implementation of the Water Chemistry program) in order to ensure adequate detection and management of cracking that may occur in the divider plates and tube-to-tubesheet welds during the period of extended operation. AMR item No. 025 in Table 3.1-1 of the SRP-SL Revision 2 report referenced the following AMR items in NUREG–1801, Revision 2 for aging management: (a) AMR item IV.D1.RP-367 for primary side divider plates in recirculating steam generators that are made from either nickel alloy materials or steel with nickel alloy cladding and are exposed to a reactor coolant environments, (b) AMR item IV.D1.RP-385 for the tube-to-tubesheet welds in recirculating steam generators that are made from nickel alloy materials and are exposed to a reactor coolant environment, and (c) AMR item IV.D2.RP-185 for the tube-to-tubesheet welds in once-through steam generators that are made from nickel alloy materials and are exposed to a reactor coolant environment. An update of the staff's aging management guidelines for these components were issued in NRC License Renewal Interim Staff Guidance (LR-ISG) No. 2016-01, "Changes to Aging Management Guidance for Various Steam Generator Components," dated December 7, 2016 (ADAMS Accession No. ML16237A383). Therefore, the staff determined that the previous versions of AMR items IV.D1.RP-367, IV.D1.RP-385, and IV.D2.RP-185 in the GALL Revision 2 report were acceptable for retention in NUREG–2191, but with the need for certain modifications of the line item. Specifically, the staff updated the further evaluation acceptance criteria guidelines in SRP-SLR Section 3.1.2.2.11 and review procedure guidelines in SRP-SLR 3.1.3.2.11 to be consistent with the changes made to these sections in LR-ISG-2016-01, "Changes to Aging

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Management Guidance for Various Steam Generator Components,”. AMR items IV.D1.RP-367, IV.D1.RP-385, and IV.D2.RP-185 were then updated to indicate that the AMPs in GALL-SLR AMP XI.M2, “Water Chemistry,” and AMP XI.M19, “Steam Generators,” may be used to manage cracking in the components, when coupled to a the staff’s further evaluation guidelines in SRP-SLR Section 3.1.2.2.11.1 for the assessment of divider plates in recirculating SGs (i.e., the subject of the AMR in item IV.D1.RP-367) and in SRP-SLR Section 3.1.2.2.11.2 for the assessment of SG tube-to-tubesheet welds in recirculating and once-through SG designs (i.e., the subject of the AMRs in items IV.D1.RP-385 and IV.D2.RP-185). AMR item No. 025 in Table 3.1-1 in Table 3.1-1 of NUREG–2192 was modified accordingly. Under the updated guidelines in LR-ISG-2016-01, implementation of the AMPs in GALL AMP XI.M19, “Steam Generators,” and GALL AMP XI.M2, “Water Chemistry,” are acceptable bases for managing any cracking that may occur in these components, when subject to and evaluated in accordance with the staff’s updated further evaluation acceptance criteria for these components in SRP-SLR Sections 3.1.2.2.11.1 and 3.1.2.2.11.2. The corresponding review procedures for performing these reviews of these AMR items are given in SRP-SLR Sections 3.1.3.2.11.1 and 3.1.3.2.11.2.
IV.D2.R-31	The staff determined that the previous version of AMR item IV.D2.R-31 in the GALL Revision 2 report was acceptable for retention in Table IV.D2 of the NUREG–2191 Report , with the exception of the following changes that the staff incorporated into the line item: (a) the staff the changed the listed environment from a “Air with leaking secondary-side water and/or steam” environment to a “treated water, steam” environment, and (b) the staff changed the “Structures and/or Component” description to identify that the seating surface areas are the areas in the manway or handhold covers that may be subject to erosion are the seating surfaces in the covers. In addition, in order to align GALL-SLR Table IV.D1 (i.e., the AMR table in GALL-SLR for recirculating SG designs) with GALL-SLR Table IV.D2 (i.e., the AMR table in GALL-SLR for once-through SG designs), the staff created a new AMR item (No.IV.D1.R 31) that is analogous to the modified version of item IV.D2.R-31 in GALL-SLR Table IV.D2. AMR item No.44 in Table 3.1-1 of NUREG–2192 was modified accordingly to be consistent with these changes. The AMP in GALL AMP XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” remains as valid bases for managing any loss or material or walling thinning that may occur in these components as a result of erosion, without any need for performing further evaluation of the program element criteria for managing the aging effect.
IV.E.RP-353 IV.E.RP-06	In the previous versions of these line items NUREG–1801, Revision 2 (GALL Revision 2 report), the staff identified that there are not any aging effects that need to be managed for steel components in concrete or any AMPs that are needed to manage potential aging effects associated with this material-environment combination (i.e., the AMR item sites “None-None” for the applicable aging effect-AMP combination of the line item). The staff determined that AMR items IV.E-RP-353 and IV.E.RP-06 would need to be modified in order to retain them in Table IV.E in NUREG–2191. Specifically, the staff determined that some aging mechanisms and effects could occur if certain environmental conditions were present in the concrete surrounding the components. Specifically, the line items were editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR and SRP-SLR tables. As a result, the first two provisos

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	from GALL Report Revision 2 (i.e., ACI standards, OE) were relocated to the further evaluation section. A third proviso was added to the further evaluation, “the piping is not potentially exposed to groundwater.” During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with these line items, which had stated that there are no AERM when the materials are exposed to concrete (subject to meeting the two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. Thus, the AMR items were revised to cite the new further evaluation section in the SRP-SLR report that addresses the potential for ground water penetration through the concrete, as well as the original provisos for the AMR items. The staff also administratively edited these line items to delete the words “piping elements” from the line items. Per Table IX.B in the GALL-SLR Report, the term “piping elements” specifically refers to piping components that are made from glass materials, and not metallic materials. Given the new SRP-SLR further evaluation sections, aging management of steel and stainless steel RCS piping components is now addressed by the following AMRs: (a) amended version of AMR items No. 105 and the inclusion of new AMR item No. 115 in Table 3.1-1 of the SRP-SLR report, and (b) amended version of AMR items IV.E.RP-353 and IV.E.RP-06 in Table IV.E of the GALL-SLR Report. Therefore, these AMR items have been amended to state that the components addressed in the AMR items are subject to the further evaluation acceptance criteria guidelines in SRP-SLR Section 3.1.2.2.15 and the corresponding review procedure guidelines in SRP-SLR Section 3.1.3.2.15.
IV.A2.R-87 IV.A2.R-90 IV.A2.RP-55 IV.A2.RP-57 IV.A2.RP-59 IV.B1.RP-26 IV.C2.R-09 IV.C2.R-217 IV.C2.R-25 IV.C2.R-56 IV.C2.RP-156 IV.D1.RP-232 IV.D1.RP-36 IV.D2.RP-36	Simple editorial change involving deletion of the words “for Class 1 components” from the “Aging Management Program (AMP)/TLAA” column entries of the line items.
IV.C1.R-23 IV.E.RP-05 IV.E.RP-07 IV.E.RP-378	Simple editorial change involving deletion of the words “and piping elements” from the “Structure and/or Component” column entries of the line items.
IV.C1.R-15 IV.C1.R-225	Editorial edits of AMR items for managing cracking in BWR isolation condenser components. Simple editorial changes involving deletion of the following wording from the from the “Aging Management Program (AMP)/TLAA” column

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	entries of the line items: “for Class 1 components The AMP in AMP XI.M1 is to be augmented to detect cracking due to cyclic loading and verification of the program's effectiveness is necessary to ensure that significant degradation is not occurring and the component intended function will be maintained during the extended period of operation. An acceptable verification program includes temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.”
IV.C2.RP-159	Simple editorial change involving deletion of the words “and piping elements” from the “Structure and/or Component” column entry of the line item and the words “for Class 1 components” from the “Aging Management Program (AMP)/TLAA” column entry of the line item.
IV.C1.RP-231	Simple editorial change involving deletion of the words “for ASME Code components” from the “Aging Management Program (AMP)/TLAA” column entry of the line item.
IV.C2.RP-344	Simple editorial change involving deletion of the words “and piping elements” from the “Structure and/or Component” column entry of the line items and the words “for ASME Code components” from the “Aging Management Program (AMP)/TLAA” column entry of the line items.
IV.C2.RP-37	Simple editorial change involving addition of the words “. . . steel with . . .” to the “Material” column entry of the line item and deletion of the words “for Class 1 components” from the “Aging Management Program (AMP)/TLAA” column entry of the line item.
IV.C2.R-05	Simple editorial changes involving the following changes to the line item: (a) deletion of the words “and piping elements” from the “Structure and/or Component” column entry of the line item, (b) addition of the words “AMP XI.M2, “Water Chemistry,” and plant-specific aging management program” to the “Aging Management Program (AMP)/TLAA” column entry of the line item, and (c) administrative deletion of the words “Monitoring and control of primary water chemistry in accordance with EPRI 1014986 minimize the potential for SCC. Material selection according to NUREG–0313, Revision 2, guidelines of ≤0.035% C and ≥7.5% ferrite reduces susceptibility to SCC. For CASS components that do not meet either one of the above, a plant-specific aging management program is evaluated. The program is to include (a) adequate inspection methods to ensure detection of cracks and (b) flaw evaluation methodology for CASS components that are susceptible to thermal aging embrittlement” from the “Aging Management Program (AMP)/TLAA” column entry of the line item.
IV.A2.RP-154 IV.D1.R-39	Simple editorial changes involving the following changes: (a) simplification of the “Aging Management Program (AMP)/TLAA” column entries in the line items to state “Plant-specific aging management program,” and (b) simplification of the “Further Evaluation” column entries to state “Yes” for further evaluation basis for managing aging in the line items. TLAAs have always required further evaluation because they are required evaluated in accordance with the requirements in 10 CFR 54.21(c)(1).
IV.A1.RP-50 IV.A2.RP-28	Simple editorial changes to the component descriptions in the “Structure and/or Component” column entries that do not involve component type additions or deletions in the line items and that do not change the prior AMR item basis for the equivalent AMR line item in the GALL Revision 2 report.
IV.B1.R-104	Simple editorial change involving deletion of the words “for lower plenum” from the “Aging Management Program (AMP)/TLAA” column entry of the line items.
IV.B4.RP-376	Simple editorial changes of the AMR line item involving: (a) deletion of the words “ductility and” from the “Aging Effect” column entry of the line item,

Table 2-17 Changes to Existing GALL Report Revision 2 Chapter IV AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	(b) addition of the words "TLAA, SRP-SLR Section 4.7, "Other Plant-Specific TLAAs" to the "Aging Management Program (AMP)/TLAA" column entry of the line item, (c) deletion of the words "Ductility - Reduction in fracture toughness is a TLAA (BAW-2248A) to be evaluated for the subsequent period of extended operation. See the SRP-SLR, Section 4.7, Other Plant-Specific TLAAs, for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1) to TLAA, SRP-SLR Section 4.7, Other Plant-Specific TLAAs from the "Aging Management Program (AMP)/TLAA" column entry of the line item.
IV.D1.RP-368	Simple editorial changes of the AMR item involving: (a) deletion of the words "for Class 2 components," from the "Aging Management Program (AMP)/TLAA" column entry of the line item, and (b) deletion of the words "As noted in NRC IN 90-04, if general and pitting corrosion of the shell exists, AMP XI.M1 methods may not be sufficient to detect general and pitting corrosion (and the resulting corrosion-fatigue cracking), and additional inspection procedures are to be developed. This issue is limited to Westinghouse Model 44 and 51 Steam Generators where a high stress region exists at the shell to transition cone weld" from the "Aging Management Program (AMP)/TLAA" column entry of the line item, and (c) deletion of the words "detection of aging effects is to be evaluated" from the "Further Evaluation" column entry of the line item.
IV.D2.RP-47	Simple editorial change involving deletion of the words "exposed to reactor coolant" from the "Structure and/or Component" column entry of the line item and the words "for Class 1 components" from the "Aging Management Program (AMP)/TLAA" column entry of the line item.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
Page V A-1 Page V D1-1 Page V D2-1	The following phrase was deleted from each of the cited Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report pages "They are also subject to replacement based on qualified life or a specified time period." This phrase appears in a paragraph under Systems, Structures, and Components. The phrase was associated with pump and valve internals. During the development of the GALL-SLR Report, the industry submitted a comment that these items are not necessarily subject to replacement based on a qualified or specified time period. The staff agreed with this comment and deleted the phrase. The cited pages retain the phrase, "Pump and valve internals perform their intended functions with moving parts or with a change in configuration." This statement provides an adequate basis for not subjecting the parts to aging management review.
Page V F-1	The introduction to the Common Miscellaneous Material/Environment Combinations Table was revised. The associated aging management review (AMR) item table states that there are no aging effects requiring management and no recommended aging management program (AMP). However, some of the components listed in the table could be within the scope of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, "Rules for Inspection and Testing of Components of Light-Water-Cooled Plants." The staff added, "With the exception of components within the scope of ASME Section XI," to the statement that no aging management programs are required for the components in the Common Miscellaneous Material/Environment Combinations Table. The aging effects associated with components within the scope of ASME Code Section XI are managed by AMPs, such as AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The introduction to this table could have misled the user without this clarification.
V.D2.E-07 V.D2.E-09 V.D2.E-11 V.F.EP-19 V.F.EP-22 V.D1.E-47 V.F.EP-115 V.F.EP-7 V.D2.EP-71 V.A.EP-98 V.C.EP-98 V.D1.EP-98 V.D2.EP-98	Deletion of piping element only
V.D2.E-21	Editorial changes – the only change was that it was added to the GALL-SLR item column in SRP-SLR item 3.2-1, 027. It was present as a GALL Revision 2 AMR item, but not listed in the SRP-SLR Table 3.2-1.
V.E.E-02	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Chapter IX when the staff and industry consolidated the number of air-related terms. The three cited environments represent those air-related environments to which it is expected that closure bolting could be exposed and aging effects would occur.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Pitting and crevice corrosion were added as aging mechanisms because they are applicable to steel in an environment with moisture. Stainless steel and nickel alloy were added to provide a greater range of materials in the GALL-SLR Report. For stainless steel and nickel alloy items, Electric Power Research Institute (EPRI) 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "External Surface Tool," states that these materials are susceptible to pitting and crevice corrosion in an aggressive environment (i.e., industrial, marine). As documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090), leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting. In general for stainless steel and nickel alloy components exposed to an air environment, the SRP-SLR recommends a further evaluation (e.g., Section 3.2.2.2.2). However, for closure bolting the staff is not recommending a further evaluation because AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of loss of material in closure bolting. The lack of leakage would provide reasonable assurance that the bolting has not experienced a consequential loss of material.
V.E.E-03	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Chapter IX when the staff and industry consolidated the number of air-related terms. The environment was revised to air, soil, and underground because these environments represent those to which it is expected that high-strength closure bolting could be exposed and stress corrosion cracking (SCC) could occur. In general, for SCC to occur in high-strength steel bolting, one of the parameters that is required to be present is an adverse environment. As documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting. Both the soil and underground environment can have contaminants based on potential exposure to ground water and the outdoor air environment. Cyclic loading could occur regardless of the environment. AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of closure bolting cracking. The lack of leakage would provide reasonable assurance that the bolting has not experienced consequential cracking.
V.D2.E-10	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
V.A.E-12 V.D1.E-12	Steel (with stainless steel or nickel alloy cladding) was added to provide a consistent item for plants where the safety injection tank (accumulator) could be at elevated temperature due to containment temperatures exceeding the threshold or long-term in-leakage from the reactor coolant system results in elevated temperatures. See the basis for the deletion of item E-38. AMP XI.M32, Table XI.M32-1, "Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component," cites examination techniques capable of detecting cracking.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
V.D1.E-13	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
V.C.E-22	The component description was changed from containment isolation piping and components (Internal surfaces) to piping and piping components because for the material, environment, and aging effect, there was nothing unique limiting the component to containment isolation piping. The term “fouling that leads to corrosion” was deleted as an aging mechanism associated with “loss of material” based on the following. “Forms of Corrosion Recognition and Prevention,” Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for “fouling that leads to corrosion.” The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an aging effect requiring management (AERM) based on the staff’s review of industry operating experience (OE). Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
V.D1.E-24	The phrase “when centrifugal HPSI pumps are used for normal charging,” was added to limit the applicability of this item to only those using the high-pressure safety injection (HPSI) pumps for normal charging. The staff has concluded that there is reasonable assurance that periodic use of the HPSI will not result in significant loss of material due to erosion based on stainless steels relative resistance to erosion. The basis for this conclusion is as follows: Routine surveillance testing of the high-pressure safety injection pumps required by 10 CFR 50.55a(f)(4)is capable of detecting changes in flow that would be indicative of erosion in the recirculation orifices. The staff has concluded that if the HPSI pumps have been used to provide normal charging, a sufficient number of surveillance tests would have been conducted prior to the subsequent period of extended operation to detect indications of loss of material due to erosion License Renewal Interim Staff Guidance (LR-ISG)-2012-01, “Wall Thinning Due to Erosion Mechanisms,” was issued to address wall thinning due to erosion mechanisms such as cavitation, flashing, droplet impingement, and solid particle impingement. This ISG revised AMP XI.M17 to address wall thinning due to erosion mechanisms. These changes included expanded the scope of materials to materials other than carbon steel. Based on the staff’s review of industry operating experience, it is known that stainless steel piping is susceptible to erosion. For erosion mechanisms, the AMP cites the use of extent-of-condition reviews from corrective actions associated with plant-specific and industry operating experience.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	As incorporated in the GALL Report Revision 2, this item cited a further evaluation. SRP-SLR Section 3.2.2.2.4 recommended that a plant-specific program be developed to evaluate whether potential loss of material due to erosion was occurring due to extended use of centrifugal HPSI pumps. This AMR item was based on Licensee Event Report 50-275/94-023. The staff has concluded that use of a one-time inspection, along with the associated acceptance criteria and correction actions for AMP XI.M32, will be sufficient to determine whether loss of material due to wear could affect the intended function of the HPSI pump or HPSI mini-flow recirculation orifice.
V.B.E-25	The component description and environment no longer cite “internal” because it is obvious that the aging effect is managed by an internally oriented AMP. Pitting and crevice corrosion were added to be consistent with other items citing steel exposed to air-indoor uncontrolled (e.g., EP-42).
V.B.E-27 V.D1.E-27 V.D2.E-27	The environment no longer cites “internal” because it is obvious that the aging effect is managed by an internally oriented AMP.
V.A.E-29 V.D2.E-29	The component description and environment no longer cite “internal” because it is obvious that the aging effect is managed by an internally oriented AMP. Pitting and crevice corrosion were added to be consistent with other items citing steel exposed to air-indoor uncontrolled (e.g., EP-42).
V.C.E-34	The component description was changed from containment isolation piping and components (Internal surfaces) to piping and piping components because for the material, environment, and aging effect, there was nothing unique limiting the component to containment isolation piping. The term “fouling that leads to corrosion” was deleted as an aging mechanism associated with “loss of material” based on the following. “Forms of Corrosion Recognition and Prevention,” Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for “fouling that leads to corrosion.” The staff reviewed all of the AMR items in GALL Report, Revision 2 and the proposed GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
V.D2.E-37	The component description, material, and environment were revised to be consistent with the corresponding descriptions in AMP XI.M7.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
V.A.E-43 V.D1.E-43	Closed-cycle cooling water was added to the list of environments based on the staff's review of the license renewal application (LRA) AMR items. AMP XI.M33 addresses both environments and provides recommendations for managing loss of material due to selective leaching for this material and environment combination.
V.E.E-44	Air-outdoor and condensation were added to allow consolidation of items (e.g., deletion of E-45 and E-46). Condensation frequently occurs during humid periods of normal plant operation and can also occur during plant shutdown when normally hot components might be below the dew point. The aging effects from condensation occurring during humid periods of normal plant operation should be evaluated for license renewal. The staff concluded that It is less likely that condensation during plant shutdowns would result in loss of material, unless plant-specific operating experience dictates otherwise (e.g., as a result of extended plant shutdowns). Therefore, if the plant had experienced extended shutdowns during operating periods prior to the proposed period of extended operation, loss of material due to exposure to condensation should be addressed. AMP XI.M36 includes recommendations for periodic visual inspections of the external surfaces (both insulated and uninsulated) of in-scope components that are capable of detecting loss of material. Pitting and crevice corrosion were added to be consistent with other GALL-SLR items for steel exposed to air environments with a potential presence of moisture.
V.A.E-400 V.B.E-400 V.C.E-400 V.D1.E-400 V.D2.E-400	These items were revised to cite a specific AMP rather than a plant-specific AMP. Based on the review of several LRAs, the staff noted that most applicants are revising existing programs rather than developing a plant-specific program to manage loss of material due to recurring internal corrosion. Citing a specific GALL-SLR Report AMP decreases the level of effort for applicants that elect to use these AMPs in lieu of a plant-specific AMP. It adds no burden to applicants that elect to develop a plant-specific AMP.
V.A.E-401 V.B.E-401 V.C.E-401 V.D1.E-401 V.D2.E-401	Based on the review of several LRAs, the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. Lubricating oil was removed as a cited environment because the associated aging effects could be managed by A-416. The aging effects associated with cementitious coatings were revised to cite loss of material and cracking in lieu of spalling because spalling is not the only aging effect that could occur for internal cementitious coatings.
V.D1.E-402 V.D2.E-402	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air or condensation should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from this item, steel tanks would not have to be addressed in the further evaluation. Moist air was deleted from GALL-SLR Chapter IX when the staff and industry consolidated the number of air-related terms. The basis for the deletion of the

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	term “moist air” is documented in the staff’s response to industry comment No. 015-006, part 4. The broader term “air” is cited instead of air-outdoor and air-indoor uncontrolled because the term “air” encompasses the other two terms and the staff concluded it was unlikely that tanks within the scope of AMP XI.M29 would be located in an air-indoor controlled environment. Consistent with other items in the GALL-SLR Report (e.g., EP-4, AP-2, SP-1), there are no recommended aging effects for steel components exposed to air-indoor controlled. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a soil or raw water environment as cited in ASM Handbook Volume 13A, Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. However, MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
V.E.E-403a	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from this item, steel components would not have to be addressed in the further evaluation. Copper alloy was deleted from this item because the staff has concluded that there are no aging effects requiring management for copper alloy components exposed to air or condensation. See the technical basis for this change to AP-144. AMP XI.M29 was deleted as a cited AMP and item E-403b was incorporated to specifically address tanks within the scope of AMP XI.M29. The air-outdoor environment was replaced by the term “air.” Steel components would not be expected to be susceptible to loss of material in an air-indoor controlled environment, which is encompassed within the term “air.” However, given that these components are insulated, the steel material could be susceptible to corrosion under insulation as a result of leakage from bolted connection (e.g., flanges, packing) in the vicinity. AMP XI.M36 recommends periodic inspections that are capable of detecting loss of material or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component.
V.E.E-403b	See the discussion for E-403a. The aging effects associated with Insulated portions of a tank can be effectively managed by either AMP XI.M29 or AMP XI.M36. The “detection of aging

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	effects" program element of AMP XI.M36 allows the use of AMP XI.M29 to manage aging effects associated with insulated portions of a tank. Likewise, the "scope of program" program element of AMP XI.M29 allows the use of AMP XI.M36 to manage aging effects for tank surfaces that are fully visible. AMP XI.M29 and AMP XI.M36 recommend periodic inspections that are capable of detecting loss of material or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component.
V.A.E-404 V.D1.E-404 V.D2.E-404	MIC was added because it is known to potentially affect steel and stainless steel materials as cited in ASM Handbook Volume 13A, Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional information for steel components and EP-63 for stainless steel components. The one-time visual inspections recommended by AMP XI.M32 are capable of detecting loss of material. The staff has concluded that MIC only occurs in fuel oil environments for aluminum components. The staff reached this conclusion based on its review of the following: A Practical Manual on Microbiologically Influenced Corrosion, Volume 2 (2nd Edition), John G Stoecker, NACE International, 2001, Chapter 7, "MIC in the Power Industry," and Chapter 8, "MIC in the Waste Treatment Industries," which state, "[m]icrobial influences can cause localized corrosion, often at rates one or more orders of magnitude greater than the expected general corrosion rates, for copper-based alloys, carbon steels, and stainless steels." There was no mention of aluminum alloys. ASM Handbook, Volume 13A, "Corrosion: Fundamentals, Testing, and Protection," Stephen D. Cramer, 2003, Section 58, "Microbiologically Influenced Corrosion," Stephen C. Dexter, University of Delaware, page 407 MIC of aluminum alloys is only cited for aircraft fuel tanks.
V.D1.E-405 V.D2.E-405	The air and condensation environments were deleted because the staff has concluded that managing cracking for stainless steel and aluminum materials exposed to air and condensation should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). Aluminum was removed as an applicable material because there are unique material and environment considerations for aluminum exposed to soil or concrete. These are discussed in SRP-SLR Section 3.2.2.2.8. Aluminum tanks exposed to soil or concrete are addressed in AMR item E-445. Although other stainless steel components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential cracking, the further evaluation section is not cited for this item because AMP XI.M29 recommends a similar approach of either periodic inspections or a one-time inspection based on plant-specific conditions. These inspections are capable of detecting loss of material.

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V.E.E-406	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air or condensation should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from this item, copper alloy (>15% Zn or >8% Al) would not have to be addressed in the further evaluation. The outdoor air environment was changed to air. Cracking due to stress corrosion cracking can occur on copper alloy (>15% Zn or >8% Al) surfaces due to the presence of ammonia-based compounds. These could be present in indoor air environments due to their presence in plant systems47. They could be conveyed to the surface of a copper alloy (>15% Zn or >8% Al) component via leakage through the insulation from bolted connections (e.g., flange joints, valve packing). AMP XI.M29 was deleted as an applicable AMP because with the deletion of stainless steel and aluminum, it is not anticipated that tanks within the scope of this program would be constructed of copper alloy (>15% Zn or >8% Al) material. AMP XI.M36 recommend periodic inspections that are capable of cracking, or following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component
V.D1.E-407	The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of AMP XI.M17 is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
V.D1.E-408	The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of AMP XI.M17 is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
V.A.E-414 V.B.E-414 V.C.E-414 V.D1.E-414 V.D2.E-414	Based on the review of several LRAs, the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. Lubricating oil was removed as a cited environment because the associated aging effects could be managed by A-414. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed

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	GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. The staff deleted cracking due to SCC as an aging effect, as cited in the version that was issued for public comment, based on an industry comment. The staff’s basis is documented in the response to industry comment No. 015-013.
V.A.E-415 V.B.E-415 V.C.E-415 V.D1.E-415 V.D2.E-415	Ductile iron was added as an applicable material. The staff’s basis for this change is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). Waste water was added as an environment. Waste water is addressed in AMP XI.M33 and should naturally be included in this AMR item.
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	The staff concluded that in contrast to GALL Report Revision 2, which states that there are no aging effects for aluminum components exposed to air-indoor uncontrolled, the staff has concluded that loss of material can occur when aluminum components are exposed to air or condensation when contaminants are present. Based on its review of “Corrosion of Aluminum and Aluminum Alloys,” J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. In addition, loss of material can occur in water environments that could potentially contain deleterious materials (e.g., raw water, ground water). The environment was revised to address internal environments only. The external environment is addressed in EP-114. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.2.2.2.10 for further details. Tanks were added because for the same material and environment, the aging effects and recommended AMP are the same. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
V.F.EP-4	The term “external” was removed from the environment description because it is immaterial whether the environment is on the inside or outside of the pipe. The GALL-SLR Report includes a greater emphasis on the potential for aging effects due to leakage of bolted joints than was included in GALL Report Revision 2. Revision 2 of the SRP-LR Section A.1.2.1 (7) states:

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	For example, abuse due to human activity is an abnormal event; aging effects from such abuse need not be postulated for license renewal. When a safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures (see Appendix B to 10 CFR Part 50) to ensure functionality of the equipment. The equipment degradation is not due to aging; corrective action is not necessary solely for the period of extended operation. However, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion. Thus, the aging effects from leakage of bolted connections should be evaluated for license renewal. As a result, the GALL-SLR Report Chapter IX.D terms “air,” “air-indoor controlled,” and “air-indoor uncontrolled,” include the statement, “The potential for leakage from bolted connections (e.g., flanges, packing) impacting in-scope components exists when citing the [cited air] environment.” The staff broadly applied this concept in items associated with stainless steel, aluminum, and nickel alloy components exposed to an air environment. The leakage could result in the introduction of halogens to the surface of the components. All of these items, with the exception of closure bolting, fire water storage tanks, components exposed to air with borated water leakage, and components exposed to air-dry, cite further evaluations. These do not cite further evaluations because: • Bolted connections are periodically inspected as recommended by AMP XI.M18. • Fire water storage tanks are periodically inspected as recommended by AMP XI.M27. • Aluminum, stainless steel, and nickel alloy components are not susceptible to loss of material in an air with borated water leakage environment. • The air-dry environment is a specific internal environment addressing components downstream of instrument air dryers. The GALL Report Revision 2 cites no aging effects for steel components exposed to the air-indoor controlled environment (e.g., EP-4, AP-2, SP-1). The basis for this is that this environment is humidity-controlled and therefore it is not expected that there will be sufficient moisture to result in loss of material for steel components. Likewise, the GALL-SLR Report states that there are no aging effects associated with steel exposed to the air-indoor controlled environment. However, if a steel component is in the vicinity of a bolted connection (e.g., flanges, packing joints) it could be exposed to moisture that could result in loss of material. It would then appear to be inconsistent that the GALL-SLR Report does not cite loss of material for steel components exposed to air-indoor controlled. The staff did not cite loss of material for steel piping exposed to air-indoor controlled because if leakage should occur onto steel components, the loss of material would be readily apparent as rust staining. The staff has concluded that there is reasonable assurance that a licensee

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
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	would address this loss of material in its corrective action program prior to a loss of intended function of the component. In contrast, loss of material for stainless steel, aluminum, and nickel alloy components would not be as readily apparent unless the inspections specifically cited the need to observe for pitting and crevice corrosion. For insulated components, the rust stains could be hidden; therefore, the GALL-SLR Report includes items to address corrosion under insulation (i.e., A-405a, E-403a, S-402a) regardless of the air environment.
V.F.EP-10	The staff concluded that copper alloys are not susceptible to loss of material when exposed to an air environment. The staff reviewed: (a) "Atmospheric Corrosion of Copper Alloys Exposed for 15 to 20 Years," L.P. Costos, ASTM International, 1982, which tested copper alloys in marine, industrial and rural environments; and (b) "General Localized and Stress Corrosion Resistance of Copper Alloys in Natural Atmospheres," A P. Castillo, ASTM International, 1982, which tested copper alloys in urban industrial (with some sea salt and road salt) and heavy industrial (with ammonia and sulfur dioxide) environments. The general loss of material rates (pitting was not a factor) ranged from 0.009 mils per year (mpy) to 0.09 mpy and 0.12 mpy to 0.14 mpy (in the latter study). These environments envelope what would be expected in a nuclear power plant air environment and the loss of material rates would not be expected to challenge the intended function of a copper alloy component. In light of the above basis, the environment was revised from air-indoor uncontrolled to air, condensation, or gas to allow for consolidation of items. The term "external" was removed from the description of the environment because in these environments, aging effects do not occur regardless of whether the environment is on the internal or external surface of the component.
V.F.EP-12	This item was revised to delete the original cited material, copper alloy (≤15% Zn and ≤8% Al). The term "copper alloy" implies that the zinc content is less than or equal to 15% and the aluminum content is less than or equal to 8%. GALL-SLR Chapter IX.C, "Use of Terms," was revised to reflect this convention. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy >8% Al is not susceptible to loss of material due to boric acid corrosion. In contrast, copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
V.F.EP-14	Piping and piping components were added to the component description because like for ducting, there is reasonable assurance that no aging effects that could impact an intended function would occur for galvanized piping and piping components exposed to air-indoor controlled. This is based on the minimal potential for the presence of moisture. See the discussion for item EP-4 associated with the potential for leakage from bolted connections. The term "external" was removed from the description of the environment because in an air-indoor controlled environment aging effects do not occur regardless of whether the air is on the internal or external surface of the component.
V.F.EP-15	The environment was changed to the more generic term "air" from air-indoor uncontrolled and the underground environment was added. The staff has concluded that based on historical evidence of the durability of glass, aging effects sufficient to result in a loss of intended function will not occur in any of these environments reasonably expected to be present at a nuclear facility.

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	The term "external" was removed from the description of the environment because in an air or underground environment aging effects do not occur regardless of whether the air is on the internal or external surface of the component.
V.F.EP-20	This item was editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 (i.e., ACI standards, OE) were relocated to the further evaluation section. A third proviso (a technical change) was added to the further evaluation, "the piping is not potentially exposed to groundwater." During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no AERM when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
V.A.EP-27 V.B.EP-27 V.D1.EP-27 V.D2.EP-27	Treated water was added to the list of environments based on the staff's review of LRA AMR items. AMP XI.M33 includes treated water as an applicable environment and provides recommendations for managing loss of material due to selective leaching for this material and environment combination.
V.F.EP-28	Although no changes were incorporated into this item, the staff elected to establish the basis for why flow blockage due to fouling is not addressed for glass piping elements exposed to raw water when it is for all other materials. As stated in GALL-SLR Chapter IX.B, the term "piping elements" apply only to components or portions of components made of glass (e.g., the glass portion of sight glasses and level indicators). The only source of fouling for glass elements would be upstream corrosion products or debris from the raw water source. This debris would be detected by plant staff if the glass element were to become blocked. Given this, the staff concluded that flow blockage due to fouling could be managed by routine observations of the glass component.
V.A.EP-37 V.B.EP-37 V.D1.EP-37 V.D2.EP-37	Treated water was added to the list of environments based on the staff's review of LRA AMR items. AMP XI.M33 includes treated water as an applicable environment and provides recommendations for managing loss of material due to selective leaching for this material and environment combination.
V.E.EP-38	Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy >8% Al is not susceptible to loss of material due to boric acid corrosion. In contrast, copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
V.A.EP-41 V.D1.EP-41	Heat exchanger components were added to the component description based on the staff's review of LRA AMR items. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." The staff noted that EPRI Report 1010639 states, "[t]here are many treated water systems such as the borated emergency core cooling systems in PWRs

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	that have not experienced MIC problems during the life of the plant. The potential for MIC contamination of these systems is highly unlikely and is not expected to be a concern during the license renewal period." However, given the potential for stagnant flow locations and a longer interval for exposing the component to potential contamination, the staff concluded that loss of material due to MIC should be managed.
V.A.EP-42 V.C.EP-42 V.D1.EP-42	The environment no longer cites "internal" because it is obvious that the aging effect is managed by an internally oriented AMP. The staff added items citing Table V.C., containment isolation components and Table D1, emergency core cooling system [pressurized water reactor (PWR)] because these systems could have encapsulated components.
V.A.EP-43 V.C.EP-43 V.D1.EP-43	The environment no longer cites "internal" because it is obvious that the aging effect is managed by an internally oriented AMP. The staff added items citing Table V.C., containment isolation components and Table D1, emergency core cooling system (PWR) because these systems could have encapsulated components.
V.D1.EP-52	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). Treated water was added to the list of environments based on the staff's review of LRA AMR items. AMP XI.M33 includes treated water as an applicable environment and provides recommendations for managing loss of material due to selective leaching for this material and environment combination.
V.B.EP-54 V.D1.EP-54 V.D2.EP-54	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090).
V.D1.EP-55	Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
V.B.EP-58	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The environment was changed to air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report Chapter IX.E. The environment no longer cites "internal" because it is obvious that the aging effects are managed by an internally oriented AMP.
V.B.EP-59	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item.

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	The environment was changed to air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report Chapter IX.D. The environment no longer cites "external" because it is obvious that the aging effects are managed by an externally oriented AMP.
V.D2.EP-60	Microbiologically influenced corrosion (MIC) was added based on a review of EPRI 1010639, Appendix A, "Treated Water," Section 3.1.7, "MIC," which states, MIC is not likely in treated water systems where sulfates and chlorides are low (<150 ppb). However, contamination of treated water systems can lead to MIC. One example of MIC in treated water components is torus damage at BWRs. Treated water systems typically are low in the nutrients required to sustain microorganisms, but in stagnant or low flowing areas, corrosion products and contaminants can accumulate and settle. The same contamination source for the microorganism could also allow introduction of the nutrients required to sustain these microbes. There are several sources of nutrients and microorganisms. Heat exchangers with treated water on one side and either raw water or lube oil on the other side have the potential for contamination if leakage exists for a considerable time period. In some cases the source of the treated water may have been contaminated, especially if the source is open to outdoor air or if there is inadequate control on makeup or other interfacing systems. Many emergency feedwater systems at PWRs are cross connected to the raw water system and contamination is possible during testing or inadvertent opening of valves. Maintenance of treated water system components can also result in contamination. Based on the potential for MIC to occur, the staff has concluded that it is appropriate to cite it as an aging mechanism.
V.D2.EP-61a V.D2.EP-61b V.D2.EP-61c V.D2.EP-61d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639 Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

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V.C.EP-62	The component description was changed from containment isolation piping and components to piping and piping components because there was nothing unique to containment penetration piping in the material, environment, aging effect, and AMP combination. The component description no longer cites "internal surfaces" because it is obvious that with the environment, treated water, and citing AMP XI.M2, the aging effect is associated with internal surfaces. MIC was added because it is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional information. The one-time visual inspections recommended by AMP XI.M32 are capable of detecting loss of material.
V.C.EP-63	The component description was changed from containment isolation piping and components to piping and piping components because there was nothing unique to containment penetration piping in the material, environment, aging effect, and AMP combination. The component description no longer cites "internal surfaces" because it is obvious that with the environments, treated water or treated borated water, and citing AMP XI.M2, the aging effect is associated with internal surfaces. Treated borated water was added as an environment because containment isolation components (GALL-SLR Report, Table V.C) can be exposed to treated water or treated borated water. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." The staff noted that EPRI 1010639 states, "[t]here are many treated water systems such as the borated emergency core cooling systems in PWRs that have not experienced MIC problems during the life of the plant. The potential for MIC contamination of these systems is highly unlikely and is not expected to be a concern during the license renewal period." However, given the potential for stagnant flow locations and a longer interval for exposing the component to potential contamination, the staff concluded that loss of material due to MIC should be managed.
V.F.EP-66	The term "(Internal/External)" was removed from the description of the environment because it is immaterial whether the environment is on the internal or external surfaces of the component.
V.D1.EP-71	Item EP-71 was revised to include an item citing GALL-SLR Report, Table D1, "Emergency Core Cooling System (PWR)," based on the staff's observations during audits. Treated borated water was included based on it being an applicable environment for PWR plants.
V.E.EP-72 V.D2.EP-72	Tanks were added to the component description because the same aging effects apply for nickel alloy components exposed to soil or concrete as for stainless steel components. MIC is known to potentially affect stainless steel and nickel alloy materials in a soil environment as cited in ASM Handbook Volume 13A, "Corrosion

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	Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water. Although other stainless steel and nickel alloy components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting loss of material. This item citing Table D2 was editorially deleted to cite a GALL-SLR Report, Table E, "External Surfaces of Components and Miscellaneous Bolting," item.
V.D2.EP-73	Heat exchanger components were added to the component description because the same aging effects apply for heat exchanger components exposed to treated water as for stainless steel piping and piping components. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." The staff noted that EPRI 1010639 states, "[t]here are many treated water systems such as the borated emergency core cooling systems in PWRs that have not experienced MIC problems during the life of the plant. The potential for MIC contamination of these systems is highly unlikely and is not expected to be a concern during the license renewal period." However, given the potential for stagnant flow locations and a longer interval for exposing the component to potential contamination, the staff concluded that loss of material due to MIC should be managed.
V.A.EP-76 V.D1.EP-76 V.D2.EP-76	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
V.A.EP-77 V.D1.EP-77 V.D2.EP-77	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.

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V.D1.EP-80	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
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	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.A.EP-90 V.D1.EP-90 V.D2.EP-90	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
V.A.EP-91 V.D1.EP-91 V.D2.EP-91	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual
V.A.EP-92 V.D1.EP-92 V.D2.EP-92	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information.
V.A.EP-93 V.D1.EP-93 V.D2.EP-93	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
V.A.EP-94 V.D1.EP-94 V.D2.EP-94	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information.
V.A.EP-95 V.C.EP-95 V.D1.EP-95 V.D2.EP-95	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
V.A.EP-97 V.B.EP-97 V.D1.EP-97 V.D2.EP-97	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. Galvanic corrosion is best managed by

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
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	design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information.
V.C.EP-99	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
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	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
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	Tanks were deleted from the component description because they are covered in items EP-81 and E-449. The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The EP-107c items citing Tables B, C, D1, and D2 cited AMP XI.M29. These items were deleted because tanks within the scope of AMP XI.M29 are addressed in other AMR items (see E-449 AMR items). The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.B.EP-111	The term "with coating or wrapping" was removed from the component description because AMP XI.M41 addresses steel piping regardless of whether it is coated or wrapped.

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.
V.F.EP-112	This item was editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 (i.e., ACI standards, OE) were relocated to the further evaluation section. A third proviso (a technical change) was added to the further evaluation, "the piping is not potentially exposed to groundwater." During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no AERM when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
V.D2.EP-113a V.D2.EP-113b	In the SRP-LR Revision 2, Section 3.2.2.2.5 recommended that an applicant establish a plant-specific AMP to address accelerated corrosion and fouling due to alternate wetting and drying of the drywell and suppression chamber system piping and piping components. Based on its review of NRC Information Notice 2013-06, "Corrosion in Fire Protection Piping Due to Air and Water Interaction," March 25, 2013, the staff concluded that flow blockage due to the accumulation of corrosion products principally occurs in normally dry periodically wetted piping system where the configuration of the piping does not provide complete drainage. As a result, the staff revised SRP-SLR Section 3.2.2.2.3 (renumbered from 3.2.2.2.5) to address: (a) the identification of portions of the system that are normally dry but periodically wetted; (b) the verification that plant-specific procedures exist to drain the normally dry wetted portions of the system; and (c) Whether the plant-specific configuration of the piping allows sufficient drainage to empty the normally dry pipe. With the above considerations, there is reasonable assurance that loss of material and flow blockage will not result in a loss of intended function if the results of a plant-specific search of OE and a one-time inspection do not reveal the aging effects. The staff cited metallic as the material for the orifice and nozzles to accommodate multiple material types. Flow blockage due to fouling is applicable for orifice and nozzle materials that would not be expected to

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	generate fouling products such as stainless steel because the predominate source of fouling products would be upstream piping that could generate sufficient fouling products, as discussed above. Condensation was added as an environment given the potential for residual moisture when the lines are drained. The two AMPs were selected as follows. If a search of plant-specific OE does not reveal aging effects, AMP XI.M32 will be adequate because there would have been sufficient time for loss of material to occur if it was going to occur sufficient to challenge the intended functions of the components. If either the search of plant-specific OE or the one-time inspection reveal aging effects that could affect the intended function of the components, the periodic inspections recommended by AMP XI.M38 are capable of detecting loss of material and flow blockage.
V.E.EP-114b V.E.EP-114c V.E.EP-114d	Based on its review of "Corrosion of Aluminum and Aluminum Alloys," J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.2.2.2.10 for further details. Tanks were added because for the same material and environment, the aging effects and recommended AMP are the same. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
V.E.EP-116	The material was changed to metallic because the potential for loss of preload is independent of the material. The term "any" environment includes submerged environments (e.g., raw water, waste water, fuel oil). GALL-SLR Report AMP XI.M18 was revised to include recommendations for managing loss of preload for bolting that is submerged (e.g., bolted components in a drain sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage. The soil and underground environments were added because as per the use of terms documented in GALL-SLR Chapter IX, soil and underground environments are not included in the environmental term, "any." The staff did not cite loss of preload as an applicable aging effect for closure bolting exposed to concrete because AMP XI.M41 recommends inspections for

Table 2-18 Changes to Existing GALL Report Revision 2 Chapter V AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	loss of material by inspecting the top and a portion of the sides of the cementitious material that is encasing the metallic components. The acceptance criterion states that there are no cracks that could admit groundwater to the surface of the component. In the absence of groundwater, there is reasonable assurance that no significant loss of material will occur for the closure bolting. In addition, the staff concluded that the surrounding concrete would restrain any gross movement of the flange if the shank of the closure bolting was degraded, thus minimizing the potential for leakage due to loss of preload.
V.E.EP-123	Stainless steel material was deleted from this item because the staff has concluded that loss of material for stainless steel components exposed to an air or condensation environment should be managed by a further evaluation item. See the basis for E-455. By deleting stainless steel, aging effects associated with steel components exposed to an underground environment would not be associated with a further evaluation item. The environment was revised from citing air-indoor uncontrolled or condensation to the underground environment. As described in the GALL-SLR Report Chapter IX.D, underground components are those that are located below grade, but are contained within a tunnel or vault such that they are in contact with air and are located where access for inspection is limited. In some instances, the air in a tunnel or vault could be considered to be air-outdoor in lieu of air–indoor uncontrolled or condensation.

Table 2-19 Changes to Existing GALL Report Revision 2 Chapter VI AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VI.A.LP-23	Clarified by removing fatigue from ohmic heating, thermal cycling, and electrical transients and separating these from chemical contamination, corrosion, and oxidation. Clarified further by adding a new aging management review (AMR) item (VI.A.L-07) that contains fatigue from ohmic heating, thermal cycling, and electrical transients.
VI.A.LP-24	Clarified potential aging effect/mechanism and whether an aging management program (AMP) is required depending on the location of the fuse holders in the actual plant environment.
VI.A.LP-32	Editorial clarifications and added new AMP XI.E7.
VI.A.LP-35a	The staff concluded that it is appropriate to provide additional guidance and clarifications by expanding AMP XI.E3 with three new AMPs based on the particular type of cables (medium voltage, Instrumentation and control, and low voltage power).
VI.A.LP-35b	The staff concluded that it is appropriate to provide additional guidance and clarifications by expanding AMP XI.E3 with three new AMPs based on the particular type of cables (medium voltage, Instrumentation and control, and low voltage power).
VI.A.LP-35c	The staff concluded that it is appropriate to provide additional guidance and clarifications by expanding AMP XI.E3 with three new AMPs based on the particular type of cables (medium voltage, Instrumentation and control, and low voltage power).
VI.A.LP-39	Change was made to standardize the Further Evaluation Recommended column of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).
VI.A.LP-46	Added All Aluminum Conductor, since these conductors are also not affected by corrosion.
VI.B.L-05	Added areas that could be subject to harsh environment to clarify environmental qualification (EQ) aspect of this time-limited aging analysis (TLAA).
VI.A.LP-31	Clarified fatigue by adding fuse removal.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
Page VII A3-1 Page VII A4-1 Page VII A5-1 Page VII C1-1 Page VII C2-1 Page VII C3-1 Page VII D-1 Page VII E1-1 Page VII E2-1 Page VII E3-1 Page VII E4-1 Page VII E5-1 Page VII G-1	The following phrase was deleted from each of the cited Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report pages: "They are also subject to replacement based on qualified life or a specified time period." This phrase appears in a paragraph under Systems, Structures, and Components. The phrase was associated with pump and valve internals. During the development of the GALL-SLR Report, the industry submitted a comment that these items are not necessarily subject to replacement based on a qualified or specified time period. The staff agreed with this comment and deleted the phrase. The cited pages retain the phrase, "Pump and valve internals perform their intended functions with moving parts or with a change in configuration." This statement provides an adequate basis for not subjecting the parts to aging management review.
Page VII J-1	The introduction to the Common Miscellaneous Material/Environment Combinations table was revised. The associated aging management review (AMR) item table states that there are no aging effects requiring management and no recommended aging management program (AMP). However, some of the components listed in the table could be within the scope of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, "Rules for Inspection and Testing of Components of Light-Water-Cooled Plants." The staff added, "With the exception of components within the scope of ASME Code Section XI," to the statement that no AMPs are required for the components in the Common Miscellaneous Material/Environment Combinations table. The aging effects associated with components within the scope of ASME Code Section XI are managed by AMPs such as AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The introduction to this table could have misled the user without this clarification.
VII.C1.A-47 VII.C3.A-47 VII.H2.A-47 VII.A3.A-56 VII.E1.A-103 VII.J.AP-13 VII.J.AP-18 VII.J.AP-22 VII.J.AP-6 VII.J.AP-9 VII.A4.AP-32 VII.C2.AP-32 VII.E3.AP-32 VII.E4.AP-32 VII.J.AP-37 VII.A3.AP-43 VII.A4.AP-43 VII.C2.AP-43 VII.E1.AP-43 VII.E3.AP-43 VII.E4.AP-43 VII.F1.AP-43 VII.F2.AP-43	Items for which piping elements was deleted, no other changes

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.F3.AP-43 VII.F4.AP-43 VII.H1.AP-43 VII.H2.AP-43 VII.H2.AP-104 VII.H2.AP-128 VII.C1.AP-138 VII.C2.AP-138 VII.E1.AP-138 VII.E4.AP-138 VII.G.AP-138 VII.H2.AP-138 VII.J.AP-160 VII.H2.AP-162 VII.I.AP-173 VII.I.AP-175 VII.C2.AP-186 VII.E3.AP-186 VII.E4.AP-186 VII.C2.AP-254 VII.H2.AP-255 VII.J.AP-260 VII.J.AP-268 VII.J.AP-277 VII.E5.AP-278 VII.E5.AP-279	
VII.C1.A-02 VII.C3.A-02 VII.G.A-02 VII.H1.A-02 VII.H2.A-02	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Supplemental Staff Guidance document issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090).
VII.I.A-03	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. The three cited environments represent those air-related environments to which it is expected that closure bolting could be exposed and aging effects would occur. Pitting and crevice corrosion were added as aging mechanisms because they are applicable to steel in an environment with moisture. Stainless steel and nickel alloy were added to provide a greater range of materials in the GALL-SLR Report. For stainless steel and nickel alloy items, Electric Power Research Institute (EPRI) Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, Figure 1, "External Surface Tool," states that these materials are susceptible to pitting and crevice corrosion in an aggressive environment (i.e., industrial, marine). As documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090), leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	In general, for stainless steel and nickel alloy components exposed to an air environment, the SRP-SLR recommends a further evaluation (e.g., Section 3.2.2.2.2). However, for closure bolting the staff is not recommending a further evaluation because AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of loss of material in closure bolting. The lack of leakage would provide reasonable assurance that the bolting has not experienced a consequential loss of material.
VII.I.A-04	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. The environment was revised to air, soil, and underground because these environments represent those to which it is expected that high-strength closure bolting could be exposed and stress corrosion cracking (SCC) could occur. In general, for SCC to occur in high-strength steel bolting, one of the parameters that is required to be present is an adverse environment. As documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090) leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting. Both the soil and underground environment can have contaminants based on potential exposure to ground water and the outdoor air environment. Cyclic loading could occur regardless of the environment. AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of closure bolting cracking. The lack of leakage would provide reasonable assurance that the bolting has not experienced consequential cracking.
VII.B.A-06	The component term was revised to “Cranes: bridges, structural members, and structural components” to be more descriptive of the components within the scope of the time-limited aging analysis (TLAA). The “scope of program” program element of AMP XI.M23 was revised to reflect the new term. The environment was changed to “any” because the potential for fatigue damage to steel structural girders is independent of the air environment. In addition, “external” was removed from the environmental term because the aging effect is managed by a TLAA.
VII.B.A-07	The component term was revised to “Cranes: rails, structural members, structural components” to be more descriptive of the components within the scope of this item. The environment was revised to air as an overall term. See GALL-SLR Report, Chapter IX.D, for the use of the general term “air.” In addition, “external” was removed from the environmental term because it is obvious that the aging effects are managed by an externally oriented AMP. Deformation and cracking were added to the aging effects because these aging effects are cited in American Society of Mechanical Engineers (ASME) Safety Standard B30.2, “Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)” Section 2-2.1.5, “Periodic Inspections.”

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.F1.A-08 VII.F2.A-08 VII.F3.A-08 VII.F4.A-08	“Internal” was removed from the environmental term because it is obvious that the aging effect is managed by an internally-oriented AMP.
VII.G.A-19	The environment was changed to air or condensation because the aging effects can occur regardless of the specific air environment. The aging effects occur due to thermal aging, exposure to ozone, oxidation, photolysis, and radiation. See GALL-SLR Report, Chapter IX.D. The aging mechanism was editorially revised to standardize terminology with GALL-SLR Report, Chapter IX for elastomer degradation.
VII.G.A-21	The environment was changed to air because wear to fire doors occurs regardless of the air environment.
VII.I.A-24	Item VII.H1.A-24 was editorially relocated to GALL-SLR Report, Chapter VII, Table I, “External Surfaces of Components and Miscellaneous Bolting,” because AMP XI.M36 is the cited AMP. The term “external” was removed from the environmental term because it is obvious that the aging effect is managed by an externally oriented AMP.
VII.D.A-26 VII.E5.A-26 VII.F1A-26 VII.F2.A-26 VII.F3.A-26 VII.F4.A-26 VII.H2.A-26	The term “compressed air system” was removed from the component description. The staff concluded that since the only cited GALL-SLR Report table for this item is Table D, “Compressed Air System,” removal of the information was editorial. Tanks were added to the material, environment, aging effect, and AMP combination to consolidate similar items (deletion of AP-280). The cited AMP was changed from GALL-SLR Report, AMP XI.M24, “Compressed Air Monitoring,” to AMP XI.M38 because the “scope of program” program element of AMP XI.M24 was revised to address aging effects of piping downstream of the compressed air system dryers. Components downstream of the instrument air dryers would not normally be exposed to condensation. Components upstream of the instrument air dryers could be exposed to condensation. AMP XI.M24 states that aging effects of upstream components are managed by AMP XI.M38.
VII.G.A-33	The staff added treated water and raw water (potable) based on license renewal application (LRA) reviews. It was noted that some units use these two water sources for their fire water systems. Flow blockage due to fouling was added as an aging effect requiring management (AERM) based on the staff’s review of industry operating experience (OE). Steel piping exposed to raw water or raw water (potable) is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. In particular for fire water systems, see further information in U.S. Nuclear Regulatory Commission (NRC) Information Notice 2013-06, “Corrosion in Fire Protection Piping Due to Air and Water Interaction,” March 25, 2013. Flow blockage due to fouling can be detected by the internal visual inspections recommended in GALL-SLR Report, AMP XI.M27.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in Generic Aging Lessons Learned (GALL) Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.E1.A-34 VII.E3.A-34	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
VII.G.A-47	The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. Copper alloy (>15% Zn or >8% Al) components are susceptible to loss of material due to selective leaching in all water environments.
VII.C2.A-50 VII.F3.A-50	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090).
VII.C1.A-51 VII.C3.A-51 VII.G.A-51 VII.H2.A-51	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems.
VII.C2.A-52	Microbiologically influenced corrosion (MIC) was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398–416, 2003.
VII.C3.A-53	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. In addition, EPRI 1010639, Figure 3, "Raw Water / Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys Tool," states that MIC is a concern if the pH is less than 10.5. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in GALL-SLR Report, AMP XI.M20.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Loss of material due to MIC and flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C1.A-54	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. In addition, EPRI 1010639 Figure 3, "Raw Water / Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys Tool," states that MIC is a concern if the pH is less than 10.5. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Loss of material due to MIC and flow blockage due to fouling can be detected by the internal visual inspections recommended in GALL-SLR, AMP XI.M20. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.G.A-55	The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect stainless steel materials in a treated water, raw water, or raw water (potable) environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-63 for additional detail. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Raw water (potable) and treated water were not included because the staff concluded that the potential for corrosion of upstream steel piping and the presence of fouling products is much reduced than that for raw water sources such as rivers, lakes, and oceans.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Loss of material due to MIC and flow blockage due to fouling can be detected by the internal visual inspections recommended in GALL-SLR Report, AMP XI.M27. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.E1.A-57	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
VII.E4.A-61	Four of the five changes to A-61 consisted of adding: (a) nickel alloy; (b) intergranular stress corrosion cracking (IGSCC); (c) the size limit of greater than or equal to 4 nominal pipe size (NPS); and (d) change of the temperature threshold. These changes were incorporated to make the item and AMP XI.M7 consistent. IGSCC is an appropriate aging mechanism. EPRI Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, Section 3.2.2, "Stress Corrosion Cracking," states that, "IGSCC is the predominate form of SCC in BWRs." Nickel alloy was added because IGSCC can affect nickel alloy as well as stainless steel. The fifth change was to not cite a further evaluation for this item. The staff's basis for these changes is documented in its response to industry comment No. 015-024.
VII.E3.A-62 VII.E4.A-62	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
VII.E1.A-69	This item had recommended that the AMP was to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading, such as including temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes. However, based on its review of many LRAs, the staff concluded that for most pressurized water reactor (PWR) plants, plant-specific OE did not reveal cracking in the nonregenerative heat exchangers. The staff revised SRP-SLR, Further Evaluation Section 3.3.2.2.2 to state that if a search of plant-specific OE does not reveal cracking, then cracking is adequately managed by AMP XI.M2. In most GALL-SLR Report items citing stainless steel components exposed to treated borated water >60°C (>140°F), AMP XI.M2 and AMP XI.M32 are recommended to manage cracking. The staff concluded that for this limited component set, it was not necessary to recommend AMP XI.M32 because the

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	review of plant-specific operating experience would have revealed whether cracking had occurred in non-regenerative after a significant operating period. If plant-specific OE does reveal cracking, then cracking is managed by item VII.E1.A-69a. See Table 2-5, "New AMR Items Added in GALL-SLR, Chapter VII," for the staff's basis for item VII.E1.A-69a.
VII.I.A-77	By including the condensation and air-outdoor environments, several AMR items were deleted. The condensation and air-outdoor environments were added because steel components are susceptible to loss of material in these environments. Pitting and crevice corrosion were added as aging mechanisms to be consistent with other similar items were steel components are potentially exposed to moisture.
VII.G.A-90	The environment was revised to air in lieu of air-indoor, uncontrolled because concrete will age in any air environment. The specific aging mechanisms will vary depending upon the specific air environment. For example, weathering would not be expected to occur in any indoor air environment. However, the use of the term "air" provides flexibility in citing this item for structural fire barriers, which can be exposed to many different air environments. The staff revised the aging mechanisms to align with terms described in: • Sections 21, "Cracking," and 2.2, "Distress," in ACI 201.1R-08, "Guide for Conducting a Visual Inspection of Concrete in Service." • Section 1.3, "Cracking of hardened concrete," in ACI 224.1R-07, "Causes, Evaluation, and Repair of Cracks in Concrete Structures." The visual inspections recommended in GALL-SLR Report, AMP XI.M26, can detect cracking and loss of material. These are the key inspection parameters to demonstrate that the component is capable of performing its intended function.
VII.A1.A-94	The term "external" was removed from the environmental term because it is obvious that the aging effect is managed by an externally oriented AMP.
VII.A2.A-98	LR-ISG-2011-01, "Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1," revised the GALL Report to include VII.A2.A-98. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." See the basis for EP-63 for additional information.
VII.A2.A-99	MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." See the basis for EP-63 for additional information.
VII.E1.A-100	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
VII.C1.A-400 VII.C3.A-400 VII.E5.A-400 VII.G.A-400	Treated water and raw water (potable) were added as environments for fire water systems. The staff noted that some applicants have modified their fire water systems to use treated water or raw water (potable) instead of raw water due to internal corrosion issues. However, unless a very rigorous campaign is conducted to eliminate all MIC sites, loss of material due to recurring internal corrosion can continue to occur.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.C3.A-401 VII.E5.A-401 VII.H1.A-401	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air (and raw water environments for aluminum) should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from these items, steel tanks would not have to be addressed in the further evaluation. Raw water was added as an applicable environment because loss of material is known to occur in steel exposed to raw water. Moist air was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. The basis for the deletion of the term "moist air" is documented in the staff's response to industry comment No. 015-006, part 4. The broader term "air" is cited instead of air-outdoor and air-indoor uncontrolled because the term "air" encompasses the other two terms and the staff concluded it was unlikely that tanks within the scope of GALL-SLR Report, AMP XI.M29 would be located in an air-indoor controlled environment. Consistent with other items in the GALL-SLR Report (e.g., EP-4, AP-2, SP-1), there are no recommended aging effects for steel components exposed to air-indoor controlled. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a soil or raw water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. However, MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material.
VII.G.A-403	Moist air was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. Condensation is sufficient to address the presence of moisture for this material and environment combination. In addition, the term "air," as described in GALL-SLR Report, Chapter IX.D, envelopes the previously cited terms "air-indoor controlled," "air-indoor uncontrolled," and air-outdoor. The staff clarified that MIC is only applicable in the raw water, raw water (potable), and treated water environments. Air and condensation environments would not potentially cause MIC. In the environments encountered at a commercial nuclear power station, MIC only occurs in fuel oil

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	environments for aluminum components. The staff reached this conclusion based on its review of the following: • A Practical Manual on Microbiologically Influenced Corrosion, Volume 2 (2nd Edition), John G Stoecker, NACE International, 2001, Chapter 7, "MIC in the Power Industry," and Chapter 8, "MIC in the Waste Treatment Industries," which state, "[m]icrobial influences can cause localized corrosion, often at rates one or more orders of magnitude greater than the expected general corrosion rates, for copper-based alloys, carbon steels, and stainless steels." There was no mention of aluminum alloys. • ASM Handbook, Volume 13A, "Corrosion: Fundamentals, Testing, and Protection," Stephen D. Cramer, 2003, Section 58, "Microbiologically Influenced Corrosion," Stephen C. Dexter, University of Delaware, page 407 MIC of aluminum alloys is only cited for aircraft fuel tanks. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.G.A-404	The term "air," as described in GALL-SLR Report, Chapter IX.D, envelopes the previously cited terms "air-indoor uncontrolled," and air-outdoor. Loss of material was disassociated from this item because it is addressed as follows: (a) steel in A-722 and AP-143; (b) stainless steel in AP-221; (c) aluminum in A-763; and (d) copper alloy in AP-144. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.I.A-405a	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air or condensation should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from this item, the remaining materials would not have to be addressed in the further evaluation. Copper alloy was deleted from this item because the staff has concluded that there are no aging effects requiring management for copper alloy components exposed to air or condensation. See the technical basis for this change to AP-144. The air-outdoor environment was replaced by the term "air." Steel components would not be expected to be susceptible to loss of material in an air-indoor controlled environment, which is encompassed within the term "air." However, given that these components are insulated, the steel material could be susceptible to corrosion under insulation as a result of leakage from bolted connection (flanges, packing) in the vicinity. GALL-SLR Report, AMP XI.M29 was deleted as a cited AMP and item A-405b was incorporated to specifically address tanks within the scope of AMP XI.M29. GALL-SLR Report, AMP XI.M36 recommend periodic inspections that are capable of detecting loss of material or cracking or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component. Subsequent to issuance of the SRP-SLR and GALL-SLR Report, the staff noted that "(steel only)" had been located following the term "general" instead of "loss of material." As written, the loss of material would apply to copper alloy (> 15% Zn or 8% Al). This is not the staff's intent. Insulated copper alloy (> 15% Zn or 8% Al) components are subject to cracking in this environment due to the potential for ammonia-based compounds to leach through the insulation onto the surface of the component. However, neither copper alloy nor copper alloy (> 15% Zn or 8% Al) insulated components are subject to loss of material in an air or condensation environment. The staff's position is reinforced by NACE SP0198-2010, "Control of Corrosion Under Thermal Insulation and Fireproofing Materials—A Systems Approach," which does not cite copper alloys as an applicable material.
VII.I.A-405b	See the discussion for A-405a. The aging effects associated with insulated portions of a tank can be effectively managed by either GALL-SLR Report, AMP XI.M29 or AMP XI.M36. The "detection of aging effects" program element of AMP XI.M36 allows the use of AMP XI.M29 to manage aging effects associated with insulated portions of a tank. Likewise, the "scope of program" program element of AMP XI.M29 allows the use of AMP XI.M36 to manage aging effects for tank surfaces that are fully visible. AMP XI.M29 and AMP XI.M36 recommend periodic inspections that are capable of detecting loss of material or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.I.A-406	The environment was revised to cite underground (originally cited in the component description for this item) instead of air-indoor uncontrolled or condensation. As described in GALL-SLR Report, Chapter IX D, the underground environment can also include raw water, ground water, and condensation. Change in color was deleted as an aging effect because the staff has concluded that it has no impact on the intended function of the component. The periodic visual inspections of underground components recommended by GALL-SLR Report, AMP XI.M41 are capable of detecting these aging effects.
VII.E1.A-407	During the development of LR-ISG-2012-01, "Wall Thinning Due to Erosion Mechanisms" and LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," A-407 was inadvertently used for two different material, environment, aging effect, and AMP combinations. Item A-407 cited in LR-ISG-2012-01 has been retained for issuance in the GALL-SLR Report. Item A-724 has been cited in place of the item originally cited as A-407 in LR-ISG-2012-02. The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of GALL-SLR Report, AMP XI.M17, is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
VII.E3.A-408	The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of GALL-SLR, AMP XI.M17 is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
VII.C1.A-409	The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of GALL-SLR, AMP XI.M17 is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
VII.E5.A-410	The term "internal and external" was removed from the environment description because "scope of program" program element of AMP XI.M36 states, "[f]or situations where the similarity of the internal and external environments are such that the external surface condition is representative of the internal surface condition, external inspections of components may be credited for managing: (a) loss of material and cracking of internal surfaces for metallic and cementitious components…"
VII.E5.A-411	The term "internal and external" was removed from the environment description because "scope of program" program element of GALL-SLR Report, AMP XI.M36 states, "[f]or situations where the similarity of the internal and external environments are such that the external surface condition is

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	representative of the internal surface condition, external inspections of components may be credited for managing: (a) loss of material and cracking of internal surfaces for metallic and cementitious components…"
VII.G.A-412	Stainless steel and aluminum have been deleted because they are now addressed in GALL-SLR Report, A-623, A-744, A-745, and A-747. Soil and concrete were added to the list of environments for completeness of all possible environments for fire water storage. GALL-SLR Report, AMP XI.M27 provides recommendations for managing aging effects for all surfaces (i.e., top, bottom, and sides) of fire water storage tanks. Moist air was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. Condensation is sufficient to address the presence of moisture for this material and environment combination. In addition, the term "air," as described in GALL-SLR Report, Chapter IX.D, envelopes the previously cited terms "air-indoor uncontrolled," and air-outdoor. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M27, by citing AMP XI.M29 for managing aging effects associated with the bottom surface of the tank exposed to soil or concrete, recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.C3.A-413 VII.E5.A-413 VII.H1.A-413	The treated borated water environment was deleted because the staff could not identify an auxiliary system in-scope tank that was located outdoors or was a large capacity tank with this environment. Treated water was retained for instances such as where an applicant credits a demineralized storage tank for inventory during a station blackout. Raw water and waste water were added to provide consistent GALL-SLR Report items for these environments. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect steel and stainless steel materials in a treated water, raw water, or waste water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416,

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	2003. See the basis for EP-60 for additional information for steel components and EP-63 for stainless steel components. In the environments encountered at a commercial nuclear power station, MIC only occurs in fuel oil environments for aluminum components. The staff reached this conclusion based on its review of the following: • A Practical Manual on Microbiologically Influenced Corrosion, Volume 2 (2nd Edition), John G Stoecker, NACE International, 2001, Chapter 7, "MIC in the Power Industry," and Chapter 8, "MIC in the Waste Treatment Industries," which state, "[m]icrobial influences can cause localized corrosion, often at rates one or more orders of magnitude greater than the expected general corrosion rates, for copper-based alloys, carbon steels, and stainless steels." There was no mention of aluminum alloys. • ASM Handbook, Volume 13A, "Corrosion: Fundamentals, Testing, and Protection," Stephen D. Cramer, 2003, Section 58, "Microbiologically Influenced Corrosion," Stephen C. Dexter, University of Delaware, page 407 MIC of aluminum alloys is only cited for aircraft fuel tanks. Although other AMR items (e.g., A-769) cite a further evaluation for aluminum components exposed to waste eater, the staff has concluded that the periodic examinations recommended in AMP XI.M29 can be sufficient to detect loss of material.
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	Based on the review of several LRAs, the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. Fuel oil, waste water, and raw water (potable) were added as environments based on reviews of LRAs. Raw water (potable) was specifically added for fire water systems, although this item could be used for other systems exposed to raw water (potable). Several applicants have had internal coated components in their fuel oil systems and might have coatings exposed to waste water. Treated borated water was removed because it could be addressed in E-414. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. The staff deleted cracking due to SCC as an aging effect, as cited in the version that was issued for public comment, based on an industry comment. The staff's basis is documented in the response to industry comment No. 015-013.

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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	Raw water (potable) was added as a result of a review of several LRAs. Some applicants are using raw water (potable) as a source for fire water systems. Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090). Waste water was added as an applicable environment because gray cast iron and ductile iron are susceptible to loss of material due to selective leaching in aqueous environments.
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	Based on the review of several LRAs, the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. Raw water (potable) was added as a result of a review of several LRAs. Some applicants are using raw water (potable) as a source for fire water systems. The aging effects associated with cementitious coatings were revised to cite loss of material and cracking in lieu of spalling because spalling is not the only aging effect that could occur for internal cementitious coatings.
VII.E5.A-724	During the development of LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," A-407 was inadvertently used for two different material, environment, aging effect, and AMP combinations. The A-407 used in LR-ISG-2012-02 has been designated as VII.E5.A-724. Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090).
VII.C1.A-727	During the development of LR-ISG-2012-02," Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," A-408 and A-409 were inadvertently used for different material, environment, aging effect, and AMP combinations. The A-408 and A-409 items used in LR-ISG-2012-02 has been consolidated into VII.C1.A-727. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and

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	recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment and intrusion of fouling products from the raw water source.
VII.J.AP-2	The term "external" was removed from the environment description because it is immaterial whether the environment is on the inside or outside of the pipe. The GALL-SLR Report includes a greater emphasis on the potential for aging effects due to leakage of bolted joints than was included in GALL Report Revision 2. SRP-SLR, Revision 2, Section A.1.2.1 (7) states: For example, abuse due to human activity is an abnormal event; aging effects from such abuse need not be postulated for license renewal. When a safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures (see Appendix B to 10 CFR Part 50 to ensure functionality of the equipment. The equipment degradation is not due to aging; corrective action is not necessary solely for the period of extended operation. However, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion. Thus, the aging effects from leakage of bolted connections should be evaluated for license renewal. As a result, the GALL-SLR Report, Chapter IX.D, terms "air," "air-indoor controlled," and "air-indoor uncontrolled," include the statement, "The potential for leakage from bolted connections (e.g., flanges, packing) impacting in-scope components exists when citing the [cited air] environment." The staff broadly applied this concept in items associated with stainless steel, aluminum, and nickel alloy components exposed to an air environment. The leakage could result in the introduction of halogens to the surface of the components. All of these items, with the exception of closure bolting, fire water storage tanks, components exposed to air with borated water leakage, and components exposed to air-dry, cite further evaluations. These do not cite further evaluations because: • Bolted connections are periodically inspected as recommended by GALL-SLR Report, AMP XI.M18. • Fire water storage tanks are periodically inspected as recommended by GALL-SLR Report, AMP XI.M27. • Aluminum, stainless steel, and nickel alloy components are not susceptible to loss of material in an air with borated water leakage environment.

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	• The air-dry environment is a specific internal environment addressing components downstream of instrument air dryers. The GALL Report Revision 2 cites no aging effects for steel components exposed to the air-indoor controlled environment (e.g., EP-4, AP-2, SP-1). The basis for this is that this environment is humidity-controlled and therefore it is not expected that there will be sufficient moisture to result in loss of material for steel components. Likewise, the GALL-SLR Report states that there are no aging effects associated with steel exposed to the air-indoor controlled environment. However, if a steel component is in the vicinity of a bolted connection (e.g., flanges, packing joints) it could be exposed to moisture that could result in loss of material. It would then appear to be inconsistent that the GALL-SLR Report does not cite loss of material for steel components exposed to air-indoor controlled. The staff did not cite loss of material for steel piping exposed to air-indoor controlled because if leakage should occur onto steel components, the loss of material would be readily apparent as rust staining. The staff has concluded that there is reasonable assurance that a licensee would address this loss of material in its corrective action program prior to a loss of intended function of the component. In contrast, loss of material for stainless steel, aluminum, and nickel alloy components would not be as readily apparent unless the inspections specifically cited the need to observe for pitting and crevice corrosion. For insulated components, the rust stains could be hidden; therefore, the GALL-SLR Report includes items to address corrosion under insulation (i.e., A-405a, E-403a, S-402a) regardless of the air environment.
VII.J.AP-11	This item was revised to delete the original cited material, copper alloy (≤15% Zn and ≤8% Al). The term "copper alloy" implies that the zinc content is less than or equal to 15% and the aluminum content is less than or equal to 8%. GALL-SLR Report, Chapter IX.C, "Use of Terms," was revised to reflect this convention. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy >8% Al is not susceptible to loss of material due to boric acid corrosion. In contrast, copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
VII.J.AP-14	The environment was changed from air-indoor uncontrolled (external) to underground. Item AP-48 (unchanged from GALL Report Revision 2) already cited the more general environment term, "air," which encompass the term "air-indoor uncontrolled" originally cited in this item. The term "underground," as cited in GALL-SLR Report, Chapter IX.D, is an encompassing term including environments expected to occur in underground vaults: air-outdoor, air-indoor uncontrolled, air, raw water, ground water, and condensation. The staff has concluded that based on historical evidence of the durability of glass, aging effects sufficient to result in a loss of intended function will not occur in any of these environments reasonably expected to be present at a nuclear facility. The term "external" was removed from the description of the environment because in an air or underground environment aging effects do not occur regardless of whether the air is on the internal or external surface of the component.

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VII.J.AP-19	This item was editorially revised to cite a Further Evaluation section in order to delete excessive detail from the GALL-SLR Report and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 [i.e., American Concrete Institute (ACI) standards, OE] were relocated to the further evaluation section. A third proviso (a technical change) was added to the further evaluation, "the piping is not potentially exposed to groundwater." During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no AERM when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
VII.A3.AP-31 VII.A4.AP-31 VII.C2.AP-31 VII.E1.AP-31 VII.E3.AP-31 VII.E4.AP-31 VII.F1.AP-31 VII.F2.AP-31 VII.F4.AP-31 VII.G.AP-31	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090).
VII.I.AP-40	The term "external" was removed from the environmental term because it is obvious that the aging effect is managed by an externally oriented AMP. Items citing Tables G and H2 were editorially consolidated to cite a single GALL-SLR Report, Table I, "Common Miscellaneous Material/Environment Combinations."
VII.I.AP-41	The term "external" was removed from the environmental term because it is obvious that the aging effect is managed by an externally oriented AMP. Items citing Tables F1, F2, F3, F4, G, and H2 were editorially consolidated to cite a single GALL-SLR Report, Table I, "Common Miscellaneous Material/Environment Combinations."
VII.J.AP-50	Although no changes were incorporated into this item, the staff elected to establish the basis for why flow blockage due to fouling is not addressed for glass piping elements exposed to raw water when it is for all other materials. As stated in GALL-SLR Report, Chapter IX.B, the term "piping elements" apply only to components or portions of components made of glass (e.g., the glass portion of sight glasses and level indicators). The only source of fouling for glass elements would be upstream corrosion products or debris from the raw water source. This debris would be detected by plant staff if the glass element were to become blocked. Given this, the staff concluded that flow blockage due to fouling could be managed by routine observations of the glass component.

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VII.H2.AP-55	Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in GALL-SLR Report, AMP XI.M20. This AMR item was editorially moved to SRP-SLR, item 3.3.1-40 because the material, environment, aging effect, and AMP was similar. This allowed for the deletion of item 3.3.1-41.
VII.I.AP-66	Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy >8% Al is not susceptible to loss of material due to boric acid corrosion. In contrast, copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
VII.C1.AP-75 VII.G.AP-75	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. GALL-SLR Report, AMR item AP-75 was revised to recommend that hardening or loss of strength due to elastomer degradation be managed by AMP XI.M38. The AMR item previously cited XI.M20, "Open-Cycle Cooling Water System." The staff concluded that rather than referring to AMP XI.M38 in AMP XI.M20, it is appropriate to directly cite AMP XI.M38 for this material, environment, and aging effect combination. AMP XI.M38 was revised to state that, "[a]ging effects associated with elastomers and flexible polymeric components installed in open-cycle cooling water, closed-cycle cooling water, ultimate heat sink, and fire water systems are managed by this program in lieu of…" AMP XI.M38 includes recommendations for managing hardening or loss of strength due to elastomer degradation. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. The staff concluded that there is reasonable assurance that components exposed to raw water (potable) and treated water would not be susceptible to flow blockage due to fouling because there is a low likelihood that there would be sufficient fouling products from these sources of water. As a result of the changes to AMP XI.M20, an item citing GALL-SLR Report, Table C1, "Open-Cycle Cooling Water System (Service Water System)," was added.
VII.C1.AP-76 VII.G.AP-76	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. Elastomeric components exposed to raw water, raw water (potable),

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	and treated water environments are subject to loss of material due to wear due to the potential presence of abrasive particles or flow velocity changes (for all water environments) where the configuration of the piping system causes perturbations in flow velocity. Air was added as an environment because loss of material due to wear can also occur in this environment. For example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Section IX.F). Wear can also occur due to abrasive particles in the air. The AMR item previously cited XI.M20, "Open-Cycle Cooling Water System." The staff concluded that rather than referring to AMP XI.M38 in AMP XI.M20, it is appropriate to directly cite AMP XI.M38 for this material, environment, and aging effect combination. AMP XI.M38 was revised to state that, "[a]ging effects associated with elastomers and flexible polymeric components installed in open-cycle cooling water, closed-cycle cooling water, ultimate heat sink, and fire water systems are managed by this program in lieu of…" AMP XI.M38 includes recommendations for managing these aging effects. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. The staff concluded that there is reasonable assurance that components exposed to raw water (potable) and treated water would not be susceptible to flow blockage due to fouling because there is a low likelihood that there would be sufficient fouling products from these sources of water. The mechanism was changed from erosion to wear to better align with the term "wear" in GALL-SLR Report, Section IX.F.
VII.A2.AP-79 VII.A3.AP-79 VII.E1.AP-79	LR-ISG-2011-01, "Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1" had revised this AMR item to state that loss of material due to pitting and crevice corrosion should be managed by AMP XI.M2 and AMP XI.M32. Nickel alloy was added because, given the environment, the same aging effects are applicable. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." See the basis for EP-63 for additional information.
VII.E1.AP-82	LR-ISG-2011-01, "Aging Management of Stainless Steel Structures and Components in Treated Borated Water, Revision 1" had revised the component description for VII.E1.AP-82 to state that primary oxygen levels are controlled. However, based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change and the citing of AMP XI.M32 is documented in the response to comment No. 015-007.

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VII.J.AP-97	The term "Internal/External" was removed from the description of the environment because in these environments, aging effects do not occur regardless of whether the environment is on the internal or external surface of the component.
VII.F1.AP-99a VII.F1.AP-99b VII.F1.AP-99c VII.F2.AP-99a VII.F2.AP-99b VII.F2.AP-99c VII.F2.AP-99a VII.F3.AP-99b VII.F3.AP-99c VII.F4.AP-99a VII.F4.AP-99b VII.F4.AP-99c	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."
VII.A3.AP-100	The component description was changed from elastomer linings to piping, piping components, and seals because aging effects associated with linings are now managed by AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."
VII.A4.AP-101	The component description was changed from elastomer linings to piping, piping components, and seals because aging effects associated with linings are now managed by AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."
VIII.I.AP-102	The component description was changed to piping, piping components, ducting, and ducting components and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The environment was changed to air or condensation in lieu of air-indoor uncontrolled because aging effects associated with elastomers exposed to air can be induced by thermal aging, exposure to ozone, oxidation, photolysis (due to ultraviolet light), and radiation. These environmental factors could be present in any air or condensation environment depending on the components location in the plant. See GALL-SLR, Chapter IX.D. The "internal/external" designation for the environment was deleted because AMP XI.M36 provides the option of monitoring for hardening or loss of strength by external inspections when the external environment is representative of the internal environment. The Table F1 through F4 items were deleted to consolidate items because citing a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables.
VIII.F1.AP-103 VIII.F2.AP-103 VIII.F3.AP-103 VIII.F4.AP-103	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The environment was changed to air in lieu of air-indoor uncontrolled because loss of material due to wear can be independent of the air environment. For

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	example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Section IX.F). Wear can also occur due to abrasive particles in the air. The raw water and waste water environments were also added because these environments can entrain particles that could cause wear. The condensation environment is predominantly linked with the air environment in GALL-SLR Report items. However, with the exception of items citing polymeric materials as a general material term, it is not cited along with the air environment for items citing loss of material due to wear (i.e., A-797, E-677, S-483). The staff has concluded that polymeric components exposed to condensation are not susceptible to loss of material due to wear because it is unlikely that there would be a high enough velocity to result in droplet impingement damage. Flow blockage can occur due to potential intrusion of fouling products from the raw water or waste water source. The term "internal" was removed from the environmental term because it is obvious that the aging effects are managed by an internally oriented AMP. The internal visual inspections recommended in AMP XI.M38 can be capable of detecting these aging effects.
VII.H1.AP-105 VII.H2.AP-105 VII.H1.AP-105a VII.H2.AP-105a	These items were split into two items based on a change to AMP XI.M30. The "detection of aging effects" program element states: For components constructed of the same material as the fuel oil storage tank, when the fuel oil storage tank is not coated on its internal surface, one-time inspections are not conducted. For components constructed of materials other than the fuel oil storage tank (when the tank is not internally coated), one-time inspections are not conducted when the SLR application states the basis for why water pooling or separation is not possible for a specific material type. As a result, based on the plant-specific configuration, one-time inspections might be or might not be conducted. The staff will review the applicant's documentation during an audit. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and

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	recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.E3.AP-106 VII.E4.AP-106	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398–416, 2003. See the basis for EP-60 for additional information.
VII.A4.AP-108	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 and EP-63 for additional information. General corrosion was added as an applicable aging mechanism after cladding degradation because, consistent with AP-106, steel exposed to treated water is subject to general corrosion.
VII.A4.AP-110 VII.E3.AP-110 VII.E4.AP-110	This AMR item was editorially realigned from SRP-SLR, item 3.3.1-25 to 3.3.1-203 in order to separate aluminum from stainless steel components. Based on a review of EPRI 1010639, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” Revision 4, Figure 1, “Treated Water / Stainless Steel and Nickel-Base Alloys,” the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff’s basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because, given the environment, the same aging effects are applicable. MIC was cited as an applicable aging mechanism based on the staff’s review of EPRI 1010639, Figure 1, “Treated Water / Stainless Steel and Nickel Alloys.” See the basis for EP-63 for additional information.
VII.A4.AP-111	This AMR item was editorially realigned from SRP-SLR, item 3.3.1-25 to 3.3.1-203 in order to separate aluminum from stainless steel components. Based on a review of EPRI 1010639, “Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools,” Revision 4, Figure 1, “Treated Water / Stainless Steel and Nickel-Base Alloys,” the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff’s basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because it has the same AERM and is cited in the further evaluation section.

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	MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys." See the basis for EP-63 for additional information.
VII.I.AP-113	The component description was changed to piping, piping components, ducting, ducting components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item. The environment cites air in lieu of specific air environments (e.g., air-indoor uncontrolled) because loss of material due to wear can be independent of the air environment. For example, wear can occur due to intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force (see GALL-SLR Report, Section IX.F). Wear can also occur due to abrasive particles in the air. In addition, "external" was removed from the environmental term because it is obvious that the aging effect is managed by an externally oriented AMP. The periodic visual inspections, accompanied by physical manipulation, recommended in GALL-SLR Report, AMP XI.M36, are sufficient to detect hardening or loss of strength due to elastomer degradation for this material and environment combination. The Tables F1 through F4 items were deleted to consolidate items because citing a single item associated with GALL-SLR Report, Table I, "External Surfaces of Components and Miscellaneous Bolting," envelopes the four tables.
VII.G.AP-116	This item no longer cites AMP XI.M39, because the oil in these components is leak-off from the reactor coolant pumps. It can become contaminated with dirt and water in its travel path to the oil collection tank(s). As a result, there is no need to manage lubricating oil quality with AMP XI.M39. The one-time inspections of AMP XI.M32 (after at least 50 years of operation) will be adequate to detect whether loss of material is occurring. MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC. Waste oil was added to the environment description in GALL-SLR Report, Chapter IX.D in order to differentiate the environment for this item from normal lubricating oil systems. These two environments [i.e., lubricating oil, lubricating oil (waste oil)] represent two distinct environments for one-time inspections.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.G.AP-117	This item no longer cites AMP XI.M39 because the oil in these components is leak-off from the reactor coolant pumps. It can become contaminated with dirt and water. As a result, there is no need to manage lubricating oil quality with AMP XI.M39. The one-time inspections of AMP XI.M32 (after at least 50 years of operation) will be adequate to detect whether loss of material is occurring. MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, “MIC,” states, “While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal.” The document further states, “In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems.” Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC. Waste oil was added to the environment description in GALL-SLR Report, Chapter IX.D, in order to differentiate the environment for this item from normal lubricating oil systems. These two environments [i.e., lubricating oil, lubricating oil (waste oil)] represent two distinct environments for one-time inspections.
VII.I.AP-124	The material was changed to metallic because the potential for loss of preload is independent of the material. The term “any” environment includes submerged environments (e.g., raw water, waste water, fuel oil). AMP XI.M18 was revised to include recommendations for managing loss of preload for bolting that is submerged (e.g., bolted components in a drain sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage. The soil and underground environments were added because as per the use of terms documented in GALL-SLR Report, Chapter IX, soil and underground environments are not included in the environmental term, “any.” The staff did not cite loss of preload as an applicable aging effect for closure bolting exposed to concrete because AMP XI.M41 recommends inspections for loss of material by inspecting the top and a portion of the sides of the cementitious material that is encasing the metallic components. The acceptance criterion states that there are no cracks that could admit groundwater to the surface of the component. In the absence of groundwater, there is reasonable assurance that no significant loss of material will occur for the closure bolting. In addition, the staff concluded that the surrounding concrete would restrain any gross movement of the flange if the shank of the closure bolting was degraded, thus minimizing the potential for leakage due to loss of preload.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
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	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
VII.G.AP-129 VII.H1.AP-129 VII.H2.AP-129 VII.G.AP-129a VII.H1.AP-129a VII.H2.AP-129a	These items were split into two items based on a change to GALL-SLR Report, AMP XI.M30. The "Detection of Aging Effects" program element states: For components constructed of the same material as the fuel oil storage tank, when the fuel oil storage tank is not coated on its internal surface, one-time inspections are not conducted. For components constructed of materials other than the fuel oil storage tank (when the tank is not internally coated), one-time inspections are not conducted when the SLR application states the basis for why water pooling or separation is not possible for a specific material type. As a result, based on the plant-specific configuration, one-time inspections might be or might not be conducted. The staff will review the applicant's documentation during an audit.
VII.A4.AP-130 VII.C2.AP-130 VII.E3.AP-130 VII.E4.AP-130 VII.H2.AP-130	PWR systems were added to this item because this material, environment, and aging effect combination could exist at a PWR.
VII.H2.AP-131	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.G.AP-132 VII.H1.AP-132 VII.H2.AP-132 VII.G.AP-132a VII.H1.AP-132a VII.H2.AP-132a	These items were split into two items based on a change to AMP XI.M30. The "Detection of Aging Effects" program element states: For components constructed of the same material as the fuel oil storage tank, when the fuel oil storage tank is not coated on its internal surface, one-time inspections are not conducted.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	For components constructed of materials other than the fuel oil storage tank (when the tank is not internally coated), one-time inspections are not conducted when the SLR application states the basis for why water pooling or separation is not possible for a specific material type. As a result, based on the plant-specific configuration, one-time inspections might be or might not be conducted. The staff will review the applicant's documentation during an audit.
VII.C1.AP-133 VII.C2.AP-133 VII.E1.AP-133 VII.E4.AP-133 VII.G.AP-133 VII.H2.AP-133	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
VII.G.AP-136 VII.H1.AP-136 VII.H2.AP-136 VII.G.AP-136a VII.H1.AP-136a VII.H2.AP-136a	These items were split into two items based on a change to AMP XI.M30. The "Detection of Aging Effects" program element states: For components constructed of the same material as the fuel oil storage tank, when the fuel oil storage tank is not coated on its internal surface, one-time inspections are not conducted. For components constructed of materials other than the fuel oil storage tank (when the tank is not internally coated), one-time inspections are not conducted when the SLR application states the basis for why water pooling or separation is not possible for a specific material type. As a result, based on the plant-specific configuration, one-time inspections might be or might not be conducted. The staff will review the applicant's documentation during an audit.
VII.I.AP-137	Nickel alloy was added because it has the same AERM and its incorporation provides a greater range of options for an applicant to cite a consistent item. MIC was added as an aging mechanism. Based on the staff's review of EPRI 1010639, Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," MIC is known to potentially affect stainless steel and nickel alloy materials. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Although other stainless steel and nickel alloy components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting loss of material. VII.C1.AP-137, VII.C3.AP-137, VII.G.AP-137, and VII.H1.AP-137 were editorially replaced by the new AMR item VII.I.AP-137.
VII.A4.AP-140 VII.E3.AP-140 VII.E4.AP-140	General corrosion was deleted as an aging mechanism. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to treated water. Although EPRI 1010639, Appendix A, "Treated Water," Section 3.1.1 states that copper alloys are susceptible to general corrosion in certain instances, it later clarifies that the faster rates of uniform thinning occur in oxidizing acids, sulfur-bearing compounds, ammonia, and cyanides. It continues by stating that copper corrosion rates are negligible in unpolluted air and water. MIC was added as an aging mechanism. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information.
VII.E2.AP-141	This AMR item was editorially realigned from SRP-SLR, items 3.3.1-25 to 3.3.1-203 in order to separate aluminum from stainless steel components. Based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because it has the same AERM and is cited in the further evaluation section. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys."
VII.G.AP-143	The staff deleted copper alloy as a material because it is not susceptible to loss of material in a condensation environment. See the staff discussion for AP-144. Steel was added as a material based on the review of several LRAs. The addition of this material provides flexibility in citing consistent AMR items.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The reference to AMP XI.M38 was deleted based on input from the industry. The use of an option to select between two AMPs is difficult to model in current databases. This item now only cites AMP XI.M27 because Table G in Chapter VII is associated with fire water systems.
VII.J.AP-144	The staff concluded that copper alloys are not susceptible to loss of material when exposed to an air environment. The staff reviewed: (a) "Atmospheric Corrosion of Copper Alloys Exposed for 15 to 20 Years," L. P. Costos, ASTM International, 1982, which tested copper alloys in marine, industrial and rural environments; and (b) "General Localized and Stress Corrosion Resistance of Copper Alloys in Natural Atmospheres," A. P. Castillo, ASTM International, 1982, which tested copper alloys in urban industrial (with some sea salt and road salt) and heavy industrial (with ammonia and sulfur dioxide) environments. The general loss of material rates (pitting was not a factor) ranged from 0.009 mils per year (mpy) to 0.09 mpy and 0.12 mpy to 0.14 mpy (in the latter study). These environments envelope what would be expected in a nuclear power plant air environment and the loss of material rates would not be expected to challenge the intended function of a copper alloy component. In light of the above basis, the environment was revised from air-indoor uncontrolled to air or condensation to allow for consolidation of items. The term "Internal/External" was removed from the description of the environment because in these environments, aging effects do not occur regardless of whether the environment is on the internal or external surface of the component.
VII.G.AP-149	The water environments were added to address the internal environment within fire hydrants. Most of the fire hydrant is periodically exposed to the water environment (i.e., when the hydrant is opened). Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Given that the periodic wetting and drying of the internal surfaces of the hydrant could result in loss of material, AMP XI.M27, Table XI.27-1 recommends periodic fire hydrant flushes conducted in accordance with National Fire Protection Association (NFPA)-25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems," Section 7.3.2. Although the flushes are designed to remove foreign material, it can also be used to demonstrate that there is adequate structural integrity to allow flow from the hydrant. The staff concluded that this is adequate because Section 7.3.2 also requires that the barrel of the hydrant be drained of water subsequent to the flushing procedure. As a result, for the majority of the time, then internal surfaces of the barrel will not be exposed to water that could promote accelerated loss of material.
VII.G.AP-150	The condensation and outdoor air environments were added because halon systems could be present in these environments. In addition, the same aging effect and AMP apply steel components exposed to these environments.
VII.C1.AP-152a VII.C1.AP-152b VII.C3.AP-152a VII.E4.AP-152a VII.H2.AP-152a	This item was revised to address titanium components without modifiers to a specific grade of titanium. This item would be used when plant-specific documentation does not include sufficient details to determine the specific grade of titanium. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12 are not

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. ASM Handbook Volume 13B, "Corrosion: Materials," 2005, page 256, states: "because of its protective oxide film, titanium exhibits anodic pitting potentials, Eb, that are very high (»1 V); thus, pitting corrosion is generally not of concern for titanium alloys." The staff also reviewed Uhlig's Corrosion Handbook, 3rd Edition. Page 866 which states "[e]xcellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 ° C. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such as metal ions, sulfides, sulfates, and carbonates." As a result, the staff did not identify loss of material as an aging effect for titanium components exposed to raw water. Heat exchanger components, regardless of the material type are subject to flow blockage due to fouling when the environment is raw water. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. The recommended periodic inspections in AMP XI.M20 and AMP XI.M38 are capable of detecting flow blockage.
VII.I.AP-157	The material description was revised to reflect a broader range of potentially cementitious piping material types. The staff revised the aging mechanisms to align with terms described in: • Sections 21, "Cracking," and 2.2, "Distress," in ACI 201.1R-08, "Guide for Conducting a Visual Inspection of Concrete in Service" and • Section 1.3, "Cracking of hardened concrete," in ACI 224.1R-07, "Causes, Evaluation, and Repair of Cracks in Concrete Structures." Changes in material property were deleted because the visual inspections of the recommended AMP would not be able to directly assess a change in material property. However, the visual inspections recommended in AMP XI.M41 can detect cracking and loss of material. These are the key inspection parameters to demonstrate that the component is capable of performing its intended function.
VII.C1.AP-161a VII.C1.AP-161b VII.C3.AP-161a VII.E4.AP-161a VII.H2.AP-161a	This item was revised to address titanium components without modifiers to a specific grade of titanium. This item would be used when plant-specific documentation does not include sufficient details to determine the specific grade of titanium. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12 are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. ASM Handbook Volume 13B, "Corrosion: Materials," 2005, page 256, states: "because of its protective oxide film, titanium exhibits anodic pitting potentials, Eb, that are very high (»1 V); thus, pitting corrosion is generally not of concern

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	for titanium alloys." The staff also reviewed Uhlig's Corrosion Handbook, 3rd Edition. Page 866 which states ""[e]xcellent resistance of titanium to general corrosion in seawater is obtained to temperatures well in excess of 250 ° C. This includes brackish, polluted, stagnant, aerated, or deaerated water containing contaminants such as metal ions, sulfides, sulfates, and carbonates." As a result, the staff did not identify loss of material as an aging effect for titanium components exposed to raw water. Piping and piping components, regardless of the material type are subject to flow blockage due to fouling when the environment is raw water. Flow blockage can occur due to potential intrusion of fouling products from the raw water source. The recommended periodic inspections in AMP XI.M20 and AMP XI.M38 are capable of detecting flow blockage.
VII.I.AP-171	Tanks were added to provide more components for which an applicant can cite a consistent AMR item and they are subject to the same aging effects as piping. The underground environment was added based on its inclusion in AMP XI.M41. Loss of material due to pitting and crevice corrosion could occur due to the potential for deleterious elements in the underground environment due to groundwater intrusion. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.
VII.I.AP-172	Tanks were added to provide more components for which an applicant can cite a consistent AMR item and they are subject to the same aging effects as piping. The underground environment was added based on its inclusion in AMP XI.M41. Loss of material due to pitting and crevice corrosion could occur due to the potential for deleterious elements in the underground environment due to groundwater intrusion. MIC was added as an aging mechanism in the soil environments only. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, "Corrosion: Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.I.AP-174	The staff concluded that copper alloys are not susceptible to loss of material unless exposed to a water environment. See the basis for EP-10 for further information. The staff recognizes that underground vaults can experience in-leakage from groundwater and rain. In addition, the soil environment is subject to groundwater. As a result, loss of material for copper alloy components is managed for the soil and underground environments.
VII.I.AP-176	Concrete was removed from the environment for VII.C1.AP-176 because the staff has concluded that unlike the soil environment where groundwater can be abundant, fiberglass components embedded in concrete will not be exposed to sufficient water to result in cracking, blistering, or loss of material. In addition, should water penetrate the concrete barrier and cause aging effects of the fiberglass piping, the concrete encapsulating the fiberglass provides reasonable assurance that the pressure boundary function of the piping will still be met. GALL-SLR Report, AMR item A-710 states that fiberglass components exposed to concrete have no AERM and no recommended AMP. A common AERM was developed for all fiberglass items. As a result, loss of material was added to the aging effects based on the staff's in-field observation of degrading fiberglass piping. In some items such as this one where the environment is soil, not all of the aging mechanisms apply (i.e., ultraviolet light, ozone, radiation). Change in color was deleted as an aging effect because the staff has concluded that it has no impact on the intended function of the component. These aging effects can be detected by the visual inspections recommended by AMP XI.M41.
VII.C1.AP-179	The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.G.AP-180	The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. The term “fouling that leads to corrosion” was deleted as an aging mechanism associated with “loss of material” based on the following. “Forms of Corrosion Recognition and Prevention,” Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for “fouling that leads to corrosion.” The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.
VII.E2.AP-181	Tanks were added to the component list in order to address the standby liquid control tanks at BWR plants. The one-time inspections recommended by AMP XI.M32 are capable of detecting this aging effect.
VII.C1.AP-183	The staff has removed galvanic corrosion as an aging mechanism from the AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information. The term “fouling that leads to corrosion” was deleted as an aging mechanism associated with “loss of material” based on the following. “Forms of Corrosion Recognition and Prevention,” Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for “fouling that leads to corrosion.” The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.C1.AP-187 VII.C3.AP-187 VII.G.AP-187 VII.H2.AP-187	Copper alloy and titanium were added to provide more materials for which an applicant can cite a consistent AMR item. AMP XI.M38 was added for fire protection components, Table G, because these components are not part of the ultimate heat sink; therefore, AMP XI.M20 would not be applicable. The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. Cracking due to SCC is cited as an applicable aging mechanism for titanium items that do not cite a specific grade of material. Titanium Grades 3, 4, or 5 are susceptible to cracking, see items A-795, E-475, or S-482. In contrast, titanium Grades 1, 2, 7, 9, 11, or 12 are not susceptible to cracking, see items A-766, E-459, or S-465. Given that for these items, a specific grade is not cited, cracking due to SCC has been cited as an applicable aging effect. Citing reduction of heat transfer due to fouling is consistent with GALL Report Revision 2, items AP-139, EP-74, SP-96, and SP-100.
VII.A3.AP-189 VII.A4.AP-189 VII.C2.AP-189 VII.E1.AP-189 VII.E3.AP-189 VII.E4.AP-189 VII.F1.AP-189 VII.F2.AP-189 VII.F3.AP-189 VII.F4.AP-189	The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
VII.E3.AP-191 VII.E4.AP-191	Pitting and crevice corrosion were added as aging mechanisms based on a review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys." The staff concluded that several factors affect pitting and crevice corrosion, including oxygen content, halide content, and the potential for stagnant flow.
VII.H2.AP-193	Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C1.AP-194 VII.C3.AP-194 VII.H2.AP-194	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C3.AP-195	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C1.AP-196	The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Copper alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.G.AP-197	The staff added treated water and raw water (potable) based on LRA reviews. It was noted that some units use these two water sources for their fire water systems. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Loss of material due to general corrosion can occur in copper piping exposed to raw water environments; predominantly due to the pH of the water. The lower the pH, the higher the rate of general corrosion. The staff concluded that for raw water (potable), the copper components could be susceptible to general corrosion because the chemistry parameters are not controlled or monitored. However, there is reasonable assurance that components exposed to raw water (potable) would not be susceptible to flow blockage due to fouling because: (a) general corrosion of copper alloy components would not produce sufficient quantities of corrosion products to block the pipe; and (b) there is a low likelihood that there would be sufficient fouling products from the raw water (potable) source.
VII.I.AP-198	The term "with coating or wrapping" was removed from the component description because AMP XI.M41 addresses steel piping regardless of whether it is coated or wrapped. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water. VII.C1.AP-198, VII.C3.AP-198, and VII.G.AP-198, VII.H1.AP-198 were editorially replaced by the new AMR item VII.I.AP-198.
VII.A3.AP-199 VII.A4.AP-199 VII.C2.AP-199 VII.E1.AP-199 VII.E3.AP-199 VII.E4.AP-199 VII.F1.AP-199 VII.F2.AP-199 VII.F3.AP-199 VII.F4.AP-199 VII.H1.AP-199 VII.H2.AP-199	General corrosion was deleted as an aging mechanism. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to closed-cycle cooling water. The staff reviewed EPRI 1007820, "Closed Cooling Water Chemistry Guidelines." This document includes tables for each type of chemical treatment program showing parameters monitored, acceptable ranges, monitoring frequencies, and action level ranges. All chemical treatment programs monitor pH. Most cite pH levels greater than 8.5 and below 11.0. The only exceptions are "pure water" systems (which cites >5.5 and <8.0) and "blended glycol" (which cites >7.5 and <11). The staff also reviewed Oilfield Water Technology, NACE International, 2006, Section 6.5, "Copper Alloys," page 94, which states, "In aerated water, if pH drops below about 5, copper alloys corrode. In deaerated water, even at low pH, corrosion resistance is good." Given the lower limit of a pH below 5, the chemistry controls for closed-cycle cooling water are sufficient to minimize the potential for general corrosion. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Fundamentals, Testing, and Protection,: Stephen C. Dexter, pages 398-416, 2003.
VII.C2.AP-202 VII.F1.AP-202 VII.F2.AP-202 VII.F3.AP-202 VII.F4.AP-202 VII.H2.AP-202	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
VII.E1.AP-203 VII.F1.AP-203 VII.F3.AP-203	General corrosion was deleted as an aging mechanism. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to closed-cycle cooling water. The staff reviewed EPRI 1007820, "Closed Cooling Water Chemistry Guidelines." This document includes tables for each type of chemical treatment program showing parameters monitored, acceptable ranges, monitoring frequencies, and action level ranges. All chemical treatment programs monitor pH. Most cite pH levels greater than 8.5 and below 11.0. The only exceptions are "pure water" systems (which cites >5.5 and <8.0) and "blended glycol" (which cites >7.5 and <11). The staff also reviewed Oilfield Water Technology, NACE International, 2006, Section 6.5, "Copper Alloys," page 94, which states, "In aerated water, if pH drops below about 5, copper alloys corrode. In deaerated water, even at low pH, corrosion resistance is good." Given the lower limit of a pH below 5, the chemistry controls for closed-cycle cooling water are sufficient to minimize the potential for general corrosion. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. Galvanic corrosion is best managed by design and maintenance activities. See GALL-SLR Report, Chapter IX.F for additional information. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
VII.C1.AP-206 VII.C3.AP-206	General corrosion was deleted based on a review of EPRI 1010639, Appendix B, "Raw Water," Section 3.1.1, "General Corrosion," which states, "[t]herefore for the purposes of this tool, general corrosion of stainless steels, nickel-base alloys, and titanium and titanium alloys will not be a significant aging mechanism since the dominant failure mode would be from local pitting (or crevice corrosion in the case of titanium) rather than from loss of wall thickness because of uniform general corrosion. MIC was added as an aging mechanism based on a review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys." The staff concluded that that temperature and pH can affect the potential for MIC in nickel-based alloys. In addition, EPRI 1010639 Figure 3, "Raw Water / Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys Tool," states that MIC is a concern if the pH is less than 10.5. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Nickel alloy piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C1.AP-209a VII.C2.AP-209a VII.C3.AP-209a VII.D.AP-209a VII.E1.AP-209a VII.E4.AP-209a VII.F1.AP-209a VII.F2.AP-209a VII.F3.AP-209a VII.F4.AP-209a VII.G.AP-209a VII.H1.AP-209a VII.H2.AP-209a VII.C1.AP-209b VII.C2.AP-209b VII.C3.AP-209b VII.D.AP-209b VII.E1.AP-209b VII.E4.AP-209b VII.F1.AP-209b VII.F2.AP-209b VII.F3.AP-209b VII.F4.AP-209b VII.G.AP-209b VII.H1.AP-209b VII.H2.AP-209b VII.C1.AP-209c VII.C2.AP-209c VII.C3.AP-209c VII.D.AP-209c VII.E1.AP-209c VII.E4.AP-209c VII.F1.AP-209c VII.F2.AP-209c VII.F3.AP-209c VII.F4.AP-209c VII.G.AP-209c VII.H1.AP-209c VII.H2.AP-209c VII.C1.AP-209d VII.C2.AP-209d VII.C3.AP-209d VII.D.AP-209d VII.E1.AP-209d VII.E4.AP-209d VII.F1.AP-209d VII.F2.AP-209d VII.F3.AP-209d VII.F4.AP-209d VII.G.AP-209d VII.H1.AP-209d	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.H2.AP-209d	
VII.C1.AP-221a VII.C2.AP-221a VII.C3.AP-221a VII.D.AP-221a VII.E1.AP-221a VII.E4.AP-221a VII.F1.AP-221a VII.F2.AP-221a VII.F3.AP-221a VII.F4.AP-221a VII.G.AP-221a VII.H1.AP-221a VII.H2.AP-221a VII.C1.AP-221b VII.C2.AP-221b VII.C3.AP-221b VII.D.AP-221b VII.E1.AP-221b VII.E4.AP-221b VII.F1.AP-221b VII.F2.AP-221b VII.F3.AP-221b VII.F4.AP-221b VII.G.AP-221b VII.H1.AP-221b VII.H2.AP-221b VII.C1.AP-221c VII.C2.AP-221c VII.C3.AP-221c VII.D.AP-221c VII.E1.AP-221c VII.E4.AP-221c VII.F1.AP-221c VII.F2.AP-221c VII.F3.AP-221c VII.F4.AP-221c VII.G.AP-221c VII.H1.AP-221c VII.H2.AP-221c VII.C1.AP-221d VII.C2.AP-221d VII.C3.AP-221d VII.D.AP-221d VII.E1.AP-221d VII.E4.AP-221d VII.F1.AP-221d VII.F2.AP-221d VII.F3.AP-221d VII.F4.AP-221d VII.G.AP-221d VII.H1.AP-221d VII.H2.AP-221d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090) and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.G.AP-234 VII.G.AP-234a	These items were split into two items based on a change to AMP XI.M30. The "detection of aging effects" program element states: • For components constructed of the same material as the fuel oil storage tank, when the fuel oil storage tank is not coated on its internal surface, one-time inspections are not conducted. • For components constructed of materials other than the fuel oil storage tank (when the tank is not internally coated), one-time inspections are not conducted when the SLR application states the basis for why water pooling or separation is not possible for a specific material type. As a result, based on the plant-specific configuration, one-time inspections might be or might not be conducted. The staff will review the applicant's documentation during an audit. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
VII.C1.AP-238	The term "internal" was removed from the environmental term because it is obvious that the aging effects are managed by an internally oriented AMP. A common AERM was developed for all fiberglass items. As a result, loss of material was added to the aging effects based on the staff's in-field observation of degrading fiberglass piping. In some items such as this one where the environment is raw water, not all of the aging mechanisms apply (i.e., ultraviolet light, ozone). Change in color was deleted as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Fiberglass piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. The aging effects can be detected by the internal visual inspections recommended in AMP XI.M20.
VII.C1.AP-239	The "internal" environment was removed because it is obvious that the aging effects are managed by an internally oriented AMP. Change in color was deleted as an aging effect because the staff has concluded that it has no impact on the intended function of the component. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. High density polyethylene (HDPE) piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. These aging effects can be detected by the internal visual inspections recommended in AMP XI.M20.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.I.AP-241	MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.
VII.I.AP-243	MIC was added as an aging mechanism in the soil environment only. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report, AMR items. MIC is known to potentially affect stainless steel and nickel alloy materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.
VII.C1.AP-250	The material description was revised to reflect a broader ranges of potentially cementitious piping material types. The staff revised the aging mechanisms to align with terms described in: • Sections 21, “Cracking,” and 2.2, “Distress,” in ACI 201.1R-08, “Guide for Conducting a Visual Inspection of Concrete in Service.” • Section 1.3, “Cracking of Hardened Concrete,” in ACI 224.1R-07, “Causes, Evaluation, and Repair of Cracks in Concrete Structures.” Changes in material property were deleted because the visual inspections of the recommended AMP would not be able to directly assess a change in material property. However, visual inspections can detect cracking and loss of material. These are the key inspection parameters to demonstrate that the component is capable of performing its intended function. Loss of material due to cavitation was added for the raw water environment because the periodic or continuous flow rates in raw water systems are capable of causing loss of material due to cavitation. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Cementitious piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.I.AP-253	The material description was revised to reflect a broader ranges of potentially cementitious piping material types. The staff revised the aging mechanisms to align with terms described in: • Sections 21, "Cracking," and 2.2, "Distress," in ACI 201.1R-08, "Guide for Conducting a Visual Inspection of Concrete in Service" and • Section 1.3, "Cracking of Hardened Concrete," in ACI 224.1R-07, "Causes, Evaluation, and Repair of Cracks in Concrete Structures." The visual inspections recommended in AMP XI.M26 can detect cracking and loss of material. These are the key inspection parameters to demonstrate that the component is capable of performing its intended function. Changes in material property were deleted because the visual inspections of the recommended AMP would not be able to directly assess a change in material property.
VII.C2.AP-259	The component description was changed to piping, piping components, and seals in lieu of seals and components to be more descriptive. For example, the revised term makes it clearer that items such as flexible hoses are included within the item.
VII.J.AP-269	GALL-SLR Report, AMR item AP-269 was revised to include the raw water (potable) and raw water environments. The staff concluded that there are no aging effects requiring management and no recommended AMP based on the following sources. The PVC Pipe – Design and Installation – Manual of Water Supply Practices, M23, American Water Works Association, 2nd Edition , 2002, states, "PVC and PVCO pipes are resistant to almost all types of corrosion- both chemical and electrochemical-that are experienced in underground piping systems. Because polyvinyl chloride (PVC) is a nonconductor, galvanic and electrochemical effects are nonexistent in PVC piping systems. PVC pipe cannot be damaged by aggressive waters or corrosive soils." It also states, "PVC pipe is nearly totally resistant to biological attack. Biological attack can be described as degradation or deterioration caused by the action of living microorganisms or macroorganisms." It further states that, "PVC pipe is well suited to applications where abrasive conditions are anticipated." Appendix A, Chemical Resistance tables of this document lists PVC as generally resistant to chemicals up to 60 °C [140 °F], such as bleach (12.5% active chlorine), potassium hydroxide, sodium hydroxide, kerosene, hydrochloric acid, hydrogen peroxide (90%), sea water, soaps, and sulfuric acid (70%). The staff also noted that "PVC Formulary," G Wypych, Chem Tec Publishing, 2009 states, "[a]s a general rule, PVC is not resistant to polar solvents but very resistant to acids, bases, salts, alcohols, esters, and hydrocarbons." The term "internal" was removed from the environmental term because it is obvious that there are no aging effects regardless of whether the environment is on the inside or outside of the component. As issued for public comment, this item cited the waste water environment. The staff deleted the waste water environment because it is addressed in new item VII.E5.A-787c. Item A-787c addresses PVC piping exposed to waste

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	water because it is susceptible to loss of material and flow blockage due potential particles in the waste water flow stream.
VII.E5.AP-270	Flow blockage due to fouling was added as an applicable AERM for steel components. Although raw water (potable) is treated in order to allow for human consumption, the condition of the water could promote sufficient loss of material to result in flow blockage due to corrosion products. Flow blockage due to fouling was not cited for stainless steel components because general corrosion is not an applicable aging mechanism and raw water (potable), unlike raw water, is not anticipated to result in intrusion of fouling products from the water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M38. The staff noted that the raw water (potable) environment would probably not be present in GALL-SLR Report, Table E5, "Waste Water Systems;" however, there is no better applicable system table and this is not a change from GALL Report Revision 2.
VII.E5.AP-271	General corrosion was added to the list of aging mechanisms to be consistent with other GALL Report, Revision 2 items. While the staff concluded that copper alloys exposed to air, gas, and condensation environments have no aging effects requiring management (see the basis for item AP-144), loss of material due to exposure to raw water (potable) environments should be managed due to unknown chemistry parameters (e.g., pH) in the water supply. MIC was added as an applicable aging mechanism to be consistent with other existing GALL-SLR Report AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff noted that the raw water (potable) environment would probably not be present in GALL-SLR Report, Table E5, "Waste Water Systems;" however, there is no better applicable system table and this is not a change from GALL Report, Revision 2.
VII.E5.AP-272	Heat exchanger components were added because given the material and environment, the aging effects are the same. General corrosion was added to the list of aging mechanisms to be consistent with other GALL Report, Revision 2 items. While the staff concluded that copper alloys exposed to air, gas, and condensation environments have no aging effects requiring management (see the basis for item AP-144), loss of material due to exposure to waste water environments should be managed due to unknown chemistry parameters (e.g., pH) in the water supply. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report, AMR items. MIC is known to potentially affect copper alloy materials as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection, Stephen C. Dexter, pages 398-416, 2003. Flow blockage can occur due to potential intrusion of fouling products from the waste water source.

Table 2-20 Changes to Existing GALL Report Revision 2 Chapter VII AMR Items Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VII.E5.AP-275 VII.E5.AP-276 VII.E5.AP-278 VII.E5.AP-279	Flow blockage was added because it can occur due to potential intrusion of fouling products from the waste water source. The internal visual inspections recommended by AMP XI.M38 are capable of detecting flow blockage.
VII.E5.AP-281	Heat exchanger components were added to provide more components for which an applicant can cite a consistent AMR item. Flow blockage can occur due to potential intrusion of fouling products from the waste water source.
VII.J.AP-282	This item was editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR Report and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 (i.e., ACI standards, OE) were relocated to the further evaluation section. A third proviso (a technical change) was added to the further evaluation, “the piping is not potentially exposed to groundwater.” During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no AERM when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
VII.E3.AP-283	The term “outboard the second containment isolation valves with a diameter ≥4 inches nominal pipe size” was added to the component description to better align the AMR item with AMP XI.M25. The temperature limit was changed from >60 °C [>140 °F] to >93 °C [>200 °F] to align with AMP XI.M25, “BWR Reactor Water Cleanup System.”
VII.I.AP-284	Stainless steel, copper alloy, and aluminum components were removed as cited materials. The staff has concluded that managing loss of material for stainless steel and aluminum materials exposed to an underground environment should be addressed as further evaluations. See AMR items A-741 and A-775. Copper alloy components are addressed in AP-174.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
Page VIII A-1 Page VIII B1-1 Page VIII B2-1 Page VIII C-1 Page VIII D1-1 Page VIII D2-1 Page VIII E-1 Page VIII F-1	The following phrase was deleted from each of the cited Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report pages: "They are also subject to replacement based on qualified life or a specified time period." This phrase appears in a paragraph under Systems, Structures and Components. The phrase was associated with pump and valve internals. During the development of the GALL-SLR Report, the industry submitted a comment that these items are not necessarily subject to replacement based on a qualified or specified time period. The staff agreed with this comment and deleted the phrase. The cited pages retain the phrase, "Pump and valve internals perform their intended functions with moving parts or with a change in configuration." This statement provides an adequate basis for not subjecting the parts to aging management review.
Page VIII I-1	The introduction to the Common Miscellaneous Material/Environment Combinations table was revised. The associated aging management review (AMR) item table states that there are no aging effects requiring management and no recommended aging management program (AMP). However, some of the components listed in the table could be within the scope of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, "Rules for Inspection and Testing of Components of Light-Water-Cooled Plants." The staff added, "With the exception of components within the scope of ASME Section XI," to the statement that no AMPs are required for the components in the Common Miscellaneous Material/Environment Combinations table. The aging effects associated with components within the scope of ASME Section XI are managed by AMPs such as AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." The introduction to this table could have misled the user without this clarification.
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 VIII.I.SP-4 VIII.I.SP-15 VIII.I.SP-23 VIII.E.SP-29 VIII.F.SP-29 VIII.G.SP-29 VIII.A.SP-30 VIII.E.SP-30 VIII.F.SP-30 VIII.G.SP-30 VIII.E.SP-54 VIII.F.SP-54 VIII.G.SP-54 VIII.E.SP-55	Items for which piping elements was deleted, no other changes

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VIII.F.SP-55 VIII.G.SP-55 VIII.A.SP-71 VIII.B1.SP-71 VIII.C.SP-71 VIII.B1.SP-88 VIII.C.SP-88 VIII.D1.SP-88 VIII.E.SP-88 VIII.F.SP-88 VIII.G.SP-88 VIII.A.SP-95 VIII.D1.SP-95 VIII.D2.SP-95 VIII.E.SP-95 VIII.G.SP-95 VIII.A.SP-98 VIII.B1SP-98 VIII.B2.SP-98 VIII.G.SP-114 VIII.I.SP-148 VIII.I.SP-152 VIII.A.SP-155 VIII.B1.SP-155 VIII.B2.SP-155 VIII.B1.SP-157 VIII.B2.SP-160	
VIII.H.S-02	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. The three cited environments represent those air-related environments to which it is expected that closure bolting could be exposed and aging effects would occur. Pitting and crevice corrosion were added as aging mechanisms because they are applicable to steel in an environment with moisture. Stainless steel and nickel alloy were added to provide a greater range of materials in the GALL-SLR Report. For stainless steel and nickel alloy items, Electric Power Research Institute (EPRI) Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4, Figure 1, "External Surface Tool," states that these materials are susceptible to pitting and crevice corrosion in an aggressive environment (i.e., industrial, marine). As documented in the GALL-SLR Report and Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Supplemental Staff Guidance document issued on March 29, 2016, Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090), leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting. In general, for stainless steel and nickel alloy components exposed to an air environment, the SRP-SLR recommends a further evaluation (e.g., Section 3.2.2.2.2). However, for closure bolting the staff is not

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	recommending a further evaluation because AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of loss of material in closure bolting. The lack of leakage would provide reasonable assurance that the bolting has not experienced a consequential loss of material.
VIII.H.S-03	The environment was revised because air with steam or water leakage was deleted from GALL-SLR Report, Chapter IX, when the staff and industry consolidated the number of air-related terms. The environment was revised to air, soil, and underground because these environments represent those to which it is expected that high-strength closure bolting could be exposed and stress corrosion cracking (SCC) could occur. In general, for SCC to occur in high-strength steel bolting, one of the parameters that is required to be present is an adverse environment. As documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090), leakage from mechanical connections (e.g., flanges, valve packing) can result in an adverse environment on the surfaces of components if the water transports deleterious compounds to the surface of the closure bolting. Both the soil and underground environment can have contaminants based on potential exposure to ground water and the outdoor air environment. Cyclic loading could occur regardless of the environment. AMP XI.M18 recommends periodic visual inspections to detect leakage at all flanged joints. Leakage could be potentially indicative of closure bolting cracking. The lack of leakage would provide reasonable assurance that the bolting has not experienced consequential cracking.
VIII.B1.S-08 VIII.B2.S-08 VIII.D1.S-11 VIII.D2.S-11 VIII.G.S-11	The environment was changed to any environment because fatigue can occur regardless of a specific environment.
VIII.A.S-23 VIII.E.S-23 VIII.F.S-23 VIII.G.S-23	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings and (e) sacrificial anodes.
VIII.E.S-25 VIII.F.S-25 VIII.G.S-25	Microbiologically influenced corrosion (MIC) was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect stainless steel materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VIII.H.S-29	Air-outdoor and condensation were added to allow consolidation of items (e.g., deletion of S-41 and S-42). Pitting and crevice corrosion were added as aging mechanisms to be consistent with other steel items exposed to outdoor air.
VIII.A.S-400a VIII.E.S-400a VIII.F.S-400a VIII.G.S-400a VIII.A.S-400b VIII.D1.S-400b VIII.D2.S-400b VIII.E.S-400b VIII.F.S-400b VIII.G.S-400b	The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items." The staff did not cite AMP XI.M29 for tanks even though the tank could be within the scope because the use of AMP XI.M38 could be adequate when enhanced to address recurring internal corrosion.
VIII.E.S-401 VIII.F.S-401 VIII.G.S-401	Based on the review of several license renewal applications (LRAs), the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. Treated borated water was deleted from the environment list given the low probability that it would be an applicable environment in the condensate, blowdown, or auxiliary feedwater systems. The aging effects associated with cementitious coatings were revised to cite loss of material and cracking in lieu of spalling because spalling is not the only aging effect that could occur for internal cementitious coatings.
VIII.H.S-402a	Stainless steel and aluminum were deleted as applicable materials because the staff has concluded that managing loss of material and cracking for stainless steel and aluminum materials exposed to air or condensation should be addressed as further evaluation items. These further evaluation items are addressed in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090). By deleting stainless steel and aluminum from this item, the remaining materials would not have to be addressed in the further evaluation. Copper alloy was deleted from this item because the staff has concluded that there are no aging effects requiring management for copper alloy components exposed to air or condensation. See the technical basis for this change to AP-144. The air-outdoor environment was replaced by the term "air." Steel components would not be expected to be susceptible to loss of material in an air-indoor controlled environment, which is encompassed within the term "air." However, given that these components are insulated, the steel material could be susceptible to corrosion under insulation as a result of leakage from bolted connection (flanges, packing) in the vicinity. AMP XI.M29 was deleted as a cited AMP and item S-402b was incorporated to specifically address tanks within the scope of AMP XI.M29. AMP XI.M36 recommends periodic inspections that are capable of detecting loss of material or cracking or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	Subsequent to issuance of the SRP-SLR and GALL-SLR Report, the staff noted that "(steel only)" had been located following the term "general" instead of "loss of material." As written, the loss of material would apply to copper alloy (> 15% Zn or 8% Al). This is not the staff's intent. Insulated copper alloy (> 15% Zn or 8% Al) components are subject to cracking in this environment due to the potential for ammonia-based compounds to leach through the insulation onto the surface of the component. However, neither copper alloy nor copper alloy (> 15% Zn or 8% Al) insulated components are subject to loss of material in an air or condensation environment. The staff's position is reinforced by NACE SP0198-2010, "Control of Corrosion Under Thermal Insulation and Fireproofing Materials—A Systems Approach," which does not cite copper alloys as an applicable material.
VIII.H.S-402b	See the discussion for S-402a. The aging effects associated with Insulated portions of a tank can be effectively managed by either AMP XI.M29 or AMP XI.M36. The "detection of aging effects" program element of AMP XI.M36 allows the use of AMP XI.M29 to manage aging effects associated with insulated portions of a tank. Likewise, the "scope of program" program element of AMP XI.M29 allows the use of AMP XI.M36 to manage aging effects for tank surfaces that are fully visible. AMP XI.M29 recommends periodic inspections that are capable of detecting loss of material or, following initial acceptable inspections, evidence of jacketing degradation that could admit moisture to the surface of the component.
VIII.H.S-403	Non-metallic thermal insulation exposed to an air or condensation environment was initially added in GALL Report Revision 2, Chapter VIII by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation." The previously cited materials (calcium silicate, fiberglass, and foamglass®) were consolidated into "any" type of non-metallic thermal insulation. Metallic thermal insulation is not included because insufficient moisture could accumulate to significantly adversely affect thermal insulation resistance.
VIII.E.S-405 VIII.G.S-405	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel and stainless steel materials in a treated water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional information for steel materials and EP-63 for stainless steel materials. In the environments encountered at a commercial nuclear power station, MIC only occurs in fuel oil environments for aluminum components. The staff reached this conclusion based on its review of the following: A Practical Manual on Microbiologically Influenced Corrosion, Volume 2 (2nd Edition), John G. Stoecker, NACE International, 2001, Chapter 7, "MIC in the Power Industry," and Chapter 8, "MIC in the Waste Treatment Industries," which state, "[m]icrobial influences can cause localized corrosion, often at rates one or more orders of magnitude greater than the expected general

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	corrosion rates, for copper-based alloys, carbon steels, and stainless steels." There was no mention of aluminum alloys. ASM Handbook, Volume 13A, "Corrosion: Fundamentals, Testing, and Protection," Stephen D. Cramer, 2003, Section 58, "Microbiologically Influenced Corrosion," Stephen C. Dexter, University of Delaware, page 407 MIC of aluminum alloys is only cited for aircraft fuel tanks.
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	The steam environment was added because steam flow can result in loss of material due to erosion and the steam turbine, main steam, and extraction steam systems (Tables A, B1, B2, and C) are included within the scope of GALL-SLR Report, Chapter VIII. The staff recognizes that, depending on the quality of the steam in the main steam system, it might be possible to justify not managing loss of material due to erosion for this system. The material was changed to metallic from any for two reasons. First, the "parameters monitored or inspected" program element of AMP XI.M17 is based on conducting wall thickness measurements. Non-metallic materials do not lend themselves to external wall thickness measurements. Second, all metallic materials were included because as stated in AMP XI.M17, "there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms."
VIII.E.S-414 VIII.F.S-414 VIII.G.S-414	Based on the review of several LRAs, the staff changed the cited material from metallic to any material. Some applicants have internally lined cementitious piping. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states "that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. The staff deleted cracking due to SCC as an aging effect, as cited in the version that was issued for public comment, based on an industry comment. The staff's basis is documented in the response to industry comment No. 015-013.
VIII.E.S-415 VIII.F.S-415 VIII.G.S-415	Ductile iron was added as an applicable material. The staff's basis for this change is documented in the SLR Supplement issued on March 29, 2016 (ADAMS Accession No. ML16041A090). Waste water was added as an applicable environment because selective leaching can occur in this environment.
VIII.I.SP-1	The term "external" was removed from the environment description because it is immaterial whether the environment is on the inside or outside of the pipe.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The GALL-SLR Report includes a greater emphasis on the potential for aging effects due to leakage of bolted joints than was included in GALL Report Revision 2. Revision 2 of the SRP-LR Section A.1.2.1 (7) states: For example, abuse due to human activity is an abnormal event; aging effects from such abuse need not be postulated for license renewal. When a safety-significant piece of equipment is accidentally damaged by a licensee, the licensee is required to take immediate corrective action under existing procedures (see Appendix B to 10 CFR Part 50) to ensure functionality of the equipment. The equipment degradation is not due to aging; corrective action is not necessary solely for the period of extended operation. However, leakage from bolted connections should not be considered as abnormal events. Although bolted connections are not supposed to leak, experience shows that leaks do occur, and the leakage could cause corrosion. Thus, the aging effects from leakage of bolted connections should be evaluated for license renewal. As a result, the GALL-SLR Report, Chapter IX.D, terms “air,” “air-indoor controlled,” and “air-indoor uncontrolled,” include the statement, “The potential for leakage from bolted connections (e.g., flanges, packing) impacting in-scope components exists when citing the [cited air] environment.” The staff broadly applied this concept in items associated with stainless steel, aluminum, and nickel alloy components exposed to an air environment. The leakage could result in the introduction of halogens to the surface of the components. All of these items, with the exception of closure bolting, fire water storage tanks, components exposed to air with borated water leakage, and components exposed to air-dry, cite further evaluations. These do not cite further evaluations because: • Bolted connections are periodically inspected as recommended by AMP XI.M18. • Fire water storage tanks are periodically inspected as recommended by AMP XI.M27. • Aluminum, stainless steel, and nickel alloy components are not susceptible to loss of material in an air with borated water leakage environment. • The air-dry environment is a specific internal environment addressing components downstream of instrument air dryers. The GALL Report, Revision 2, cites no aging effects for steel components exposed to the air-indoor controlled environment (e.g., EP-4, AP-2, SP-1). The basis for this is that this environment is humidity-controlled and therefore it is not expected that there will be sufficient moisture to result in loss of material for steel components. Likewise, the GALL-SLR Report states that there are no aging effects associated with steel exposed to the air-indoor controlled environment. However, if a steel component is in the vicinity of a bolted connection (e.g., flanges, packing joints) it could be exposed to moisture that could result in loss of material. It would then appear to be inconsistent that the GALL-SLR Report does not cite loss of material for steel

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	components exposed to air-indoor controlled. The staff did not cite loss of material for steel piping exposed to air-indoor controlled because if leakage should occur onto steel components, the loss of material would be readily apparent as rust staining. The staff has concluded that there is reasonable assurance that a licensee would address this loss of material in its corrective action program prior to a loss of intended function of the component. In contrast, loss of material for stainless steel, aluminum, and nickel alloy components would not be as readily apparent unless the inspections specifically cited the need to observe for pitting and crevice corrosion. For insulated components, the rust stains could be hidden; therefore, the GALL-SLR Report includes items to address corrosion under insulation (i.e., A-405a, E-403a, S-402a) regardless of the air environment.
VIII.I.SP-6	The staff concluded that copper alloys are not susceptible to loss of material when exposed to an air environment. The staff reviewed: (a) “Atmospheric Corrosion of Copper Alloys Exposed for 15 to 20 Years,” L.P. Costos, ASTM International, 1982, which tested copper alloys in marine, industrial, and rural environments; and (b) “General Localized and Stress Corrosion Resistance of Copper Alloys in Natural Atmospheres,” A. P. Castillo, ASTM International, 1982, which tested copper alloys in urban industrial (with some sea salt and road salt) and heavy industrial (with ammonia and sulfur dioxide) environments. The general loss of material rates (pitting was not a factor) ranged from 0.009 mils per year (mpy) to 0.09 mpy and 0.12 mpy to 0.14 mpy (in the latter study). These environments envelope what would be expected in a nuclear power plant air environment and the loss of material rates would not be expected to challenge the intended function of a copper alloy component. In light of the above basis, the environment was revised from air-indoor uncontrolled to air, condensation, or gas to allow for consolidation of items. The term “external” was removed from the description of the environment because in these environments, aging effects do not occur regardless of whether the environment is on the internal or external surface of the component.
VIII.E.SP-8 VIII.F.SP-8 VIII.G.SP-8	General corrosion, as published in the public comment version of the GALL-SLR Report, was deleted as an aging mechanism. The staff has concluded that there is reasonable assurance that general corrosion will not result in a loss of intended function of copper alloy components exposed to closed-cycle cooling water. The staff reviewed EPRI 1007820, “Closed Cooling Water Chemistry Guidelines.” This document includes tables for each type of chemical treatment program showing parameters monitored, acceptable ranges, monitoring frequencies, and action level ranges. All chemical treatment programs monitor pH. Most cite pH levels greater than 8.5 and below 11.0. The only exceptions are “pure water” systems (which cites >5.5 and <8.0) and “blended glycol” (which cites >7.5 and <11). The staff also reviewed Oilfield Water Technology, NACE International, 2006, Section 6.5, “Copper Alloys,” page 94, which states, “In aerated water, if pH drops below about 5, copper alloys corrode. In deaerated water, even at low pH, corrosion resistance is good.” Given the lower limit of a pH below 5, the chemistry controls for closed-cycle cooling water are sufficient to minimize the potential for general corrosion. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	copper alloy materials as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings; and (e) sacrificial anodes.
VIII.I.SP-13	This item was editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 [i.e., American Concrete Institute (ACI) standards, operating experience (OE)] were relocated to the further evaluation section. A third proviso (a technical change) was added to the further evaluation, “the piping is not potentially exposed to groundwater.” During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no aging effect requiring management (AERM) when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
VIII.E.SP-26 VIII.G.SP-26 VIII.A.SP-27 VIII.E.SP-27 VIII.F.SP-27 VIII.G.SP-27	Ductile iron was added as an applicable material. The staff’s basis for this change is documented in the subsequent license renewal (SLR) Supplement issued on March 29, 2016 (ADAMS Accession No. ML16041A090).
VIII.A.SP-28 VIII.G.SP-28	Ductile iron was added as an applicable material. The staff’s basis for this change is documented in the SLR Supplement issued on March 29, 2016 (ADAMS Accession No. ML16041A090). Soil and groundwater were deleted as environments because they are enveloped by SRP-SLR, item 3.4.1-32.
VIII.A.SP-31 VIII.E.SP-31 VIII.F.SP-31 VIII.G.SP-31	General corrosion was added to the list of aging mechanisms to be consistent with other GALL Report, Revision 2 items. While the staff concluded that copper alloys exposed to air, gas, and condensation environments have no aging effects requiring management, loss of material due to exposure to raw water environments should be managed due to unknown chemistry parameters (e.g., pH) in the water supply. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Copper alloy piping exposed to raw water is subject

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	to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20. General corrosion would be detected by volumetric inspection methods as recommended in AMP XI.M20.
V.F.SP-34	Although no changes were incorporated into this item, the staff elected to establish the basis for why flow blockage due to fouling is not addressed for glass piping elements exposed to raw water when it is for all other materials. As stated in GALL-SLR Report, Chapter IX.B, the term “piping elements” apply only to components or portions of components made of glass (e.g., the glass portion of sight glasses and level indicators). The only source of fouling for glass elements would be upstream corrosion products or debris from the raw water source. This debris would be detected by plant staff if the glass element were to become blocked. Given this, the staff concluded that flow blockage due to fouling could be managed by routine observations of the glass component.
VIII.E.SP-36 VIII.F.SP-36 VIII.G.SP-36	Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VIII.E.SP-39 VIII.F.SP-39 VIII.G.SP-39	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect stainless steel materials in a treated water environment as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003.
VIII.B1.SP-59 VIII.E.SP-59 VIII.G.SP-59	“Internal” was removed from the environmental term because it is obvious that the aging effect is managed by an internally oriented AMP. New items were added citing Table E and G to include this material, environment, aging effect, and AMP for condensate system and auxiliary feedwater system components.
VIII.E.SP-60 VIII.G.SP-60	“Internal” was removed from the environmental term because it is obvious that the aging effect is managed by an internally oriented AMP.
VIII.A.SP-64	The term “components and” was removed from VIII.A.SP-64 because reduction of heat transfer due to fouling is not applicable to heat exchanger components, but rather, heat exchanger tubes. In addition, revising the SP-64 item citing Table A, results in SP-64 being consistent with the other cited tables (i.e., E, F, and G).
VIII.B2.SP-73 VIII.C.SP-73 VIII.D2.SP-73 VIII.E.SP-73	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a treated water environment as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional detail.
VIII.B1.SP-74 VIII.D1.SP-74 VIII.F.SP-74 VIII.G.SP-74	MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a treated water environment as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,”

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AMR Item No.	**Technical Bases for Changes**
	Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional detail.
VIII.E.SP-75 VIII.G.SP-75	Stainless steel was removed as a cited material when the draft GALL-SLR Report was issued for public comment. At that time, the staff had concluded that stainless steel components exposed to treated water should be subject to a further evaluation. As a result of the staff's review of a public comment, it was concluded that a further evaluation was not necessary. The staff's basis for this change is documented in the response to comment No. 015-007. Nevertheless, stainless steel was not reinstated into SP-75. Managing loss of material of stainless steel tanks exposed to treated water is addressed in SP-162. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a treated water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional detail.
VIII.E.SP-77	The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings and (e) sacrificial anodes. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a treated water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. See the basis for EP-60 for additional detail.
VIII.E.SP-80 VIII.F.SP-80	Based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1, "Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because, given the environment, the same aging effects are applicable. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." See the basis for EP-63 for additional detail. SP-80 was realigned to a new SRP-SLR AMR item, 3.4.1-085 to differentiate it from materials other than stainless steel and nickel alloy.
VIII.B1.SP-87 VIII.C.SP-87	Based on a review of EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 4, Figure 1,

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VIII.D1.SP-87 VIII.D2.SP-87 VIII.E.SP-87 VIII.F.SP-87 VIII.G.SP-87	"Treated Water / Stainless Steel and Nickel-Base Alloys," the staff concluded that several factors affect loss of material including oxygen content, halide content, the potential for stagnant flow, pH, and temperature. As a result, when the draft SRP-SLR was issued for public comment, this item cited a further evaluation. Based on an industry comment, the staff revised the item to not cite a further evaluation. The staff's basis for this change is documented in the response to comment No. 015-007. Nickel alloy was added because, given the environment, the same aging effects are applicable. MIC was cited as an applicable aging mechanism based on the staff's review of EPRI 1010639, Figure 1, "Treated Water / Stainless Steel and Nickel Alloys." See the basis for EP-63 for additional detail. SP-87 was realigned to a new SRP-SLR AMR item 3.4.1-85 to differentiate it from materials other than stainless steel and nickel alloy.
VIII.D1.SP-90 VIII.D2.SP-90 VIII.E.SP-90 VIII.F.SP-90 VIII.G.SP-90	Treated borated water was added to address PWR systems. This material, environment, and aging effect combination could exist at a PWR.
VIII.A.SP-91 VIII.D1.SP-91 VIII.D2.SP-91 VIII.E.SP-91 VIII.G.SP-91	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
VIII.A.SP-92 VIII.D1.SP-92 VIII.D2.SP-92 VIII.E.SP-92 VIII.G.SP-92	MIC was added as an aging mechanism. EPRI 1010639, Section 3.1.6, "MIC," states, "While MIC contamination is possible in lubricating oil applications, the likelihood of MIC causing extensive damage in lube oil systems is minimal." The document further states, "In summary, MIC is an applicable aging mechanism for carbon and low-alloy steel, cast iron, stainless steel, aluminum and aluminum alloys, and copper and copper alloys in fuel oil systems but is not considered applicable in lubricating oil systems." Although the EPRI document states that MIC is not applicable in lubricating oil systems, it also states that it is possible. As a result, it is appropriate that a one-time inspection be conducted to confirm that loss of material is not occurring due to MIC.
VIII.A.SP-101 VIII.F.SP-101	General corrosion had been added to the list of mechanisms when the draft GALL-SLR Report was issued for public comment. Subsequent to its issuance the staff has removed general corrosion as an applicable aging mechanism for copper alloy materials exposed to lubricating oil. The staff's basis is derived from Copper and Copper Alloys, edited by J. R. Davis, ASM International, 2001 which states, "[g]eneral corrosion of copper alloys results from prolonged contact with environments in which the corrosion rate is very low, such as fresh, brackish, and salt waters; many types of soil…." In a related topic, this reference further states that pitting corrosion is somewhat

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	random and pitting depth does not continually increase, and while crevice corrosion occurs, it also appears to level off. As a result, it is appropriate to conduct a one-time inspection for pitting and crevice corrosion. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect copper alloy materials in a treated water environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003.
VIII.I.SP-104	This item was revised to delete the original cited material, copper alloy (≤15% Zn and ≤8% Al). The term "copper alloy" implies that the zinc content is less than or equal to 15% and the aluminum content is less than or equal to 8%. GALL-SLR Chapter IX.C, "Use of Terms," was revised to reflect this convention. Based on a review of ASM Handbook, Volume 13B, "Corrosion: Materials, Corrosion of Copper and Copper Alloys," ASM International, 2006, page 133, the staff has concluded that copper alloy >8% Al is not susceptible to loss of material due to boric acid corrosion. In contrast, copper alloy with greater than 15% zinc is susceptible to loss of material in this environment.
VIII.E.SP-113 VIII.G.SP-113	The term "components" was removed from VIII.G.SP-113 because reduction of heat transfer due to fouling is not applicable to heat exchanger components, but rather, heat exchanger tubes. An item was added citing Table E to include this material, environment, aging effect, and AMP for condensate system components.
VIII.E.SP-115	The previous environment, soil, or concrete was changed to soil, concrete, air, condensation. This change reflects the potential environments for indoor tanks as well as outdoor tanks within the scope of AMP XI.M29. The broader term "air" is cited instead of air-outdoor and air-indoor uncontrolled because the term "air" encompasses the other two terms and the staff concluded it was unlikely that tanks within the scope of AMP XI.M29 would be located in an air-indoor controlled environment. Consistent with other items in the GALL-SLR Report (e.g., EP-4, AP-2, SP-1), there are no recommended aging effects for steel components exposed to air-indoor controlled. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a soil environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VIII.G.SP-116	The previous environment, soil or concrete was changed to soil, concrete, air, condensation. This change reflects the potential environments for indoor tanks as well as outdoor tanks within the scope of AMP XI.M29. The broader term "air" is cited instead of air-outdoor and air-indoor uncontrolled because the term "air" encompasses the other two terms and the staff concluded it was unlikely that tanks within the scope of AMP XI.M29 would be located in an air-indoor controlled environment. Consistent with other items in the GALL-SLR Report (e.g., EP-4, AP-2, SP-1), there are no recommended aging effects for steel components exposed to air-indoor controlled. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel materials in a soil environment as cited in ASM Handbook, Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. MIC was not included as an aging mechanism for the tank bottom surfaces exposed to concrete. The staff concluded that there is reasonable assurance that the amount of water that could accumulate beneath a tank, while conducive to loss of material due to general, pitting, and crevice corrosion, would not be sufficient to result in MIC that could challenge the intended function of the tank. In addition, AMP XI.M29 recommends volumetric inspections of tank bottoms exposed to concrete or soil sufficient to detect loss of material and cracking.
VIII.E.SP-117 VIII.F.SP-117 VIII.G.SP-117	Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Stainless steel piping exposed to raw water is subject to this aging effect due to the potential intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VIII.A.SP-118a VIII.B1.SP-118a VIII.B2.SP-118a VIII.C.SP-118a VIII.D1.SP-118a VIII.D2.SP-118a VIII.E.SP-118a VIII.F.SP-118a VIII.G.SP-118a VIII.A.SP-118b VIII.B1.SP-118b VIII.B2.SP-118b VIII.C.SP-118b VIII.D1.SP-118b VIII.D2.SP-118b VIII.E.SP-118b VIII.F.SP-118b VIII.G.SP-118b VIII.A.SP-118c VIII.B1.SP-118c	The staff has concluded that cracking should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090), and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VIII.B2.SP-118c VIII.C.SP-118c VIII.D1.SP-118c VIII.D2.SP-118c VIII.E.SP-118c VIII.F.SP-118c VIII.G.SP-118c VIII.A.SP-118d VIII.B1.SP-118d VIII.B2.SP-118d VIII.C.SP-118d VIII.D1.SP-118d VIII.D2.SP-118d VIII.E.SP-118d VIII.F.SP-118d VIII.G.SP-118d	
VIII.A.SP-127a VIII.B1.SP-127a VIII.B2.SP-127a VIII.C.SP-127a VIII.D1.SP-127a VIII.D2.SP-127a VIII.E.SP-127a VIII.F.SP-127a VIII.G.SP-127a VIII.A.SP-127b VIII.B1.SP-127b VIII.B2.SP-127b VIII.C.SP-127b VIII.D1.SP-127b VIII.D2.SP-127b VIII.E.SP-127b VIII.F.SP-127b VIII.G.SP-127b VIII.A.SP-127c VIII.B1.SP-127c VIII.B2.SP-127c VIII.C.SP-127c VIII.D1.SP-127c VIII.D2.SP-127c VIII.E.SP-127c VIII.F.SP-127c VIII.G.SP-127c VIII.A.SP-127d VIII.B1.SP-127d VIII.B2.SP-127d VIII.C.SP-127d VIII.D1.SP-127d VIII.D2.SP-127d VIII.E.SP-127d VIII.F.SP-127d VIII.G.SP-127d	The staff has concluded that loss of material should be managed for stainless steel components exposed to air or condensation. The basis for the staff's position is documented in the GALL-SLR Report and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016 (ADAMS Accession No. ML16041A090), and responses to industry comment Nos. 15-004, 15-005, 015-006, 045-004, 045-006, 045-007, 045-008, 045-009, and 045-010. Some of the industry comments address aluminum components; however, the staff's response is equally pertinent to stainless steel components. Nickel alloy was added to this item based on the staff's review of EPRI 1010639, Table 4-1, "Aging Effects Summary – Stainless Steel, Nickel-Base Alloys, and Titanium and Titanium Alloys." This table states that both stainless steel and nickel-base alloys are susceptible to loss of material when exposed to halogens above threshold levels. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, "Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items."

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
VIII.G.SP-136	The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report, AMR item tables. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings and (e) sacrificial anodes. The term "fouling that leads to corrosion" was deleted as an aging mechanism associated with "loss of material" based on the following. "Forms of Corrosion Recognition and Prevention," Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for "fouling that leads to corrosion." The staff reviewed all of the AMR items in GALL Report, Revision 2, and the proposed GALL-SLR Report that cited "fouling that leads to corrosion" and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff's review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20. The AMP was changed to AMP XI.M20 because the cited system is the Auxiliary Feedwater System (Table G), which is associated with the ultimate heat sink. Components exposed to raw water, which transfer heat to the ultimate heat sink are within the scope of AMP XI.M20, not AMP XI.M38.
VIII.H.SP-141	The underground environment was added based on its inclusion in AMP XI.M41. Loss of material due to pitting and crevice corrosion could occur due to the potential for deleterious elements in the underground environment due to groundwater intrusion. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect steel bolting exposed to a soil environment as cited in ASM Handbook Volume 13A, "Corrosion Fundamentals, Testing, and Protection," Stephen C. Dexter, pages 398-416, 2003. The staff has concluded that there is reasonable assurance that MIC will not occur in components embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating the components. These inspections examine the surface of the concrete to detect cracking that could admit ground water.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff did not cite loss of preload as an applicable aging effect for closure bolting exposed to concrete because AMP XI.M41 recommends inspections for loss of material by inspecting the top and a portion of the sides of the cementitious material that is encasing the metallic components. The acceptance criterion states that there are no cracks that could admit groundwater to the surface of the component. In the absence of groundwater, there is reasonable assurance that no significant loss of material will occur for the closure bolting. In addition, the staff concluded that the surrounding concrete would restrain any gross movement of the flange if the shank of the closure bolting was degraded, thus minimizing the potential for leakage due to loss of preload.
VIII.H.SP-142	The material was changed to metallic because the potential for loss of preload is independent of the material. The term “any” environment includes submerged environments (e.g., raw water, waste water, fuel oil). GALL-SLR Report, AMP XI.M18 was revised to include recommendations for managing loss of preload for bolting that is submerged (e.g., bolted components in a drain sump). Unique recommendations are necessary for submerged bolting because external visual inspections cannot detect leakage. The soil and underground environments were added because as per the use of terms documented in GALL-SLR Report, Chapter IX, soil and underground environments are not included in the environmental term, “any.” The staff did not cite loss of preload as an applicable aging effect for closure bolting exposed to concrete because AMP XI.M41 recommends inspections for loss of material by inspecting the top and a portion of the sides of the cementitious material that is encasing the metallic components. The acceptance criterion states that there are no cracks that could admit groundwater to the surface of the component. In the absence of groundwater, there is reasonable assurance that no significant loss of material will occur for the closure bolting. In addition, the staff concluded that the surrounding concrete would restrain any gross movement of the flange if the shank of the closure bolting was degraded, thus minimizing the potential for leakage due to loss of preload.
VIII.H.SP-143	The material was changed to nickel alloy because stainless steel materials were already addressed. Item SP-145 cites stainless steel piping, piping components, closure bolting, and tanks. Nickel alloy is susceptible to the loss of material in the soil and concrete environment similar to stainless steel and loss of material can be effectively managed by AMP XI.M41 for either material. Piping and piping components were added because they had not been addressed for nickel alloy components exposed to soil or concrete. Concrete was added based on its inclusion in AMP XI.M41. MIC was added as an applicable aging mechanism to be consistent with other existing GALL Report AMR items. MIC is known to potentially affect stainless steel and nickel alloy bolting exposed to a soil environment as cited in ASM Handbook Volume 13A, “Corrosion Fundamentals, Testing, and Protection,” Stephen C. Dexter, pages 398-416, 2003.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water. Although other nickel alloy components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting loss of material. The staff did not cite loss of preload as an applicable aging effect for closure bolting exposed to concrete because AMP XI.M41 recommends inspections for loss of material by inspecting the top and a portion of the sides of the cementitious material that is encasing the metallic components. The acceptance criterion states that there are no cracks that could admit groundwater to the surface of the component. In the absence of groundwater, there is reasonable assurance that no significant loss of material will occur for the closure bolting. In addition, the staff concluded that the surrounding concrete would restrain any gross movement of the flange if the shank of the closure bolting was degraded, thus minimizing the potential for leakage due to loss of preload.
VIII.E.SP-145 VIII.G.SP-145 VIII.H.SP-145	Steel material was deleted because it is enveloped by changes to SP-161. Nickel alloy materials were deleted because they are enveloped by SP-143. The staff has concluded that there is reasonable assurance that MIC will not occur in piping embedded in concrete because sufficient ground water will not be present on the surface of the piping. AMP XI.M41 recommends periodic inspections of the concrete encapsulating components. These inspections examine the surface of the concrete to detect cracking that could admit ground water. Although other stainless steel components cite an SRP-SLR further evaluation to determine whether one-time or periodic inspections are conducted to detect potential loss of material, the further evaluation section is not cited for this item because AMP XI.M41 recommends periodic inspections of buried components. These inspections are capable of detecting loss of material. Items citing Tables E and G were editorially consolidated to cite a single GALL-SLR Report, Table, H, “External Surfaces of Components and Miscellaneous Bolting.”
VIII.E.SP-146 VIII.F.SP-146 VIII.G.SP-146	The staff has removed galvanic corrosion as an aging mechanism from the GALL-SLR Report AMR item tables. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings and (e) sacrificial anodes.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	The term “fouling that leads to corrosion” was deleted as an aging mechanism associated with “loss of material” based on the following. “Forms of Corrosion Recognition and Prevention,” Volume 1, C.P. Dillon, National Association of Corrosion Engineers, Houston, Texas, 1982, page 20, states “that crevice corrosion and deposit attack crevice corrosion is the more general term and a deposit attack suggests that the crevice has been formed by a discontinuous deposit of a foreign substance from the environment adhering to the metal surface. Because crevice corrosion is considered the more general term, there is no need to include a distinction for fouling that leads to corrosion.” The staff reviewed all of the AMR items in GALL Report Revision 2 and the proposed GALL-SLR Report that cited “fouling that leads to corrosion” and determined that they also cite loss of material due to crevice corrosion and recommend an AMP that includes internal visual inspection capable of detecting fouling deposits. Flow blockage due to fouling was added as an AERM based on the staff’s review of industry OE. Steel piping exposed to raw water is subject to this aging effect due to the potential aggressiveness of the environment on the steel components, resulting in generation of corrosion products, and intrusion of fouling products from the raw water source. Flow blockage due to fouling can be detected by the internal visual inspections recommended in AMP XI.M20.
VIII.E.SP-147a VIII.G.SP-147a VIII.E.SP-147b VIII.G.SP-147b VIII.E.SP-147c VIII.G.SP-147c VIII.E.SP-147d VIII.G.SP-147d	Based on its review of “Corrosion of Aluminum and Aluminum Alloys,” J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture that interacts with second phase particles where local anode and cathode regions result in corrosion due to the passive layer being interrupted. As a result, any air environment could have sufficient moisture to enable the aging effect. The staff determined that the most accurate and practical method for determining the susceptibility of materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. See SRP-SLR, Section 3.4.2.2.9 for further details. Tanks were added because for the same material and environment, the aging effects and recommended AMP are the same. The reason for citing specific AMPs rather than a plant-specific AMP is discussed in GALL-SLR Report, “Explanation of the Use of Multiple Aging Management Programs in Aging Management Review Items.”
VIII.I.SP-153	The term “internal” was removed from the description of the environment because in a condensation environment aging effects do not occur regardless of whether the air is on the internal or external surface of the component.
VIII.I.SP-154	This item was editorially revised to cite a further evaluation section in order to delete excessive detail from the GALL-SLR Report and SRP-SLR tables. As a result, the first two provisos from GALL Report Revision 2 (i.e., ACI standards, OE) were relocated to the further evaluation section.

Table 2-21 Changes to Existing GALL Report Revision 2 Chapter VIII AMR Items and Technical Bases	
AMR Item No.	**Technical Bases for Changes**
	A third proviso (a technical change) was added to the further evaluation, "the piping is not potentially exposed to groundwater." During the development of AMP XI.M41 for GALL Report Revision 2, the staff had concluded that loss of material should be managed by AMP XI.M41 for buried components exposed to concrete that are subject to ground water intrusion. The new AMP conflicted with this item, which had stated that there is no AERM when this material is exposed to concrete (subject to meeting the first two above provisos). The incorporation of this new further evaluation section eliminates the conflict. If the component is not potentially exposed to ground water (e.g., piping embedded in concrete within a building structure), there is no AERM and no recommended AMP. This AMR item was revised to cite the further evaluation that addresses the potential for ground water penetration through the concrete as well as the original provisos for this AMR line.
VIII.H.SP-161	The air-indoor uncontrolled and condensation environment were consolidated into the underground environment as cited in GALL-SLR Chapter IX.D. Soil and concrete were added based on their inclusion in AMP XI.M41. Stainless steel, nickel alloy, copper alloy, and aluminum were deleted because they are enveloped by the following: (a) SP-145 and S-443 for stainless steel; (b) SP-143 and S-443 for nickel alloy; and (c) S-442 and S-466 for aluminum. The soil and underground environment are addressed for copper alloy components in S-477. Copper alloy exposed to a concrete environment is addressed as having no aging effects in item S-476.

Table 2-22 Chapter IX.B – Structures & Components: Differences From Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Ducting and ducting components	Deleted “fire dampers” as one of the examples of a damper within the ducting components discussion.	The Chapter VII line items that cite ducting and ducting components cite aging management program (AMP) XI.M32, AMP XI.M36, and AMP XI.M38 to manage associated aging effects. Fire dampers are not addressed in these AMPs. A new aging management review (AMR) item (3.3.1-255 citing AMP XI.M26), addresses only fire damper assemblies to eliminate possible confusion about which program manages the associated aging effects for these components.
Electrical Insulation	Added new term.	This new term accounts for usage in AMR items to help distinguish electrical insulation from thermal insulation materials. It replaces the term “Insulation materials (e.g., bakelite, phenolic melamine or ceramic, molded polycarbonate).”
“Existing programs” components	The term was modified	This term is associated with one of four categories for reactor vessel internal components in pressurized water reactor designs, as defined in EPRI’s MRP-227-A report. The staff modified the definition to be consistent with that defined by EPRI.
“Expansion” components	The term was modified	This term is associated with one of four categories for reactor vessel internal components in pressurized water reactor designs, as defined in EPRI’s MRP-227-A report. The staff modified the definition to be consistent with that defined by EPRI.
Inaccessible Areas of Structural Components for Non-American Society of Mechanical Engineers (ASME) Structural Aging Management Programs (AMPs)	Added new term.	Clarification was needed for structures and components within the scope of the Structures Monitoring and other structural AMPs not based on the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for areas considered inaccessible.
“No Additional Measures” components	The term was modified.	This term is associated with one of four categories for reactor vessel internal components in pressurized water reactor designs, as defined in EPRI’s MRP-227-A report. The staff modified the definition to be consistent with that defined by EPRI.

Table 2-22 Chapter IX.B – Structures & Components: Differences From Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Piping, piping components, tanks	Deleted "piping elements" from the term and deleted the discussion related to the environments associated with AMP XI.M41.	The term "piping elements" is defined separately and only applies to components made of glass. Piping, piping components, and tanks considered in Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) are not made from glass. The discussion related to buried and underground piping and tanks was relocated to the terms "buried" and "underground" in GALL-SLR Report, Chapter IX.D.
Piping elements	The term was editorially revised.	The term was editorially revised to state that piping elements are not a subset of piping and piping components.
"Primary" Components	This term was modified.	This term is associated with one of four categories for reactor vessel internal components in pressurized water reactor designs, as defined in EPRI's MRP-227-A report. The staff modified the definition to be consistent with that defined by EPRI.
Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	The term "polymer" was added.	The term polymer was added in recognition that not all seals gaskets and moisture barriers are constructed specifically of elastomeric materials.
Thermal insulation	The term was newly added.	This term was added to account for usage in AMR line-items associated with the aging effect of reduced thermal insulation resistance due to moisture intrusion.

Table 2-23 Chapter IX-C – Materials: Differences From Chapter IX, GALL Report, Revision 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Aluminum	Added new term to account for usage in aging management review (AMR) items.	The cited American Society for Testing and Materials (ASTM) Standard (H35.1/H35.1M) applies to the determination of susceptible aluminum materials as discussed in Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Sections 3.2.2.2.8, 3.3.2.2.8, and 3.4.2.2.7.
Copper alloy	Deleted "≤15% Zn and ≤8% Al" from term. Also clarified the associated aging effects for copper alloy components.	The term no longer cites less than or equal to 15% zinc and 8% aluminum because copper alloy materials are either cited as containing less than the critical alloying elements (i.e., copper alloy) or above them. The staff's basis for the cited aging effects is contained in the individual Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report line items citing copper alloy materials or in the two cited references.
Copper alloy (>15% Zn or >8% Al)	Clarified the associated aging effects for copper alloy (>15% zinc or >8% aluminum) components.	The staff's basis for the cited aging effects is contained in the individual GALL-SLR Report line items citing copper alloy (>15% zinc or >8% aluminum) materials or in the three cited references.
Ductile iron	New term added and then revised based on public comments to clarify the material properties of ductile iron.	The term was initially added as discussed in "GALL-SLR and SRP-SLR Supplemental Staff Guidance," [Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090]. The staff's basis for changes to the properties of ductile iron are discussed in the staff's response to industry comment numbers 045-037 and 045-038, NUREG–2222.
Elastomers	The term was expanded to include a broader description of materials. Deleted the discussion about associated aging effects and potential influences.	The addition of "viscoelastic polymers including natural and synthetic rubbers" was to be more inclusive of other elastomeric materials. The discussion related to causes of "hardening or loss of strength" was relocated in the corresponding term in Chapter IX.E
Gray cast iron	Excess detail was deleted and selective leaching was clarified.	The sentence related to fractures was removed because it was not pertinent to describing the material or its aging effects. The reduction of strength associated with selective leaching of gray cast iron was removed because the aging effect cited in the GALL-SLR Report AMR line items is loss of material, not reduction in strength.

Table 2-23 Chapter IX-C – Materials: Differences From Chapter IX, GALL Report, Revision 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
High strength steel	Deleted designation of “>150 ksi” from term and simplified the description.	Material types were deleted from the use of the term because the key characteristic in the associated aging management programs (AMPs) is actual yield strength exceeding 150 ksi, not material type.
Polymer	The term was deleted.	This term was deleted and replaced with new terms “various organic polymers” and “various polymeric materials” in Generic Aging Lessons Learned (GALL) Report Chapter IX.C.
SA508-Cl 2 Forgings Clad With Stainless Steel Using a High-Heat-Input Welding Process	Added specific AMR item with additional bases in the usage discussion.	The discussion relating to issues associated with this material had previously been included in AMR item R-85. That discussion was deleted from the AMR item and is now included in the usage discussion for this material.
Steel	Ductile iron was added to the use of the term.	See “Ductile Iron” above for the bases associated with this change.
Titanium	The applicability of flow blockage due to fouling was added to the term. Grades 9 and 11 were added.	For specific grades of titanium there are no aging effects such as loss of material or cracking; however, reduction of heat transfer and flow blockage due to fouling may still be applicable based on the environment. For example, these two aging effects would be applicable for titanium components exposed to raw water; however, they would not be applicable for titanium components exposed to treated water. The addition of Grade 9 is based on the staff’s review of Materials Properties Handbook: Titanium Alloys, Gerhard Welsch, Rodney Boyer, and E.W. Collings, ASM International, 1993, page 217.
Various organic polymers Various polymeric materials	Newly added, as a replacement for the broader term “polymer.”	These terms were newly added to account for usage in GALL-SLR AMR items. For the mechanical AMR items, either a specific polymeric material is cited or the general term “polymer” is cited. Electrical AMR items cite “polymeric materials” but may include examples of the particular polymeric material, or “various organic polymers.” For mechanical AMR items, the term “polymeric is used when the specific type of polymeric material is not identified.

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Air	Air was added as a new term.	This term was added to allow Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report aging management review (AMR) items to be more succinct. The GALL-SLR Report includes multiple air terms; however, the new term "air" reduces the number of cited terms for some AMR items where for the material, the aging effect can occur regardless of the particular air environment. The basis for the statement associated with the potential presence of leakage in the air environment is derived from the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Appendix A.1.2.1.7. See also Supplemental Staff Guidance document Agencywide Documents Access and Management System (ADAMS) Accession No. ML16041A090).
Air-indoor controlled	A discussion was added related to the potential for leakage from bolted connections.	The basis for the statement associated with the potential presence of leakage in the air environment is derived from SRP-SLR, Appendix A.1.2.1.7. See also Supplemental Staff Guidance document (ADAMS Accession No. ML16041A090),
Air-indoor uncontrolled	A discussion was added related to the potential for leakage from bolted connections.	The basis for the statement associated with the potential presence of leakage in the air environment is derived from SRP-SLR, Appendix A.1.2.1.7. See also Supplemental Staff Guidance document (ADAMS Accession No. ML16041A090),
Air–indoor uncontrolled >35 °C (>95 °F) (Internal/External)	This term was deleted.	This term was only associated with the thermal stress threshold for elastomers. The corresponding discussion regarding the temperature sensitivity of elastomers was added to "hardening or loss of strength" in Table IX.E.
Air, moist	This term was deleted	This term was deleted based upon a joint staff and industry consolidation of air-related terms. The basis for deleting this term is documented in the staff's response to industry comment No. 015-006, NUREG–2222.
Air-outdoor	Environmental factors were added.	The potential presence of cooling tower plumes, industrial pollutants, and animal infestations (excrement) were added because they can contribute to aging effects of in-scope components.

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Air with leaking secondary-side water and/or steam	This term was deleted	This term was only cited by one item R-31. This AMR item addresses loss of material due to erosion of secondary manway covers and handhole covers. The staff revised the AMR item to cite treated water or steam, which is appropriate for the aging effects associated with the component.
Air with metal temperature up to 288 °C (550 °F)	This term was deleted	This term was deleted based upon a joint staff and industry consolidation of air-related terms. The basis for deleting this term is documented in the staff's response to industry comment No. 015-037, NUREG–2222, which consolidated the staff's response to deletion of unique air-related terms.
Air with reactor coolant leakage	This term was deleted	This term was deleted based upon a joint staff and industry consolidation of air-related terms. The basis for deleting this term is documented in the staff's response to industry comment No. 015-038, NUREG–2222, which consolidated the staff's response to deletion of unique air-related terms.
Air with steam or water leakage	This term was deleted	This term was deleted based upon a joint staff and industry consolidation of air-related terms. The basis for deleting this term is documented in the staff's response to industry comment No. 015-038, NUREG–2222, which consolidated the staff's response to deletion of unique air-related terms.
Air-dry	This term was revised to only cite the air environment downstream of the instrument air dryers in the instrument air system and remove specific detail related to specific cited AMR items.	The staff revised the dry air term to address the environmentally controlled (e.g., low moisture content) downstream of instrument air dryers. Aging management program (AMP) XI.M24 recommends that opportunistic inspections be conducted to detect potential loss of material in components downstream of the instrument air dryers. The changes to this term address this unique environment. The staff addressed an industry proposal related to this environment in its response to comment No. 015-041, NUREG–2222. The specific AMR item references were removed because they duplicated information available in the GALL-SLR Report tables.

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Any	Enhanced the description to include environments other than those associated with air and provide limitations to the use of the term.	For some components, the applicable aging effects can occur regardless of the particular environment. In addition, limitations are applied for the following uniquely identified environments: • The term does not include environments downstream of instrument air dryers because this environment is uniquely identified as “air-dry.” For mechanical components, the term does not include the environments of underground and soil, and concrete (where moisture could be present) because there are unique recommendations in AMP XI.M41 for these environments.
Buried	The buried and underground environmental terms were split into two separate terms accompanied by minor changes.	The qualifier “where water could be present” was added to differentiate GALL-SLR Report AMR items that cite AMP XI.M41 to manage aging effects from those that do not cite AMP XI.M41. For example, items EP-112 and EP-20 address steel and stainless steel components exposed to concrete where there are no aging effects if water is not present, along with two other provisions related to the concrete characteristics and plant-specific operating experience. The phrase, “the term includes exposure to ground water” was added to eliminate repeating the term “ground water” in AMR items that cite the buried environment.
Closed-cycle cooling water	Term was clarified and alternate examples of typical systems were included.	The clarification for being an AMP-specific subset of “treated water” was intended to reflect the environment cited in AMR items addressed by the Closed Treated Water Systems program.
Concrete	Term was expanded to include situations where components sit on concrete.	The concept of the component being exposed to a concrete environment by sitting on concrete was incorporated to address items, such as, tank bottoms, which sit on but are not embedded in concrete.

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Condensation	The use of the term "condensation" was clarified for components enclosed in insulation.	The term was clarified to include potential aging effects and aging mechanisms, as well as the mechanism for moisture accumulation underneath thermal insulation. The associated AMR items with corrosion under insulation were addressed in LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation."
Lubricating oil	This term was revised to address the unique waste lubricating oil environment collected from leakage from components.	The staff has concluded that the lubricating oil and lubricating oil (waste oil) are two separate environments when conducting one-time inspections. Due to the high potential for contaminants (i.e., water, dirt) in the lubricating oil (waste oil) environment, one-time inspections of components exposed to lubricating oil that is subject to chemistry controls would not be representative of components exposed to lubricating oil (waste oil). The "Detection of Aging Effects" program element of AMP XI.M32 allows some combinations of environments. In this case, "[a]n inspection of a component in a more severe environment may be credited as an inspection for the specified environment and for the same material and aging effects in a less severe environment…" is applicable. An inspection of components exposed to lubricating oil (waste oil) is a more severe environment.
Temperature threshold of 35 °C (95 °F) for thermal stresses in elastomers	This portion of GALL Report Chapter IX.D was revised to add photolysis (due to ultraviolet light) as a stressor of elastomers.	Based on the staff's review of Gillen and Clough, Rad. Phys. Chem., Vol. 18, p. 679, 1981 (Reference 4), elastomers are also susceptible to degradation due to photolysis (due to ultraviolet light).

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Temperature threshold of 60 °C (140 °F) for SCC in stainless steel	This portion of GALL-SLR Report, Chapter IX. D. was revised to state that environments harsh enough to cause stress corrosion cracking (SCC) in stainless steel are only considered event-driven when the component is exposed to an environment where water chemistry controls are utilized. In addition, the difference between outdoor ambient temperatures and surface temperatures is now discussed.	The previous wording appeared to state that for SCC to occur at ambient temperatures, an event-driven change had to occur. This is not the case for stainless steel SSCs exposed to environments where chemistry controls are not in place. Examples include outdoor air and in-leakage of groundwater to vaults. In these cases, exposure to contaminants is likely a normal occurrence depending on the local environment's concentration of halogens. Therefore, SCC does not have a temperature threshold in the absence of water chemistry controls. An applicant submitted a basis for SCC not occurring in the outdoor air environment because ambient temperatures never exceeded 38 °C (100 °F). The basis was not accepted for the staff for two reasons: (1) the applicant had not adequately demonstrated the absence of deleterious contaminants in the atmosphere; and (2) component surfaces exposed directly to sunlight (e.g., no insulation jacketing, not in a vault) are typically much hotter than the ambient air temperature. In order to ensure there is no misperception in this regard, the staff added, "surface temperatures exposed directly to sunlight will be higher than ambient air conditions to the discussion.

Table 2-24 Chapter IX.D – Environments: Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Underground	The buried and underground environmental terms were split into two separate terms accompanied by minor changes.	The term "restricted" was revised to "limited" to better clarify the intent of the scope of underground piping. Some tunnels or vaults are routinely checked by operations staff during plant tours. Even though these components would be below grade and in contact with air, access is not limited. In some instances, access to these vaults is "restricted" due to considerations such as dose or confined space requirements. However, as long as plant personnel routinely access these vaults or tunnels, and can observe the condition of the components, they would not be considered to be exposed to an underground environment. To further clarify its intent on what constitutes an underground component, the staff used an example of special lifting equipment being required to access a vault. The sentence, "When the underground environment is cited, the term includes exposure to air-outdoor, air-indoor uncontrolled, air, raw water, ground water, and condensation." was added in order to eliminate repeating these environmental terms in AMR items that cite the underground environment.

Table 2-25 Chapter IX.E – Aging Effects - Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Cracking, loss of bond, and loss of material (spalling, scaling)	The term was deleted.	Subsequent to the issuance of the GALL-SLR, the staff noted that this term was inadvertently deleted. The definition should have remained as defined in Table IX.E of GALL, Revision 2,"Cracking, loss of bond, and loss of material (spalling, scaling) when caused by corrosion of embedded steel in concrete.
Flow blockage	Changes were incorporated to better align the use of the term to the pressure boundary definition included in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) and provide examples of other functions that could be affected by flow blockage.	SRP-SLR, Table 2.1-4(b), "Typical "Passive" Component-Intended Functions states that the pressure boundary function is to "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." The staff included the heat transfer, spray, and throttle functions because all of these could be affected by fouling products.
Fretting or lockup	The term was deleted.	Line items that include fretting were revised to indicate that fretting is an aging mechanism that can lead to the aging effect of loss of material. Therefore, this term was not an aging effect associated with GALL-SLR AMR items. As a result, the staff deleted the term.
Hardening and loss of strength	Factors that cause hardening and loss of strength in elastomers were added to the use of the term. The term "polymer" was added.	The staff replaced "weathered" with "degraded" because weathering is only a subset of the mechanisms that can cause elastomer hardening or loss of strength. The temperature threshold for degradation of elastomers was relocated from the term air–indoor uncontrolled >35 °C (>95 °F) (Internal/External). Based on the staff's review of Gillen and Clough, Rad. Phys. Chem., Vol. 18, p. 679, 1981 (Reference 9), elastomers are also susceptible to degradation due to exposure to ozone, oxidation, photolysis (due to ultraviolet light), and radiation. The term polymer was added in recognition that not all seals gaskets and moisture barriers are constructed specifically of elastomeric materials. However, the staff recognizes that the aging effect hardening, would not be applicable to rigid polymers [e.g., polyvinyl chloride (PVC)].

Table 2-25 Chapter IX.E – Aging Effects - Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Reduction in impact strength	This term was added to the GALL-SLR Report.	The staff added this term to address reduction in impact strength due to long term exposure of components to sunlight as documented in GALL-SLR Report, Chapter IX.E reference No. 16.

Table 2-26 Chapter IX.F – Aging Mechanisms - Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Borated Water Intrusion	The term was deleted.	This term was not associated with Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) aging management review (AMR) items. As a result, the staff deleted the term.
Cladding breach	The term was deleted from the GALL-SLR Report.	This term was only associated with Generic Aging Lessons Learned (GALL) Report Revision 2, AMR items V.D1.EP-49 and VII.E1.AP-85. These ARM items were deleted. The basis for deletion of the line items is documented in Table 2-11 and Table 2-13.
Cladding Degradation	The terms lining and elastomer lining were removed from this term.	The staff addressed aging effects associated with loss of coating integrity in LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks." As a result, stainless steel cladding and elastomeric linings are no longer addressed in the same GALL Report AMR items.
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	The term was added to the GALL-SLR Report.	The staff added this term to address mechanisms associated with cracking and loss of material of cementitious materials in GALL-SLR Report, Chapter VII. During its review of GALL Report Revision 2, the staff noted that only visual inspections were conducted and as a result, some of the mechanisms might not be readily apparent (e.g., change in material properties). The staff researched concrete inspection industry consensus documents (as cited In GALL-SLR Report, Chapter IX.F) and recognized that: (a) visual inspections would be adequate for the expected degradation mechanisms of these components; and (b) the documents included descriptive aging effects and associated mechanism to detect cementitious material degradation by visual inspection methods.
Cyclic loading	The description was clarified.	Initial description was unclear.
Deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	The term was deleted.	This term was not associated with GALL-SLR AMR items. As a result, the staff deleted the term.

Table 2-26 Chapter IX.F – Aging Mechanisms - Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Elastomeric or polymer degradation	The description was clarified to align with the description of hardening or loss of strength related to elastomers. The term "polymer" was added.	Change in material properties was added because it can result in hardening or loss of strength of elastomeric components. It is inspected for by physical manipulation of elastomeric components. The term "polymer" was added because these materials are also susceptible to similar aging effects and mechanisms. However, the staff recognizes that the aging effect hardening, would not be applicable to rigid polymers [e.g., polyvinyl chloride (PVC)].
Fouling	The term was clarified and tuberculation was added.	Clarification provided consistency with the terminology used in flow blockage and reduction of heat transfer. Tuberculation, inorganic or organic, was added because it can represent a significant source of fouling.
Fretting	The term was clarified.	Initial description identified fretting as an aging effect. However, fretting is an aging mechanism that can lead to the aging effect of "loss of material." The definition was updated to reflect this fact.
Galvanic Corrosion	Galvanic corrosion was removed from the AMR item tables as a specific aging mechanism; however, the term was maintained in GALL Report Chapter IX.F to capture the basis for its removal from the AMR item tables.	Galvanic corrosion was removed from the AMR item tables as a specific aging mechanism. The most effective means of mitigating or preventing galvanic corrosion involve design and maintenance activities. For example: (a) selecting dissimilar metals that are close to each other in the galvanic series; (b) avoiding localized small anodes and large cathodes; (c) instituting means to insulate the dissimilar metals from each other; (d) coatings and (e) sacrificial anodes. The staff provided examples of three specific aging management programs (AMPs) that would manage loss of material due to galvanic corrosion even in the absence of it being listed as a specific aging mechanism.
General Corrosion	Detail was removed from the description.	Detail was removed from the description of the term because (a) it was incomplete (i.e., general corrosion occurs for steel components in more environments than outdoor air); and (b) pitting and crevice corrosion were added as aging mechanisms where appropriate, so the second paragraph was no longer necessary.
Plastic deformation	The term was deleted.	This term was not associated with GALL-SLR AMR items. As a result, the staff deleted the term.

Table 2-26 Chapter IX.F – Aging Mechanisms - Differences from Chapter IX, GALL Report, Rev. 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
Selective leaching	The term was expanded to the various terms used in the industry and its impact.	The expanded text is consistent with standard explanations of selective leaching including in multiple references. Based on its review of license renewal applications, the staff incorporated the statement that, "The dealloyed volume does not have mechanical properties that can be credited for structural integrity." Based on the staff's review of nuclear, nonnuclear, and military data on selective leaching, the staff has concluded that there is no lower bound value for tensile or yield properties of susceptible materials. The staff's basis is documented in the Safety Evaluation Report Related to the License Renewal of South Texas Project, Units 1 and 2 (ADAMS Accession No. ML17146B242), Section 3.0.3.3.3, "Selective Leaching of Aluminum Bronze." Although this reference is only directly applicable to selective leaching of aluminum bronze components, the conclusions are the same for gray cast iron, ductile iron, and copper with a zinc content greater than 15%.
Reduction in impact strength	This term was added to GALL Report Section IX.F (as well as Section IX.E) and thus can be either aging effect or mechanism, depending on context.	Based on a review of JM Eagle™ Technical Bulletin, "The Effects of Sunlight Exposure on PVC Pipe and Conduit," JM Manufacturing Company Inc., January 2009, long -term (2 years or longer) exposure of PVC piping, piping components, and piping elements to sunlight can result in a reduction in impact strength. Other polymeric materials are subject to embrittlement due to environmental conditions such as sunlight, ozone, chemical vapors, or loss of plasticizers due to evaporation. The staff added PVC exposed to sunlight as a new material, environment, and aging effect combination.
Wear	Added a new sentence to the existing use of the term wear to address buried polymeric components.	The staff has concluded that loss of material due to wear can occur in polymeric components buried in soil containing deleterious materials that move over time due to seasonal change effects on the soil. Although wear can also affect buried metallic components, the effects would be significantly less for these components. Damage to coatings on metallic piping is addressed in AMP XI.M41.

Table 2-27 Chapter IX.G – References --Differences from Chapter IX, GALL Report, Revision 2 and Their Technical Bases

Defined Term	Summary of Significant Changes	Technical Basis for Change
References	The following references have been added to Generic Aging Lessons Learned (GALL) Report, Chapter IX.G: • Welding Handbook, 7th Edition, Volume 4, Metals and Their Weldability, American Welding Society, 1984, p. 76-145. • Metals Handbook, 9th Edition, Volume 11, Failure Analysis, ASM International, 1980, p. 415. • EPRI-1010639, "Non- Class 1 Mechanical Implementation Guideline and Mechanical Tools, January 2006, page 2-13. • JM Eagle™ Technical Bulletin, "The Effects of Sunlight Exposure on PVC Pipe and Conduit," JM Manufacturing Company Inc., January 2009 • Relief Request RR-04-13 for the Temporary Non-Code Compliant Condition of the Class 3 Service Water System 10-Inch Emergency Diesel Generator Supply Piping Flange, October 18, 2012, ADAMS Accession No. ML12297A333. • EPRI 1000975, Boric Acid Corrosion Guidebook, Managing Boric Acid Corrosion Issues at PWR Power Stations, Revision 1.	These references were added because they are source documents that had not previously been used in developing information presented in GALL Report, Chapter IX.

Table 2-28 GALL-SLR Differences from Chapter X, TLAAs, GALL Report Revision 2 and their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
	GALL-SLR Chapter X	
NUREG–2191, Volume 2, Chapter X, Title Page and Text	The staff changed the title of Chapter X in Volume 2 of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report from "Time-Limited Aging Analyses" to "Aging Management Programs Used to Demonstrate the Acceptability of Time-Limited Aging Analyses Under 10 CFR 54.21(c)(1)(iii)." The text for Chapter X was updated to list the following aging management programs (AMPs) that are used to accept time-limited aging analyses (TLAAs) in accordance with 10 CFR 54.21(c)(1)(iii): (a) AMP X.M1, Cyclic Load Monitoring (b) AMP X.M2, Neutron Fluence Monitoring (c) AMP X.S1, Concrete Containment Unbonded Tendon Prestress (d) AMP X.E1, Environmental Qualification (EQ) of Electric Components The staff added two tables to provide examples of applicable Final Safety Analysis Report (FSAR) supplement summary descriptions: (a) Table X-01 for those that apply to these AMPs, and (b) Table X-02 for the TLAAs the correlate to these AMPs. Table X-02 was later deleted from the scope of the GALL-SLR Report.	The previous title of the Chapter X title page, as given in the Generic Aging Lessons Learned (GALL) Report, Revision 2, was misleading. Chapter X in the staff's GALL documents has always provided a list of those AMPs (and the program element criteria for the AMPs) that are commonly used to demonstrate the acceptance of generic TLAAs or even some plant-specific TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The TLAAs that correlate to the AMPs listed in Chapter X of the GALL-SLR Report are given in either Chapters 4.2, 4.3, 4.4, 4.6, or 4.7 of the SRP-SLR. Therefore, the staff revised the title of GALL-SLR Report, Chapter X to "Aging Management Programs Used to Demonstrate the Acceptability of Time-Limited Aging Analyses Under 10 CFR 54.21(c)(1)(iii)." Like the AMPs contained in Chapter XI of the GALL-SLR, the AMPs contained in Chapter X of the GALL-SLR are defined in terms of the 10 program elements that are recommended for AMPs in Appendix A.1 of the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR).
	X.M1, Cyclic Load Monitoring (previously titled "Fatigue Monitoring")	
<u>Overview of Changes</u>: Title Program Description Scope of Program	The staff updated the scope of the previous version of GALL AMP X.M1 to all type of metal or structural fatigue analyses or cyclical loading analyses that include an assessment of design transients, including:	The staff decided against renaming the title of the AMP because the staff concluded that renaming the title of the AMP would impose unnecessary expense burdens on the development of subsequent license renewal applications (SLRAs) without any safety benefit to the facilities. Thus, the name of AMP X.M1 will remain "Fatigue Monitoring."

Table 2-28 GALL-SLR Differences from Chapter X, TLAAs, GALL Report Revision 2 and their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience	(a) design basis metal fatigue analyses involving usage factor calculations (i.e., CUF or I_t analyses), (b) environmentally-assisted fatigue analyses (CUF_{en} analyses) for reactor coolant pressure boundary components, (c) fatigue waiver analyses involving cyclic loading assumptions, (d) expansion stress/maximum allowable stress calculations analyses (i.e., expansion stress analyses) for American Society of Mechanical Engineers (ASME) Code Class 2 and 3 components or United States of American Standards (USAS) American National Standards Institute (ANSI) B31.1 components, and (e) fatigue flaw growth, flaw tolerance of fracture mechanics analyses that are based on cyclic loading assumptions. The staff also updated the AMP to provide improved criteria for the programmatic activities that apply to the environmentally-assisted fatigue analyses (i.e., CUF_{en} analyses) for reactor coolant pressure boundary components.	The scope of the cycle monitoring activities and design transient monitoring activities of the previous AMP has been expanded to include monitoring against the following types of AMPs and analyses: (a) design basis metal fatigue analyses involving usage factor calculations (i.e., CUF or I_t analyses), (b) environmentally-assisted fatigue analyses (CUFen analyses), (c) fatigue waiver analyses involving cyclic loading assumptions, (d) expansion stress/maximum allowable stress calculations analyses (i.e., expansion stress analyses) for ASME Code Class 2 and 3 components or USAS ANSI B31.1 components, and (e) fatigue flaw growth, flaw tolerance of fracture mechanics analyses that are based on cyclic loading assumptions. In the past, numerous requests for additional information (RAIs) were issued on the bases for applying this AMP to cyclic loading analyses other that cumulative usage factor (i.e., CUF or I_t) analyses or environmentally-assisted fatigue (i.e., CUF_{en}) analyses. For future SLRAs, the expansion of the scope of the AMP should reduce the number of administrative of RAIs that pertain on these types of matters, as previously raised during the staff's reviews of initial LRAs for a nuclear plant's facility. One important matter covered by the AMP relates to the possibility that the current licensing basis (CLB) for a given U.S. light water reactor facility may include more than one type of cyclic loading analysis that would qualify as TLAAs, and each of the analyses may assume a different number of occurrences for common transients assumed in the

Table 2-28 GALL-SLR Differences from Chapter X, TLAAs, GALL Report Revision 2 and their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		analyses. Therefore, the administrative changes to the AMP address the expectation that the program should set applicable monitoring criteria, acceptance criteria, and corrective actions for each type of cyclic loading analysis that the AMP will be applied to for aging management. Resolution of the specific comments received on this AMP is addressed in the rows that follow.
X.M2, Neutron Fluence Monitoring		
Overview of Changes: Title Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience	The staff developed and added a new program, AMP X.M2, "Neutron Fluence Monitoring, to Chapter X of the GALL-SLR Report.	The staff developed a new AMP X.M2, "Neutron Fluence Monitoring," in the GALL-SLR Report that provides an adequate basis for accepting reactor pressure vessel (RPV) neutron embrittlement TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The use of this AMP, when coupled to an applicant's use of its Reactor Vessel Material Surveillance program (Chapter XI.M31 of the GALL-SLR), provides an adequate basis for accepting these types of TLAAs in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii) and for demonstrating that the impact of loss of fracture toughness will not result in a loss of intended functions of the RPVs during the subsequent period of extended operation. The basis for using GALL-SLR AMP X.M2 to accept these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(iii) is analogous to manner in which GALL-SLR AMP X.M1, "Fatigue Monitoring Program," to accept fatigue parameter TLAAs (i.e., cyclical loading TLAAs) in accordance with 10 CFR 54.21(c)(1)(iii) and demonstrate that the impact of fatigue-induced cracking or cumulative fatigue damage on the intended functions of the components will be adequately managed during the subsequent period of extended operation.
X.S1: Concrete Containment Unbonded Tendon Prestress (previously titled "Concrete Containment Tendon Prestress")		
Title	Reworded title to include "Unbonded"	Title was changed to properly reflect the methodology presented in the AMP for managing the effects of aging (i.e., evaluating tendon lift off forces to assess containment

Table 2-28 GALL-SLR Differences from Chapter X, TLAAs, GALL Report Revision 2 and their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		prestress) is applicable to concrete containments with unbonded tendons only.
Program Description	Clarified focus of the program to assess the adequacy of measured tendon prestress forces for the sampled group of unbonded tendons	The focus of this program is to support Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1)(iii) for each sampled tendon group (i.e., hoop, vertical, dome, inverted-U, helical) that the effects of aging on the intended function(s) will be assessed and adequately managed for the period of subsequent license renewal.
Preventive Action	Added that this is a condition monitoring program. Corrective actions should be taken before tendon prestress forces fall below design values	The type of aging management program was added consistent with Appendix A.1.1 of SRP-SLR. 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. This program periodically monitors loss of prestress forces of the sampled tendons. The importance of corrective actions is noted to ensure the design adequacy of the containment remains.
Detection of Aging Effects	Provided specifics on how to evaluate loss of tendon prestress	The program element identifies specifically how loss of concrete containment tendon prestressing forces is detected (i.e., by measuring tendon forces, analyzing (predicting) tendon forces and trending the data obtained as part of ASME Section XI, Subsection IWL examinations).
Monitoring and Trending	The Predicted Lower Limit (PLL), Minimum Required Value, and tendon (lift-off) force trend lines for each tendon group are projected to the end of the SLR period	The program element identifies in addition to ASME Code Section XI requirements, the "benchmarks" needed to evaluate containment tendon prestress adequacy to the end of the subsequent license renewal (SLR) period.
Acceptance Criteria	Emphasize the importance of the PLL for each trended group of tendons. If the tendon force trend line crosses the PLL, the cause is determined, documented, evaluated, and corrected	The importance of the PLL is noted, consistent with the referenced RG 1.35.1, "Determining Prestressing Forces for Inspection of Prestressed Concrete Containments."
X.E1: Environmental Qualification of Electric Components		
Program descriptions: (Pages X.E1-1; X.E1-2; X.E1-3; X.E1-4 and X.E-1-5)	Statement is made that the first periodic inspection is to be performed prior to the subsequent period of license renewal. This, if implemented, creates additional requirements for the environmental qualification (EQ) Program and EQ equipment prior to SLR.	The revisions to this AMP include minor editorial changes and other clarifications. NRC staff added language to new recommendations for visual inspection of adverse localized environments of AMP

Table 2-28 GALL-SLR Differences from Chapter X, TLAAs, GALL Report Revision 2 and their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
Underlying Assumptions (Pages X.E1-4).	Clarify that the SLR AMP X.E1 report is limited to passive components only. The intent of X.E1 is to manage cable and connection insulation material. Recommend defining EQ electrical equipment in the GALL Report to mean cable and connection insulation material (See SLR SRP, Section 2.5.3).	X.E1 to clarify that such inspections only apply to passive EQ equipment.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
XI.M1 ASME Section XI Inspection, Subsections IWB, IWC, and IWD		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspection Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	Updated all elements with clarifications and editorial changes. In detection of aging effects, removed reference to boiling water reactor (BWR) vessel internals (more applicable to XI.M9). In detection of aging effects, relocated reference to IWA to program description. In monitoring and trending, clarified information. In acceptance criteria, relocated information related to examination results to monitoring and trending.	The revisions to this aging management program (AMP) include minor editorial changes and other clarifications. In the "detection of aging effects" program element, the reference to BWR vessel internals was removed because it was more applicable to AMP XI.M9. In the "detection of aging effects" program element, the reference of IWA was moved to the program description. In the "monitoring and trending" program element, the staff clarified information. In the "acceptance criteria" program element, the staff relocated information to another element.
XI.M2 Water Chemistry		
Program Description References	Correct the Electric Power Research Institute (EPRI) document number for citing the Pressurized Water Reactor Primary Water Chemistry Guidelines. Revise the revision level for VIP-190.	Subsequent to the issuance of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report, the staff noted that although the revision level of the EPRI pressurized water reactor (PWR) Primary Water Chemistry Guidelines document was revised from Revision 6 to Revision 7, the EPRI document number was not revised. The staff's intent is that EPRI 3002000505, "Pressurized Water Reactor Primary Water Chemistry Guidelines," Revision 7 is the correct reference. The staff also noted that the correct full title of EPRI 1016555, Revision 7 is "Pressurized Water Reactor Secondary Water Chemistry Guidelines." Subsequent to the issuance of the GALL-SLR Report, the staff noted that the revision level of VIP-190 had not been raised to the current revision level. Consistent with the staff's evaluation

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		of an exception documented in NUREG–2205, “Safety Evaluation Report Related to the License Renewal of LaSalle County Station, Units 1 and 2,” September 2016, Section 3.0.3.2.1, “Water Chemistry,” the staff finds BWRVIP-190, Revision 1, “BWR Vessel and Internals Project, Volume 1 BWR Water Chemistry Guidelines – Mandatory, Needed, and Good Practice Guidance,” EPRI 3002002623, dated April 24, 2014, acceptable to cite without exception.
Preventative Actions Corrective Actions Confirmation Process Administrative Controls References	In preventive actions, added dose rates to the list of parameters controlled by additives. In confirmation process, removed hydrogen peroxide from the list of contaminant concentrations to monitor. Updated references.	The revisions to this AMP include minor editorial changes and other clarifications. Dose rates were added to the list of parameters controlled by additives, in accordance with industry guidance. The monitoring of hydrogen peroxide was removed from the AMP. Some plants take exception to the Generic Aging Lessons Learned (GALL) recommendation for monitoring of hydrogen peroxide, because accurate measurement of this chemical is extremely difficult due to its rapid decomposition in the sample lines. As an alternative, they monitor the molar ratio of hydrogen to oxygen. No monitoring of hydrogen peroxide is listed specifically in the GALL aging management review (AMR) line items; hydrogen peroxide only effects BWRs that use hydrogen water chemistry.
XI.M3 Reactor Head Closure Stud Bolting		
Preventive Actions	Revised to specify that the yield strength < 1,034 megapascals (MPa) [150 ksi (kilo-pounds per square inch)] for newly installed studs, or 1,172 MPa [170 ksi (kilo-pounds per square inch)] ultimate tensile strength for existing studs.	The GALL Report XI.M3 AMP, “Reactor Head Closure Stud Bolting” is based on American Society of Mechanical Engineers (ASME) Section XI, Inservice Inspections (ISI), and the recommendations of Regulatory Guide (RG) 1.65 “Materials and Inspections of Reactor Vessel Closure Studs.” During each inspection interval, 100% of the closure bolting (nuts, studs, washers, vessel flange threads) are inspected. In addition, during each refueling outage, the bolting is disassembled, cleaned, lubricated, reassembled, and the joint is pressure tested for leakage prior to the reactor being placed in operation. Currently there is no technical justification or operating experience to suggest that GALL AMP XI.M3 needs to be

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		augmented or revised significantly in order to support aging management for subsequent license renewal (SLR). There is more than 40 years of operating experience available, with no incidence of an inservice failure of a single closure bolt. In addition, the only documented event of service induced cracking was reported by a single unit (a BWR). The cracking was attributed to stress corrosion cracking (SCC) in the thread roots, due to improper heat treatment, the presence of sulfates (MoS_2), and was compounded by special events which promoted crack initiation and growth. Even so, the inspections in place at that time were sufficient to detect the cracking prior to the failure of the bolts. While this operating experience suggests that under certain circumstances cracking for these components can occur, it also demonstrates that the program is effective in the detection of the applicable aging effects. The staff believes that the continued implementation of GALL AMP XI.M3 would provide adequate aging management of the RPV Closure Bolting for the period of subsequent license renewal (i.e., 60 to 80 years of operation). However, a revision was made for the "Preventive Action" element of the AMP for SLR in order to reduce the number of requests for additional information (RAIs), and aid applicants in avoiding using unnecessary exceptions to the GALL-SLR Report, AMP XI.M3. The revision for SLR is as follows with the new edits underlined: "Using bolting material for closure studs that has an actual measured yield strength less than 1,034 megapascals (MPa) (150 kilo-pounds per square inch) <u>for newly installed studs, or 1,172 megapascals (MPa) (170 kilo-pounds per square inch) ultimate tensile strength for existing studs</u>." Based on the background of the initial change which was driven by revision to previous guidance documents as

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		discussed below, and comments from industry, the staff revised the guidance for SLR. RG 1.65, "Materials and Inspections for Reactor Vessel Closure Studs," Revision 1, dated April 2010, states in part: "The above-mentioned stud materials, when tempered to a maximum tensile strength of 1,172 megapascals (MPa) [170 kilo pounds per square inch (ksi)] (Ref. 8), are relatively immune to stress-corrosion cracking (SCC). Above this strength level, the alloy becomes increasingly susceptible to SCC. Therefore, design conservatism should be exercised in determining the sizing of the studs so that the strength level of the material selected will not result in a measured yield strength exceeding 1,034 MPa (150 ksi)." Previous version of RG 1.65, dated October 1973, states the following: "The above-mentioned, stud materials when tempered to a maximum tensile strength of 170 ksi (Ref. 2) are relatively immune to stress corrosion cracking (SCC). Above this strength level the alloy becomes increasingly susceptible to SCC. Therefore, design conservatism should be exercised in determining the sizing of the studs so that the minimum specified strength level of the material selected will not result in a measured ultimate tensile strength exceeding 170 ksi."
XI.M4 BWR Vessel ID Attachment Welds		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected	Updated all elements with clarifications and editorial changes. In corrective actions, added new reference Boiling Water Reactor Vessel and Internal Project (BWRVIP)-52-A.	The revisions to this AMP include minor editorial changes and other clarifications that are intended to more closely align the content of the program with BWRVIP-48-A. In addition, a reference to BWRVIP-52-A, "BWR Vessel and Internals Project, Shroud Support and Vessel Bracket Repair Design Criteria," dated September 2005, has been added to the "corrective actions" element of the program. This report contains NRC staff-approved guidance applicable to the repair and replacement of BWR vessel ID attachment welds. These

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References		revisions improve the program but do not result in any technical or fundamental changes to its underlying condition monitoring activities.
XI.M5 BWR Feedwater Nozzle		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	GALL AMP XI.M5, BWR Feedwater Nozzles," was deleted from the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report. The corresponding AMR items for the BWR feedwater nozzle components [i.e., GALL-SLR AMR item IV.A1.R-65 and Standard Review Plan for Subsequent License Renewal (SRP-SLR) AMR item 095 in SRP-SLR Table 3.1-1] were modified to recommend use of AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," as the condition monitoring basis for managing cracking in these components. Reference to AMP XI.M5 is no longer included in the relevant AMR items for BWR feedwater nozzles.	AMP XI.M5, "BWR Feedwater Nozzles," was retired from the GALL-SLR Report because the implementation of GALL-SLR AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," is sufficient to manage cracking in BWR feedwater nozzles that may be induced by a cyclical loading mechanism. The program in GALL-SLR AMP XI.M1 relies on implementation of ISI requirements in 10 CFR 50.55a(g) and the ASME Code Section XI. The rule also imposes conservative performance demonstration qualification requirements to demonstrate the adequacy of any ASME Section XI volumetric inspection techniques that will be performed on the components. The implementation of these requirements is sufficient to monitor for potential cracking that may occur in the nozzles by a cyclical loading mechanism.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M6 BWR Control Rod Drive Return Line Nozzle	
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	GALL AMP XI.M6 was deleted from the GALL-SLR Report. The associated AMR items for control rod drive return line nozzles and piping components in GALL-SLR Tables IV.A1 and IV.C1 and in SRP-SLR Table 3.1-1 were modified accordingly.	AMP XI.M6, "BWR Control Rod Drive Return Line Nozzles," was retired and omitted from the GALL-SLR Report because condition monitoring activities for these types of nozzles may be achieved adequately through implementation of other AMPs in the GALL-SLR Report. As cited in the GALL Report, Revision 2, BWR control rod drive (CRD) return line nozzles and their nozzle-to-vessel welds may be susceptible to cracking that is induced by a cyclical loading or fatigue mechanism. For these components, the staff finds that GALL-SLR Report, AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," requires inspection of these components in accordance with the volumetric examination requirements in the ASME Code Section XI, as subject to the regulatory requirements in 10 CFR 50.55a(g). These requirements are also supplemented by implementation of performance demonstration initiative (PDI) requirements for performing these types of inspections in 10 CFR 50.55a(g). Thus, implementation of these requirements and the programmatic criteria in GALL-SLR AMP XI.M1 are sufficient to manage any potential cracking that may occur in the components as a result of cyclical loading mechanisms.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M7 BWR Stress Corrosion Cracking	
Program Description Scope of Program Preventive Actions Detection of Aging Effects Monitoring and Trending Corrective Actions Confirmation Process Administrative Controls References	In program description, added cold work as a fabrication process that introduces residual tensile stress. In scope of program, clarified that CRD return line nozzle caps and associated welds may be included in the scope of the program. In preventive actions, clarified that program relies on countermeasures [such as use of intergranular stress corrosion cracking (IGSCC)-resistant materials]. In detection of aging effects, added the identification of stagnant flow locations and consideration of these locations when selecting inspection locations. The conditions of BWRVIP-62-A regarding water chemistry control are also referenced in the guidance for crediting hydrogen water chemistry to modify the extent and frequency of inspections.	The revisions to this AMP include minor editorial changes and other clarifications based on updates to the references. Given the deletion of AMP XI.M6, "BWR Control Rod Drive Return Line Nozzle," the program is revised to indicate that CRD return line nozzle caps and associated welds may be included in AMP XI.M7 for aging management of cracking due to IGSCC. This guidance is consistent with the scope of AMP XI.M7 that includes BWR piping and piping welds in which IGSCC can occur. Table 3 1, "Summary of Changes," of BWRVIP-75-A, Footnote 3b recommends that during the selection of locations for inspection, consideration should be given to the stagnant flow condition because this condition can promote SCC. Therefore, the clarified guidance regarding consideration of stagnant flow locations for inspection locations is consistent with the existing guidance in BWRVIP-75-A, which is referenced in the program.
	XI.M8 BWR Penetrations	
Program Description Parameters Monitored or Inspected Detection of Aging Effects Corrective Actions Confirmation Process Administrative Controls References	In program description, updated with a new reference and clarified the aging effects the program manages. In parameters monitored or inspected, clarified that different inspection methods are used to monitor different types of aging-related indications (e.g., surface-breaking discontinuity detected by visual inspections and flaw indications detected by ultrasonic testing). In detection of aging effects, added the reference to staff-approved BWRVIP guidelines.	The revisions to this AMP include minor editorial changes and other clarifications based on updates to the references.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	In corrective actions, updated information to include relevant BWRVIP documents developed since GALL Report, Revision 2. Updated references.	
	XI.M9 BWR Vessel Internals	
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	Updated all elements with clarifications and editorial changes. In scope of program, added loss of preload due to thermal or irradiation-enhanced stress relaxation for core plate rim holddown bolts and jet pump assembly holddown beam bolts; and clarified that cracking due to cyclic loading includes cracking due to flow-induced vibration (for steam dryers). The staff also added the reference to BWRVIP-180, which provides inspection and flaw evaluation guidelines for access hole covers. In parameters monitored or inspected, clarified that alternative staff-approved screening criteria may be used to determine the susceptibility of cast austenitic stainless steel to neutron or thermal aging embrittlement (such as screening criteria approved in the June 22, 2016, safety evaluation regarding BWRVIP-234). In detection of aging effects, added evaluations to determine a need for supplemental inspections. In monitoring and trending, added the reference to BWRVIP-100-A that provides flaw evaluation methodologies and fracture toughness data for stainless steel core shroud exposed to neutron irradiation.	With respect to the core plate rim holddown bolts, Section 2.1.3 of BWRVIP-25 indicates that these bolts are susceptible to loss of preload due to thermal or irradiation-enhanced stress relaxation. Therefore, this aging effect is included in the scope of GALL-SLR Report, AMP XI.M9. NRC Bulletin 80-07, “BWR Jet Pump Assembly Failure,” also indicates that attention should be paid to evidence of distress that could be indicative of loss of beam assembly preload during visual inspections. This position in the NRC Bulletin is consistent with the GALL-SLR guidance addressing the loss of preload aging effect for the jet pump assembly holddown beam bolts. The staff also noted that industry aging management activities included evaluation of neutron fluence effects on the reduction in preload of jet pump holddown beam bolts. These discussions serve as the technical basis to identify the loss of preload in holddown beam bolts within the program scope. The program scope was clarified to indicate that the cyclic loading mechanism, which can cause cracking, includes the flow-induced vibration mechanism. This clarification is consistent with the discussion in BWRVIP-193-A indicating that BWR steam dryer components are susceptible to cracking due to flow-induced vibration. BWRVIP-180 provides guidelines for inspections of shroud support plate access hole covers, including inspections using ultrasonic testing. These inspections are augmented inspections beyond the visual inspection requirements specified in ASME Code Section XI. The staff finds the inspection guidelines in BWRVIP-180 are sufficient to manage

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	In operating experience, added example related to irradiation-assisted stress corrosion cracking (IASCC).	aging for access hole covers and, therefore, the BWRVIP report is referenced in GALL-SLR Report, AMP XI.M9. The staff issued a safety evaluation (SE) regarding BWRVIP-234 on June 22, 2016. The staff-approved BWRVIP-234 provides acceptable screening criteria to determine the susceptibility of cast austenitic stainless steel (CASS) to neutron or thermal aging embrittlement. Therefore, these approved screening criteria can be used to screen BWR vessel internals made with CASS in terms of the susceptibility to loss of fracture toughness. As recommended in GALL-SLR Report, AMP XI.M9 and discussed below, the applicant needs to perform evaluations based on neutron fluence, thermal aging susceptibility, fracture toughness, and cracking susceptibility in order to ensure that the existing BWRVIP inspections are sufficient to manage loss of fracture toughness for the subsequent period of extended operation. This evaluation may identify additional inspections or program enhancements (beyond the existing BWRVIP guidelines) that are necessary for aging management during the subsequent period of extended operation. If the plant-specific conditions of CASS reactor vessel internals for the subsequent period of extended operation exceed the screening criteria approved in the SE, the applicant should perform additional inspections beyond the existing BWRVIP inspections as necessary to manage loss of fracture toughness. In the use of the screening criteria, an applicant needs to consider plant-specific neutron fluence levels of the components, which are projected for 80 years of operation. With respect to the evaluations to determine a need for supplemental inspections, the staff finds the following basis. The existing BWRVIP guidelines are mainly based on the 60 years of operation and the subsequent period of extended operation beyond 60 years will impose higher fluence levels on

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		BWR vessel internals. During the SLR term, the higher fluence can facilitate loss of fracture toughness due to thermal or neutron embrittlement (including potential combined effects) and cracking due to IASCC. Therefore, this program has been updated to include evaluations to determine whether supplemental inspections in addition to the existing BWRVIP inspections are necessary to adequately manage these aging effects for the SLR term. If the evaluations determine that supplemental inspections are necessary for certain components based on neutron fluence, cracking susceptibility and fracture toughness, this program performs the supplemental inspections for adequate aging management of loss fracture toughness and IASCC.
XI.M10 Boric Acid Corrosion		
Program Description	Clarified the objectives of Generic Letter (GL) 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," and that all components subject to AMR are included, not just components that contain borated water. Added WCAP-15988-NP, "Generic Guidance for an Effective Boric Acid Inspection Program for Pressurized Water Reactors," as providing acceptable guidance for program activities.	The clarification did not change the basic program guidance. WCAP-15988-NP is used extensively by many nuclear power plants to structure boric acid corrosion programs
Scope of Program	Added clarification that GL 88-05 recommendations are also effective for managing boric acid corrosion in components not included in GL 88-05.	The clarification does not change the basic program guidance.
Preventive Actions	Formally included preventive actions mentioned in prior versions, including corrosion resistant materials and coatings	GL 88-05 includes corrective actions to prevent recurrence as modifications using corrosion resistant materials and protective coatings/claddings, which qualify as preventive actions.
Parameters Monitored or Inspected	Added "discolored boric acid crystals" as an indication of corrosion.	Boric acid color is called out in in several sections of WCAP 15988-NP.
Parameters Monitored or Inspected	Added paragraph about identifying potential leakage through means other than during walkdowns or maintenance.	Regulatory Issue Summary (RIS) 2003-13, "NRC Review of Responses to Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		Integrity," includes a discussion on the potential for boric acid leakage to become airborne. WCAP-15988-NP includes boric acid residue in containment fans and filters, and changes in containment humidity, temperature or reactor coolant system (RCS) leak rates.
Detection of Aging Effects	Clarified the need to remove obstructions (e.g., insulation) to perform visual inspections.	WCAP-15988-NP includes a mandatory objective for removal of visual inspection obstructions, unless a technical justification is prepared.
Monitoring and Trending	Added statement for maintaining a list of components having specific attributes	WCAP-15988-NP, Section 7.7 includes data collection and documentation attributes.
Acceptance Criteria	Added statement for screening all indications of boric acid leakage.	WCAP-15988-NP, Section 7.6 includes criteria associated with screening, evaluating, and dispositioning leaks.
Corrective Actions	Added discussion for corrective actions where enclosures are used to contain borated water leakage	Considerations from NRC Information Notice 2012-15 address enclosures to contain borated water leakage.
Corrective Actions Confirmation Process Administrative Controls	Added standardized language to all three program elements.	The standardized language does not change the basic approach used for these program elements from GALL Revision 2.
Operating Experience	Clarified standardized wording for operating experience reviews to include research and development and the AMP effectiveness evaluation. Updated discussion to include examples of airborne boric acid leakage.	The standardized wording from LR-ISG-2011-05, "Ongoing Review of Operating Experience" was clarified based on the staff's recognition that research and development provides another source of operating experience information. The need for AMP effectiveness evaluation is based on the discussion in GALL-SLR Appendix B. Operating experience (OE) examples associated with airborne boric acid demonstrate the need to consider boric acid corrosion in locations well away from the leakage source.
References	Updated references	Added documents associated with new examples of OE from recent events and industry guidance documents cited in the program.
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)		
Scope of Program Detection of Aging Effects	In scope of program, clarified that the program includes the following components:	The staff added the clarification regarding the scope of program and detection of aging effects program elements based on the fact that the program relies on the inservice inspection requirements specified in 10 CFR 50.55a and the

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	(1) nickel alloy components and welds identified in ASME Code Cases N-770, N-729, and N-722 (2) all nickel alloy components and welds, which are identified at the plant in accordance with the guidelines of EPRI MRP-126; and (3) components that are susceptible to boric-acid corrosion and may be impacted by leakage of boric acid from adjacent nickel alloy components described above. In detection of aging effects, clarified that inspections are conducted in accordance with 10 CFR 50.55a; other nickel alloy components and welds not addressed by 10 CFR 50.55a are inspected in accordance with the guidance in MRP-126. In detection of aging effects, added that baseline inspection provisions for branch line connections and associated welds that are fabricated with nickel alloys susceptible to primary water stress-corrosion cracking (PWSCC).	industry guidance for Alloy 600 management described in MRP-126. This program also performs a baseline volumetric or inner-diameter surface inspection of all susceptible nickel alloy branch line connections and associated welds as identified in Table 4-1 of MRP-126 if such components or welds are of a sufficient size to create a loss of coolant accident through a complete failure (guillotine break) or ejection of the component and the normal operating temperature of the components is 525 °F (274 °C) or greater. Existing periodic inspections using volumetric or surface examination methods may be credited for this baseline inspection. The baseline inspection to be performed prior to the subsequent period of extended operation is necessary for a timely detection and adequate aging management of PWSCC for susceptible nickel alloy branch line connections. As discussed in RIS 2015-10, applicants or licensees may have not examined branch line connections and associated welds using a volumetric examination method even though the requirements specified in ASME Code Case N-770-1, as incorporated by reference in 10 CFR 50.55a, include inspections of ASME Code Class 1 branch line connections. Therefore, the program specifies the baseline inspections of safety-significant branch line connections to confirm that baseline inspection results (or the results of the existing inspections as credited) prior to the SLR period are adequately evaluated and used for aging management. The temperature threshold regarding the susceptibility to PWSCC in this guidance is consistent with that in ASME Code Case N-770-1, as incorporated by reference in 10 CFR 50.55a, “Codes and Standards.” The ASME Code Case indicates that the minimum cold leg operating temperature, which is conducive to PWSCC in Class 1 piping and butt welds, is 525 °F (274 °C).

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M12 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	
Program Description Scope of Program Detection of Aging Effects	In the program description element, revised last paragraph to clarify that AMP XI.M12 does not cover cast austenitic stainless steel (CASS) in reactor vessel internals (RVI). The program description and scope of program sections of the AMP were modified to remove language that excludes pump casings from the additional aging management recommendations of XI.M12. Language was also added to these sections to state that for pump casings, as an alternative to screening for significance of thermal aging, no further actions are needed if applicants demonstrate that the original flaw tolerance evaluation performed as part of Code Case N-481 implementation remains bounding and applicable for the SLR period, or the evaluation is revised to be applicable to 80 years. In detection of aging effects, Code Case N-824 now referenced as a method that may be used for ultrasonic (UT) examination of CASS piping as conditioned by 10 CFR 50.55a. In program description, scope of program, and detection of aging effects, generally changed "potentially susceptible" to "potentially significant," and "susceptibility" to "significance" to reflect the fact that thermal embrittlement generally occurs in CASS but only sometimes is severe enough to cause a loss of intended function of the component.	The AMP was modified to remove language that excludes pump casings from the additional aging management recommendations of XI.M12. The basis for this change is that formerly Code Case N-481 specified additional examination and flaw tolerance requirements for pump casings as an alternative to the volumetric examinations required by the ASME Code, Section XI. However, Code Case N-481 has been withdrawn and some, but not all of the provisions of the code case were incorporated into more recent editions of Section XI. Therefore, pump casings should be subject to the recommendations of the AMP including screening for thermal embrittlement and other actions such as enhanced inspections or component-specific flaw evaluations if the screening criteria are not met. However, since all plants that formerly implemented Code Case N-481 have performed a flaw tolerance evaluation for the pump casings, this evaluation could be revised to be applicable to 80 years of operation, or shown to remain applicable. Therefore, the staff added language allowing the alternative to demonstrate that the original flaw tolerance evaluation performed as part of Code Case N-481 implementation remains bounding and applicable for the SLR period, or the evaluation is revised to be applicable to 80 years, since this evaluation was considered by the staff to be the most important provision of Code Case N-481 that was not incorporated into the ASME Code, Section XI. In Detection of Aging Effects, Code Case N-824 is described as an acceptable method of performing UT examination of CASS piping, as conditioned in 10 CFR 50.55a. This change is based on the recommendation of NRC staff experts in nondestructive evaluation and the fact that Code Case N-824 has been approved by the ASME Code. Other changes include the (1) substitution of the term "potentially significant" for "susceptible" with respect to thermal aging embrittlement in recognition of the fact that CASS

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		materials that meet the screening criteria can still have fracture toughness reduced from the unaged condition, but that the loss in fracture toughness is not significant with respect to the component's structural integrity, and (2) clarification that the AMP is not applicable to CASS in reactor vessel internals. Other changes are editorial.
XI.M16A PWR Vessel Internals		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	Program elements updated to include the submittal of a gap analysis wherein applicants will identify needed changes to the AMP to account for 80-years of operation. The programmatic elements of the AMP include criteria for performing the gap analysis. The further evaluation (FE) acceptance criteria in SRP-SLR Section 3.1.2.2.9 and the review procedures in 3.1.3.2.9 were revised to provide a PWR applicant with the option of using MRP-227-A as the starting point for its AMP, but as subject to a gap analysis that would be used to identify potential changes to the inspection and evaluation (I&E) protocols in MRP-227-A if the aging assessment of the RVI components at the plant were performed on a 80-year basis. Alternatively, these SRP-SLR sections continue to allow a PWR applicant to choose the option of developing a plant-specific aging management program for its RVI components	The basis for including a gap analysis was that the technical basis for MRP-227-A, which was implemented through the GALL Revision 2 AMP, was an analysis of conditions that apply for 60-years of plant operation and an assessment over an 80-year operating period could potentially change the inspection criteria in the MRP-227-A report for some PWR RVI components. The sampling-based condition monitoring program in EPRI Report No. 1022863 (MRP-227-A) could serve as the starting point for the AMP that would be used to manage aging in PWR RVI components during a subsequent period of extended operation. A gap analysis is needed to identify changes to the plant's existing program to ensure adequate aging management of the RVI components at the facility during the subsequent period of extended operation.
XI.M17 Flow-Accelerated Corrosion		
Program Description	Added the correlation to GL 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning," and clarified the various phases of the program. Clarified the acceptability of NSAC-202L-R4, "Recommendations for an Effective Flow-Accelerated Corrosion Program (3002000563)," recent revision through footnote 1. Clarified the	Responses to GL 89-08 are considered as current licensing basis as defined by 10 CFR 54.3. Issues related to NSAC-202L-R4 are discussed in Nuclear Energy Institute (NEI) letter dated November 5, 2014 (ADAMS Accession Nos. ML14309A700 and ML14309A702). LR-ISG-2012-01, "Wall Thinning Due to Erosion Mechanisms," provides the basis for allowing erosion mechanisms to also be managed by this

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	basis for using the program for managing erosion mechanisms.	AMP. The various phases of the program were derived from NSAC-202L.
Scope of Program	Added pump bodies.	The bases for the changes between GALL Revision 2 and GALL-SLR are provided in LR-ISG-2012-02, “Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation.”
Preventive Actions	Clarified the applicability of preventive actions to both flow-accelerated corrosion (FAC) and erosion.	The clarification reduces the potential for misunderstanding whether these considerations apply to erosion mechanisms.
Parameters Monitored or Inspected	Added monitoring of relevant system changes and included opportunistic visual inspections during routine maintenance activities.	Operational parameters were derived from NSAC-202L, Section 4.3.2 based on discussions in NSAC-202L, Section 4.2.2 regarding exclusion of systems from evaluation. Visual inspections are described in NSAC-202L, Section 45
Detection of Aging Effects	Added discussion about reassessing the basis for exclusion of components based on 2% operating time cited in NSAC-202L. Clarified that suspected wall thinning identified by visual inspections are verified by wall thickness measurements. Added inspection sample expansion considerations and discussion for inspection personnel qualification	Logic dictates that the 2% operating time exclusion cannot be extended for an unlimited amount of operating time. The guidance to reassess the validity of the exclusion using actual wall thickness information is intended to provide reasonable assurance that intended functions will be maintained. Wall thickness readings at areas of suspected wall loss from visual inspections is described in NSAC-202L, Section 4.5.5. Expanded sample inspection is described in NSAC-202L, Section 4.4.6. Inspection personnel qualification consideration is based on SRP-SLR Section A.1.2.3.4.3, that all aspects of the activities to collect data are described by the program.
Detection of Aging Effects	Added standardized wording for qualifications of personnel performing inspections, including examples of inspection parameters	Based on general guidance for this program element, the staff recognized the need to address some level of qualifications for inspection personnel. Although adequately delineated for ASME Code inspections, examples of typical inspection parameters for non-ASME code inspections were provided.
Monitoring and Trending	Clarified the activities relating to wear rate determinations, remaining service life calculations, model calibration, and inspection schedule development.	Program activities were derived from NSAC-202L, Sections 4.6 and 4.7
Corrective Actions Confirmation Process Administrative Controls	Added standardized wording for use of 10 CFR Part 50, Appendix B, Quality Assurance Program and guidance in GALL-SLR, Appendix A.	The standardized recommendations use the same approach as GALL Report Revision 2 and have not changed.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Operating Experience	Updated examples to include additional erosion issues. Enhanced standardized wording for operating experience reviews to include research and development and the AMP effectiveness evaluation.	Staff reviews of licensee event reports identified additional examples of erosion issues. The standardized wording from LR-ISG-2011-05, "Ongoing Review of Operating Experience," was clarified based on the staff's recognition that research and development provides another source of operating experience information. The need for AMP effectiveness evaluation is based on the discussion in GALL-SLR Appendix B.
References	Updated references based on changes to the program.	Added documents associated with new examples of OE from recent events and a revision to the industry guidance document.
XI.M18 Bolting Integrity		
Scope of Program	Revised to exclude heating, ventilation, and air conditioning (HVAC) closure bolting from the scope of the program and instead manage associated aging effects with AMP XI.M36.	The staff recognizes that it would be difficult to use leakage as an indication for potential degradation of HVAC closure bolting exposed to air or condensation, as originally recommended in AMP XI.M18 for closure bolting. The air in HVAC ducts is only slightly pressurized. As a result, the staff has cited AMP XI.M36 to manage aging effects associated with HVAC closure bolting. HVAC leaks will typically be evident by changes in the capability of the system to cool or heat a room or enclosure, which if they are severe enough will be addressed in the corrective action program. This is in contrasts to an instrument air system (another system that is air-filled) where although air compressor run times could be trended, it would be difficult to pin point the relative location of leaking flanges. In addition, most HVAC closure bolting is relatively short and thus the potential for significant undetected corrosion to be occurring along the hidden portions of the shank is less. Most ducts have a significantly larger number of closure bolts than typical flanges and thus the joint is more tolerant of undetected aging effects occurring at a joint. As a result, the staff has concluded that the normal visual inspections conducted during personnel walkdowns as recommended by AMP XI.M36 can be capable of detecting loss of material, cracking, or loss of preload sufficient to provide reasonable assurance that the HVAC system can meet its intended function.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Parameters Monitored or Inspected	Revised to state that "[c]losure bolting is inspected for signs of leakage." GALL Report Revision 2 stated that, "bolting for safety-related pressure retaining components is inspected for leakage, loss of material, cracking, and loss of preload/loss of prestress."	This change reinforces the staff's ongoing intent (and clarifies the existing recommendation) that inspecting for leakage is adequate to provide reasonable assurance that closure bolting can perform its structural integrity intended function. Leakage would be an indication of loss of preload. The "detection of aging effects" program element states that for Code Class 1, 2, and 3 systems, ASME Code Section XI requirements are still met. For containment penetration closure bolting, where leakage is critical, the Program Description cites AMPs XI.S1, "ASME Section XI, Subsection IWE," for containment penetration testing. In addition, the AMP provides recommendations for closure bolting for systems where leakage is not readily detectable. Cracking is addressed for high-strength closure bolting, see below.
Parameters Monitored or Inspected	Revised to state that high-strength closure bolting is monitored for surface and subsurface discontinuities indicative of cracking.	The statement that inspections include detection of surface and subsurface discontinuities reinforces the recommendation that volumetric examinations be conducted for high-strength closure bolting
Parameters Monitored or Inspected Detection of Aging Effects	Revised to address: (a) submerged closure bolting; (b) closure bolting in systems containing air or gas; and (c) closure bolting in systems operating at atmospheric pressure for which leakage is difficult to detect.	The basis of the AMP for all closure bolting except high-strength closure bolting (inspected with volumetric methods) is that periodic visual inspections for leakage will detect aging effects prior to a loss of intended function. However, in most cases, it is not possible to detect leakage from submerged bolted closures, bolted closures in systems containing air or gas, and bolted closures in systems operating at atmospheric pressure. The revised AMP provides proposed alternative recommendations for inspections or testing of these joints, as well as, monitoring of isolated pressurized piping segments. These alternatives can be effective at detecting leakage. In addition, the staff proposed alternatives consisting of performance monitoring of components with closure bolting, which can be effective at detecting degradation in the closure bolting by testing vibration or frequently observing that the active component is performing its intended function (e.g., plant operator rounds checking that sump pumps are operating as expected). Addressing these closure bolts in the GALL-SLR Report is not a change in scope from GALL Report

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		Revision 2. The only change is that recommended methods of managing aging effects were added. For closure bolting for components that are not normally pressurized, the staff provided the following recommendation, "checking the torque to the extent that the closure bolting is not loose." The staff recognizes that once a joint is torqued and placed in service, it is unlikely that a subsequent check of the closure bolting torque would yield a value close to that used during fabrication. The intent of this recommendation is as stated. Torque would be applied to the closure bolting to demonstrate that it would not easily turn.
Detection of Aging Effects	Revised the recommendations associated with high-strength closure bolting to clearly state the staff's intent in regard to the use of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1, including citing a greater than 2-inch diameter threshold for inspections and citing provisions in Table IWB-2500-1 such as the acceptance standards, sample size, and frequency of examination. Provided alternatives for determining whether the actual yield strength of closure bolting exceeds the threshold to be classified as high strength. Added a recommendation that bolting for which yield strength is unknown, is monitored for surface and subsurface discontinuities indicative of cracking.	The staff continued to cite Table IWB-2500-1 in the GALL-SLR Report because it provides an industry consensus standard approach to the inspection of high-strength closure bolting. The staff continued to cite this ASME Code Section Class 1 table for all high-strength closure bolting regardless of the Code classification. For example, Class 2, Class 3, and non-class closure bolting are included within this recommendation. The staff incorporated the greater than 2-inch provision and the parenthetical statement related to the reference to Table IWB-2500-1, Examination Category B-G-1, including acceptance standards, sample size, and frequency of inspection in order to clearly state the staff's intent for the use of all of the provisions of the table for all high-strength closure bolting regardless of whether the bolting is within the scope of the code or not. The staff included design and procurement specifications, fabrication and vendor drawings, and material test reports as appropriate configuration controlled sources of actual material properties for closure bolting. The provision for closure bolting for which yield strength is unknown was added to ensure that all closure bolting that is

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		potentially high-strength would have volumetric inspections for cracking.
Detection of Aging Effects	Added a provision for inspection of bolted joints that are not readily visible during plant operations and refueling outages.	The staff concluded that not all bolted joints are readily visible during plant operations and refueling outages due to factors such as dose or line-of-sight. The recommendation for these bolted connections is that inspections are conducted when the bolted connection is made accessible and at such intervals that would provide reasonable assurance that the components' intended functions are maintained. This recommendation is the same as used in AMP XI.M36 for piping and piping components.
Detection of Aging Effects	Provided a recommended sample size for representative periodic inspections of the threaded region of submerged bolting for single unit and multi-unit sites.	The staff recognizes that for submerged bolting, any inspections will in all likelihood be limited to the exposed head of the closure bolts. However, loss of material could be occurring under the bolt head and within the threaded region. As a result, the "detection of aging effects" program element recommends a periodic inspection of the threaded region consistent with the number of inspections and periodicity recommended in other sampling-based programs (e.g., AMP XI.M38). The other sampling based AMPs recommend that the inspection locations be selected from the bounding or lead components most susceptible to aging because of time in service and severity of operating conditions. For submerged components, the staff recognizes that these components are rotated through maintenance cycles typically based on time in service. As a result, the recommendation related to selection of bolts to be inspected was not incorporated into AMP XI.M18. The recommendations related to reducing the number of bolts inspected at each unit of a multi-unit site were adopted from other sampling-based programs (e.g., AMP XI.M38).

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Revised to include standardized recommendations associated with qualifications to conduct inspections and examples of applicable inspection parameters.	Based on a review of multiple AMPs, the staff standardized inspector qualifications and inspection parameter recommendations for several balance-of-plant AMPs. While inspections required by ASME Code Section XI have adequately specified controls, the staff concluded that inspection parameters, such as lighting, distance, etc., should be defined in the plant-specific procedures.
Monitoring and Trending	Revised to address projecting degradation until the next inspection interval.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation (for one-time inspections). In addition, the AMPs were not consistent in corrective action recommendations if trending results project that a loss of an SSC's intended function could occur prior to the next planned inspection or the end of the subsequent period of extended operation for one-time inspections. The staff incorporated common wording in several AMPs. The basis for the changes is as follows: • The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Section A.1.2.3.5 and SRP-SLR Section A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. The staff's intent in relation to the term "where practical" is that unless plant--specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. Although AMP XI.M18 does not recommend quantifying observed leakage from bolted connections, the "corrective actions" program element recommends an increased frequency of inspections of bolted joints where leakage is detected, see

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		below. However, cracking detected during volumetric examinations could be projected. • The staff revised both the "monitoring and trending" and "corrective action" program elements in several AMPs to clearly state the staff's intent that corrective actions should be taken based on either: (a) not meeting the acceptance criteria in the "acceptance criteria" program element for current degradation; or (b) there being a potential that the intended function of a component will not be met based on projected degradation (i.e., trending results). Previous wording in many of the AMPs could have been interpreted that only current inspection results would drive the need for corrective actions. AMP XI.M18 is a sampling-based program in regard to high-strength closure bolting and submerged bolting. When using sampling-based AMPs, determination of the appropriate sample size or frequency of inspections needed when acceptance criteria are not met is based on the need to understand the extent of the degradation in order to provide reasonable assurance that the component's intended function will be met based on projected rates of degradation.
Acceptance Criteria	Revised the acceptance criteria for inspections not associated with ASME closure bolting inspections to state that leaking joints are not acceptable and plant-specific acceptance criteria need to be established for submerged closure bolting and that used in systems containing air or gas for which leakage is difficult to detect.	Leaking joints might be indicative of a joint that could potentially fail due to loss of material, cracking, or loss of preload. As such, prompt corrective actions are appropriate. The staff recognizes that there are many different methods that could be used to monitor submerged closure bolting, closure bolting used in systems containing air or gas, or closure bolting located in systems at atmospheric pressure for which leakage is difficult to detect. Examples include: pump vibration, performance monitoring of sump levels, visual indications of discoloration, pressure decay in isolated boundaries, soap bubble testing, and thermography. As a result, the staff recognized that recommendations related to establishing acceptance criteria should be limited to stating that

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		plant-specific acceptance criteria should be established. The acceptance criteria will be evaluated by the staff on a case-by-case basis during AMP audits and IP-71003, "Post-Approval Site Inspection For License Renewal," inspections.
Corrective Actions	Added corrective actions recommendations for leaking connections and for extent of condition inspections for sampling-based inspections (i.e., high-strength closure bolting, submerged closure bolting).	Follow-up periodic visual inspections of leaking joints are appropriate in order to monitor for a change in quantity of leakage that could be indicative of continued degradation of the joint. The staff recognizes that increased leak rates could be caused by gasket degradation and not the structural integrity of the joint; however, as the leak rate increases, more frequent inspections are appropriate. It is appropriate to evaluate the impact of leakage on potentially nearby components with an intended function in 10 CFR 54.4(a)(1) because otherwise, a loss of safety function could occur. For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Changes to the Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program (AMP) XI.M41, 'Buried and Underground Piping and Tanks.'" The staff determined that recommending this methodology be applied to other AMPs was appropriate; each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections. The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		minimum sample size of 5 inspections is derived from GL 90-05, “Guidance for Performing Temporary Non-Code Repair of ASME Class 1, 2, and 3 Piping.” GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32, XI.M38). Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term “for all components” to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria. The timing of additional inspections (e.g., refueling outage interval, 10-year inspection interval) is appropriate given the need to promptly identify other closure bolting that would not meet acceptance criteria. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.
XI.M19 Steam Generators		
Program Description Scope of Program Parameters Monitored or Inspected	In program description, parameters monitored or inspected, detection of aging effects, and acceptance criteria, updated the references to address recent EPRI guidelines for steam generators.	Changes were made to this program in a consistent manner with the updated aging management guidance for steam generator components described in License Renewal Interim Staff Guidance (LR-ISG) 2016-01, “Changes to Aging Management Guidance for Various Steam Generator Components.” The technical bases of these changes are

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects Monitoring and Trending Acceptance Criteria References	In scope of program, added steam generator divider plate assemblies, tube-to-tubesheet welds, heads (interior surfaces of channel or lower/upper heads), and tubesheets (primary side). The staff also clarified that the program does not cover the steam generator secondary side shell, nozzles attached to the secondary side shell or steam generator head, or the welds associated with these components. In parameters monitored or inspected and detections of aging effects, added general visual inspections of the steam generator head interior surfaces, including divider plate assemblies, tube-to-tubesheet welds, and tubesheets. These inspections are intended to identify signs indicating that cracking or loss of material is occurring (e.g., rust stains or other abnormal conditions such as gross cracking or distortions). These inspections are performed at least every 72 effective full power months or every third refueling outage, whichever results in more frequent inspections. In monitoring and trending, clarified that all assessments of component degradation are performed to ensure the component continues to function consistent with the design and licensing basis and to ensure technical specification requirements are satisfied.	described in LR-ISG-2016-01 in detail (ADAMS Accession No. ML16237A383). The associated *Federal Register* Notice is 81 FR 88276 (December 7, 2016). LR-ISG-2016-01 also contains the staff's dispositions of public comments for the draft LR-ISG-2016-01 and indicates that the staff intends to incorporate corresponding changes to the SLR guidance. The technical bases as well as related background information are summarized below. SRP-LR, Revision 2, Sections 3.1.2.2.11 and 3.1.3.2.11, "Cracking due to Primary Water Stress Corrosion Cracking" describe further evaluation regarding primary water stress corrosion cracking (PWSCC) in steam generator nickel alloy divider plate assemblies and tube-to-tubesheet welds. The main concern discussed in these further evaluation sections is that, when these components are fabricated with PWSCC-susceptible nickel alloy materials (e.g., Alloy 600/82/182), PWSCC could occur and such cracking could propagate into adjacent reactor coolant pressure boundary components (e.g., steam generator heads and tubesheets). The further evaluation guidance in the SRP-LR is, in part, based on foreign operating experience that PWSCC occurred in steam generator divider plate assemblies. In previous license renewal applications (LRAs), applicants typically committed to inspection or analysis approaches that will confirm that PWSCC is not occurring in these components or any potential PWSCC does not affect the integrity or design functions of steam generator (SG) components. Since the development of the further evaluation guidance in the SRP-LR, the industry performed additional evaluations, tests and analyses regarding operating experience (including inspection results), characterization of material compositions in terms of susceptibility to PWSCC, potential significance of PWSCC to the integrity and design functions of SG

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		components, and inspection activities credible to manage the aging effect. Based on these activities and findings, EPRI submitted to the NRC staff, EPRI 3002002850, "Steam Generator Management Program: Investigation of Crack Initiation and Propagation in the Steam Generator Channel Head Assembly." In its review of the EPRI report and related information, the staff found a need to update the guidance in the SRP-LR further evaluation sections and GALL AMP XI.M19, "Steam Generators," as further summarized below. The susceptibility of a material to stress corrosion cracking depends on three main factors: susceptible material, conducive environment, and sufficiently high tensile stress. Therefore, these factors need to be considered in the evaluation of material susceptibility to PWSCC. The cracks due to PWSCC in divider plate assemblies (foreign operating experience) tend to be very shallow (approximately 0.08 inches) and have not grown in depth since detection. These cracks are located in divider plates that were provided primarily by one manufacturer. In addition, the cracks discussed above are believed to have initiated as a result of significant cold work introduced through surface grinding and stub runner distortion primarily attributed to hydrostatic testing of the steam generators. All but one of these instances of PWSCC have been observed in the divider plate assemblies that are approximately 1.3 inches thick. Analyses by the industry in the foreign country further indicated that distortion of the stub runner is only expected to occur in thinner divider plates (i.e., 1.3 inches thick or less). The foreign operating experience also indicates that fabrication issues (e.g., a misalignment between the stub runner plate and

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		the divider plate after welding and subsequent realignment) may cause additional residual stresses and strains. The U.S. industry has performed analyses assuming a fully degraded divider plate assembly. These analyses conclude that the potential degradation does not affect the design functions or safety-related analyses of steam generator components. Based on crack growth and fracture mechanics analyses, cracks due to PWSCC in the divider plate assemblies are highly unlikely to affect the integrity of other pressure boundary components (such as the channel head and tube-to-tubesheet welds). The inservice inspections performed in accordance with Section XI of ASME Code include periodic volumetric inspections of steam generator head welds and tubesheet-to-head welds. The examination can confirm the structural integrity of the steam generator head welds and tubesheet-to-head welds. With respect to the tube-to-tubesheet welds, the weld chromium content for Alloy 690 tubes and Alloy 82 tubesheet cladding can range from approximately 24 to 26% chromium and the weld chromium content for Alloy 690 tubes and Alloy 182 tubesheet cladding can range from approximately 21 to 23%. In addition, the steam generator tubesheet is in compression. The staff has not identified any instances where cracks have been reported in the tubesheet cladding. Although it is unlikely that any inspections looking specifically for cracking have been performed, if cracking were prevalent, it would have most likely been detected during the performance of steam generator tube inspections.

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		Foreign and domestic operating experience indicates that loss of material due to boric acid corrosion can occur in the steel base material of the steam generator channel head and tubesheet. This operating experience is discussed in NRC Information Notice 2013-20, "Steam Generator Channel Head and Tubesheet Degradation." One means to effectively manage this aging effect is to control the reactor water chemistry to mitigate the loss of material due to boric acid corrosion for the base material in the event that the cladding is compromised and to perform periodic visual inspections of the cladded surfaces within the steam generator to detect anomalous conditions (e.g., rust stains). Based on the discussion above, general visual inspections of steam generator head interior surfaces (including the divider plates and tubesheets) are necessary as part of the steam generator program. These inspections are intended to identify signs that cracking or loss of material may be occurring (e.g., through identification of rust stains or other abnormal conditions such as distortion of divider plate assembly). As further details are described in LR-ISG-2016-01, the staff finds that, if the industry analyses (EPRI 3002002850) are bounding and applicable to applicant's steam generators, a plant-specific program may not be necessary to manage cracking of PWSCC for divider plate assemblies and tube-to-tubesheet welds in accordance with the revised GALL-SLR Report, AMP XI.M19 and SRP-LR further evaluation sections (along with AMP XI.M2, "Water Chemistry"). GALL-SLR, AMP XI.M19 and XI.M2 are also used to manage loss of material due to boric acid corrosion for steam generator heads and tubesheets. These bases and changes are consistently applied to the corresponding GALL-SLR Report and SRP-SLR guidance. In addition, the inspection frequency of the general visual inspections added to AMP XI.M19 is also consistent with the

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		maximum inspection interval allowed by the steam generator tube inspection requirements in Technical Specifications.
XI.M20 Open-Cycle Cooling Water System (OCCW)		
Program Description	Clarified specific activities being performed through GL 89-13 and the discussion that GL 89-13 was not specifically developed for aging management. Clarified that the components not within the scope of GL 89-13 can be included in AMP XI.M38, and that coating degradation may be managed by the open-cycle cooling water (OCCW) program if guidance from AMP XI.M42 is followed.	Although GL 89-13 addressed ongoing operational issues with fouling, corrosion, erosion, etc., some portions of the program are appropriate for aging management. Other activities specified in GL 89-13 that are not applicable to an aging management program, (e.g., verification of as-built configuration, ability to withstand single active failures, adequacy of operating / emergency procedures, and training) were deleted from the description. The clarification regarding use of AMP XI.M38 was intended to reduce the need for AMR items citing generic note E. Although GL 89-13 addressed protective coating failure, the new guidance developed in AMP XI.M42 for coating degradation provides more details relating to inspection frequencies, acceptance criteria, and corrective actions.
Scope of Program	Clarified discussion to eliminate unnecessary details addressed in other program elements.	The clarifications did not change the fundamental scope of the program. No bases required for clarifications.
Preventive Actions	Clarified discussion to eliminate unnecessary details or over generalizations.	The clarifications did not change the fundamentals of the preventive actions associated with the program. No bases required for clarifications
Parameters Monitored or Inspected	Clarified discussion for better alignment with program element descriptions in SRP-LR Appendix A.1. Added cracking as an aging effect being managed for certain materials. Included the cross-reference to AMP XI.M42 when the program is used to manage loss of coating/lining integrity. Added a new consideration for changes in friction or roughness factors whenever fouling is identified. Added cross-reference to American Concrete Institute (ACI) Standards 349.3R and 201.R1 for managing aging effects in concrete piping.	Terms not associated with specific aging effects were deleted or modified. Cracking of copper alloys was added based on discussions in EPRI 1010639, Appendix B, Section 3.2.2 and LER 305/2002-002. The new guidance developed in AMP XI.M42 for coating degradation provides more details relating to parameters monitored or inspected. Consideration for changes in friction or roughness factors in flow calculations was based on the AMP Effectiveness Audit (ADAMS Accession No. ML13122A009) Section 2.3.19 and AMP Effectiveness Audit Compendium (ADAMS Accession No. ML16167A076) Section 4.2.19. ACI references were added in recognition of the need for additional guidance for managing the aging effects in concrete piping.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Added guidance from GL 89-13 regarding the test frequency adjustments but the interval should not exceed 5 years. Included examinations of concrete materials with polymeric materials as being consistent with examinations in AMP XI.M38. Clarified that volumetric examinations are used to quantify loss of material, whereas visual inspections provide qualitative assessments.	The allowable frequency adjustments with a maximum of a 5-year interval was provided for better alignment with GL 89-13 in regard specifically to testing (versus inspection) activities. The recognition of the need for additional guidance for managing the aging effects in concrete piping led to the staff's determination that it could be provided in one AMP for better consistency with AMP XI.M38 being chosen. The need to distinguish between quantitative and qualitative examinations was based on the inability of visual inspections to judge when general corrosion (versus localized corrosion like pitting) becomes significant.
Detection of Aging Effects	Added standardized wording for qualifications of personnel performing inspections, including examples of inspection parameters.	Based on general guidance for this program element, the staff recognized the need to address some level of qualifications for inspection personnel. Although adequately delineated for ASME Code inspections, examples of typical inspection parameters for non-ASME code inspections were provided.
Monitoring and Trending	Added test frequency verification as the purpose of heat exchanger trending, and the use of visual inspections for heat exchanger degradation in lieu of testing. Added trending of friction or roughness factors to confirm design flow rates can be achieved. Added consideration for tending wall thickness due to ongoing aging mechanisms like microbiologically influenced corrosion (MIC) to adjust monitoring frequency and number of inspections.	GALL Revision 2 referred to trending in accordance with docketed responses to GL 89-13; however, very few of those responses addressed trending. Test frequency verification and use of visual inspections is consistent with guidance in GL 89-13. Trending of friction factor is based on the AMP Effectiveness Audit cited in Detection of Aging Effects, above. Trending of wall thickness is derived from the inclusion of recurring internal corrosion from LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," and is based on minimum wall thickness requirements discussed in the Acceptance Criteria.
Acceptance Criteria	Clarified acceptance criteria relative to meeting minimum wall thickness requirements. Added cross-reference to acceptance criteria in AMP XI.M42 for coatings or linings. Added consideration for more comprehensive corrective actions for ongoing degradation mechanism like MIC. Added acceptance criteria from ACI Standard 349.3R for concrete piping.	GALL Revision 2 referred to acceptance criteria being in accordance with docketed responses to GL 89-13; however, few (if any) addressed specific acceptance criteria. Minimum wall thickness requirements are typically derived from system design codes and standards. Acceptance criteria for coating or linings is based on the development of AMP XI.M42 in LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		Consideration for more comprehensive corrective actions is derived from discussions for recurring internal corrosion in LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation." The ACI reference was needed based on the addition of concrete components to the scope of the program.
Corrective Actions	Clarified corrective actions associated with wall thickness requirements. Added corrective actions associated with fouling identification to include consideration of heat transfer reduction, flow blockage, loss of material and chemical treatment effectiveness. Added considerations for increased frequency and extent of inspections for ongoing degradation mechanisms like MIC. Added a minimum number of additional inspections for any inspection that does not meet acceptance criteria.	The three options for actions to be taken when wall thickness requirements are not met provide the spectrum of possible corrective actions. The potential effects associated with fouling include all related aging effects as well as possible adverse effects for preventive actions. Consideration for more comprehensive corrective actions is derived from discussions for recurring internal corrosion in LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation." The minimum of five additional inspections is derived from guidance in GL 90-05. The 20% limitation was derived from other sampling based AMPs (e.g., XI.M32, XI.M38) and was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected.
Corrective Actions Confirmation Process Administrative Controls	Added standardized wording for use of 10 CFR Part 50, Appendix B, Quality Assurance Program and guidance in GALL-SLR, Appendix A.	The standardized recommendations use the same approach as GALL Report Revision 2 and have not changed.
Operating Experience	Expanded into separate aging effects and added more examples for loss of material, protective coatings failures, reduction of heat transfer, flow blockage, and cracking issues.	Continuing submission of event reports demonstrate the need for changes to the programs instituted by GL 89-13.
References	Updated references based on changes to the program.	Included additional documents associated with new examples of OE from recent events and industry guidance documents associated with inspections of concrete components.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M21A Closed Treated Water Systems	
Program Description	Added clarification for use of corrosion inhibitors except for pure water systems that meet industry guidance. Provided examples of systems addressed by this AMP and clarified which AMPs cover other systems.	Clarifications made in response to industry comments. Discussions of systems addressed or not addressed were relocated from the "scope of programs" program element.
Scope of Program	Deleted discussions about systems addressed by this AMP and systems addressed by other AMPs and relocated in the Program Description.	Clarifications were made for alignment of discussions with the appropriate program element.
Preventive Actions	Clarified aging effects being managed by this AMP to include reduction of heat transfer.	Clarification made for completeness. Reduction of heat transfer was always included in the AMP
Parameters Monitored or Inspected	Deleted discussion about use of other water chemistry standards. Changed visual appearance of surfaces to only apply for loss of material and added surface or volumetric examinations for detection of cracking. Added evaluation of heat transfer capability through visual or functional testing.	The deletion of other chemistry standards was made at the request of industry comments. See discussion associated with the cited industry comments for additional bases. The change for limiting visual appearance to loss of material and the addition of surface of volumetric exams for cracking was based on the staff's recognition of the limitations for visual exams and the need for more detailed methods to detect cracking. The use of different methods of heat transfer evaluation is based on guidance from GL 89-13, which allows visual inspections to confirm heat transfer surface cleanliness in lieu of functional testing.
Detection of Aging Effects	Added clarification to define a representative sample for periodic visual inspections. Added sample expansion if degradation is identified. Clarified that opportunistic visual inspections may be credited toward the periodic representative sample. Added discussion for susceptible locations to included heat exchanger tube surfaces as being potentially more severe.	The representative sample size definition is based on discussions from other sampling based AMPs (i.e., XI.M32, XI.M38). This clarification was also in response to an industry comment. As noted in Acceptance Criteria, no age-related degradation is expected due to chemistry controls. Consequently, if degradation is identified, the extent of the degradation should be determined through additional inspections. The clarification for crediting opportunistic visual inspections as part of the representative sample was recognition by the staff that these would be valid samples to verify the effectiveness of water chemistry controls. The discussion regarding potentially severe conditions at heat exchanger surfaces is based on operating experience associated with Licensee Event Report (LER) 263/2014-001.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Monitoring and Trending	Added clarification for projecting degradation, where practical, until next scheduled inspection and confirming sample bases remain valid.	Additional guidance was provided to be consistent with new guidance in SRP-SLR, Appendix A.1.2.3.5.3.
Acceptance Criteria	Added clarification that no age-related degradation is expected due to water chemistry controls.	Water chemistry controls are intended to prevent age-related degradation, and if degradation is identified chemistry controls may not be performing effectively and degradation evaluation needs to be conducted through the corrective action program.
Corrective Actions	Added aging effects to be evaluated if fouling is identified. Added discussion for conducting five additional inspections or a 20% sample for each inspections that does not meet acceptance criteria, if the cause has not been corrected.	The minimum of five additional inspections is derived from guidance in GL 90-05. The 20% limitation was derived from other sampling based AMPs (e.g., XI.M32, XI.M38) and was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected.
Corrective Actions Confirmation Process Administrative Controls	Added standardized wording for use of 10 CFR Part 50, Appendix B, Quality Assurance Program and guidance in GALL-SLR, Appendix A.	The standardized recommendations use the same approach as GALL Report Revision 2 and have not changed.
Operating Experience	Added LER 263/2014-001 for concentration of impurities due to localized boiling.	Although water chemistry had been adequately controlled, localized boiling concentrated impurities in the component cooling water system onto heat exchanger coil surfaces that led to SCC.
XI.M22 Boraflex Monitoring		
Program Description Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process	Throughout all elements, removed reference to blackness testing and changed “boron” to “boron 10.” In program description, modified to clarify the difference between XI.M22 and XI.M40. In monitoring and trending, added that “silica concentration is monitored against time to trend degradation. Rapid increases of silica concentration may indicate accelerated Boraflex degradation.”	The revisions to this AMP include minor editorial changes and other clarifications. The term “blackness testing” was removed from the elements because direct measurement of boron-10 areal density by blackness testing is an areal density measurement technique. Sampling and analysis for silica levels in the spent fuel pool water is performed on a regular basis, such as monthly, quarterly, or annually (depending on Boraflex panel condition), and results are trended using the EPRI RACKLIFE predictive code or its equivalent. Silica concentration in the spent fuel pool water serves as an indicator to the amount of Boraflex dissolution occurring in the spent fuel racks. It is important to trend the silica concentration against time and monitor for rapid silica excursions indicating accelerated Boraflex degradation.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Administrative Controls Operating Experience References	In monitoring and trending, clarified that the frequency to perform boron-10 areal density testing is not to exceed a 5-year interval.	
XI.M23	**Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems**	
Program Description	Deleted most of the first paragraph related to the approximate total number of cranes at a site and the potential number within the scope of Part 54, and the regulatory requirements for cranes.	The staff removed this excess material because it was not pertinent to managing aging effects associated with cranes.
Scope of Program	Revised to cite bridges, structural members, and structural components, In lieu of the terms, bridge rails, bridge, and trolley structural components.	The staff's intent with the change in terms was to reinforce that the scope of the program is on structural members (e.g., rails, bridge, structural steel) and not items such as brakes, switches, rail sweeps, and controllers.
Parameters Monitored or Inspected	Added deformation or cracking of bridges or structural members. Added cracking and loss of material to the list of bolting degradation.	These terms were added to be consistent with the inspections recommended in ASME B30.2, " Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)," Section 2-2.1.5, "Periodic Inspections." In adding these terms, the staff's intent remains that they be detected by visual inspection methods. For example, it is not expected that volumetric examinations would be conducted on bolting to detect cracking.
Detection of Aging Effects	Added, "ASME B30.2 establishes inspection frequencies based on the severity of service, as defined by the number and magnitude of lifts." Added specific examples of degradation.	The ASME B30.2 statement was added to reinforce the need to adjust inspection frequencies based on severity of service. The staff agrees that the number and magnitude of lifts are key contributors to wear and potential deformation. The examples of degradation (e.g., deformation, cracking, wear, loss of preload) are those described in the "parameters monitored and inspected" program element and in ASME B30.2.
Acceptance Criteria	Added the terms "deformation" and "cracking".	These aging effects were added to be consistent with the other program elements in AMP XI.M23.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M24 Compressed Air Monitoring	
Program Description	Removed detail from the program description.	The staff removed the details (e.g., citation of Information Notices) because the details did not have an impact on the ten program elements used to manage aging effects. The references cited at the end of the AMP provide sufficient background information.
Program Description Preventive Actions Detection of Aging Effects Acceptance Criteria	Updated referenced documents (e.g. EPRI, ASME).	Based on the staff's review of the updated references, the staff concluded that the latter version of the reference is sufficient to provide guidance for managing aging effects associated with compressed air components located downstream of instrument air dryers.
Scope of Program	Revised to address compressed air components downstream of the instrument air dryers and components exposed to an internal gas environment such as nitrogen filled accumulators. Aging effects associated with upstream components are managed by AMP XI.M38.	The basis for these changes is documented in the staff response to industry comment No. 017-000006.
Parameters Monitored or Inspected Detection of Aging Effects	Revised the recommended visual inspections to opportunistic in lieu of periodic and opportunistic.	The basis for this change is documented in the staff response to industry comment No. 017-000006.
Detection of Aging Effects	Added a recommendation that inspections and tests are performed by personnel qualified to perform the specific task.	The staff concluded that only personnel qualified to perform a task should provide input (e.g., air monitoring, opportunistic inspection results). Otherwise, inaccurate information might be used to assess the potential for adverse aging effects.
Monitoring and Trending	Revised daily readings of system dew point to be consistent with the "parameters monitored or inspected" program element.	The "parameters monitored or inspected" program element states that periodic air samples are taken. The "monitoring and trending" program element was revised to state that, "[i]f daily readings of system dew points are taken, they are recorded and trended." Daily readings can be one means of obtaining data; however, they are not the only means to establish a trend of air quality. The "monitoring and trending" program element states that the review of data should check for unusual trends.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M25 BWR Reactor Water Cleanup System	
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	In the program description, included information that linked back to the references to exhibit their significance. In the program description, clarifies AMPs applicability to cases where the NRC has not previously approved the complete elimination of the augmented GL 88 01 inspections for reactor water cleanup (RWCU) system piping outboard the second containment isolation valves. In the program description, relocated reference to XI.M2 to preventive actions element. In parameters monitored or inspected, updated references. In detection of aging effects, reworded information. In corrective actions, clarified that GL 88 01 is followed for corrective actions.	The revision to this AMP includes minor clarifications to better reflect the AMP's applicability and to more accurately describe previously approved alternatives to the GL 88-01 inspections for RWCU system piping that is located outboard of the second containment isolation valves.
	XI.M26 Fire Protection	
Program Description Scope of Program Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria	Added fire damper assemblies to the program	Fire damper assemblies were added to be consistent with new GALL-SLR Report item A-789. Although fire damper assemblies have an active function, the damper is a passive boundary between areas.
Program Description	Referenced AMP XI.S6, "Structures Monitoring."	The staff added the reference because GALL-SLR Report items cite AMP XI.S6, as well as, AMP XI.M26 for structural

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		fire barrier walls, ceilings, and floors. Citing AMP XI.S6 as well as AMP XI.M26 in the GALL items is not a change from GALL Report Revision 2.
Program Description	Added text citing the regulatory basis for fire protection requirements.	The staff added this text to provide information to individuals using GALL-SLR Report AMP XI.M26.
Program Description Scope of Program Parameters Monitored or Inspected Detection of Aging Effects Acceptance Criteria	Added clean agent systems in addition to halon and carbon dioxide (CO_2) fire suppression systems.	Clean agent systems were added for those applicants that have replaced their halon or CO_2 systems with clean agents. See response to industry comment No. 017-009.
Parameters Monitored or Inspected	Removed detail related to sample size and aging effects.	These details are included in the “detection of aging effects” program element.
Detection of Aging Effects	Relocated detail related to additional inspections of penetration seals when a sign of degradation is detected within the sample population to the “corrective actions” program element.	Scope expansions of inspections are a corrective action.
Detection of Aging Effects Monitoring and Trending	Removed the recommendation to conduct halon/CO_2 fire suppression functional tests every 6 months.	The staff has conclude that testing halon/CO_2 systems consistent with the applicant’s NRC-approved fire protection program is sufficient to provide reasonable assurance that the intended function of the systems will be met.
Monitoring and Trending	Revised program element to address projecting identified degradation and addressing the timing of future inspections.	During the staff’s review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, “Monitoring, and Trending,” focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term “where practical” because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example, a visual inspection conducted in accordance with AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” might detect light surface loss of material. AMP XI.M36 appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, “Masonry Walls,” recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff’s intent in relation to the term “where practical” is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original sampling basis when it is anticipated that acceptance criteria would not be met.
XI.M27 Fire Water System		
Program Description Parameters Monitored or Inspected Detection of Aging Effects	Added cracking as an aging effect.	Cracking was added as an aging effect based on typical materials used in fire water systems and their susceptibility to cracking due to exposure to environments cited in GALL-SLR Report items.
Preventive Actions	Revised to state that flushes mitigate or prevent flow blockage by clearing corrosion products and sediment.	The staff recognizes that flushes can have a positive and negative impact on the condition of the internal surfaces of the fire water system. In raw water systems, flushes can introduce new bacteria to the piping system which can lead to MIC.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		Flushes also replenish oxygen, which can lead to further corrosion. Subsequent to the issuance of LR-ISG-2012-02, “Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation,” the staff recognized that flushes do serve to mitigate or prevent flow blockage by clearing corrosion products and sediment [e.g., National Fire Protection Association (NFPA) 25 Section 7.3.2.1].
Parameters Monitored or Inspected Detection of Aging Effects	Replaced “wall loss to below nominal pipe wall thickness” as a criterion for conducting follow-up wall thickness measurements with “an unexpected level of degradation due to corrosion and corrosion product deposition.”	Subsequent to the issuance of LR-ISG-2012-02, “Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation,” the staff recognized that use of the term “wall loss to below nominal pipe wall thickness” was overly restrictive, because, by design, piping can be supplied up to 12.5% below nominal wall. As a result the AMP could unnecessarily recommend wall thickness measurements in the as-supplied condition.
Parameters Monitored or Inspected	Added loss of material and cracking as parameters to be monitored or inspected for cementitious materials.	Recognizing the potential for different materials of construction, a new AMR item for concrete and cementitious components was added. The basis for GALL-SLR Report item A-647 discusses the relevant aging effects associated with this item.
Detection of Aging Effects	Revised to state that unless recommended otherwise, external visual inspections are conducted on a refueling outage interval.	This statement was added because periodic external visual inspections of components such as piping were not described in Table XI.M27-1.
Detection of Aging Effects	Relocated guidance for inspection of bottom surfaces exposed to soil or concrete to be in accordance with GALL-SLR AMP XI.M29, Table XI.M29-1, from Table XI.M27-1, footnote 4. Added guidance for tank bottom inspections of indoor tanks when concrete interface is periodically wetted.	Table XI.M29-1 provides a consistent approach for managing aging effects for the bottom surfaces of tanks regardless of the service.
Detection of Aging Effects	Revised to include standardized recommendations associated with qualifications to conduct inspections and examples of applicable inspection parameters.	Based on a review of multiple AMPs, the staff standardized inspector qualifications and inspection parameter recommendations for several balance-of-plant AMPs. While inspections required by ASME Code Section XI have adequately specified controls, the staff concluded that inspection parameters, such as lighting, distance, etc., should be defined in the plant-specific procedures.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Revised to allow the use of AMP XI.M36 and AMP XI.M38 for inspecting fire water system piping where its only intended function is leakage boundary (spatial) or structural integrity (attached) as defined in SRP-LR Table 2.1-4(b). Also added that flow blockage due to fouling need not be managed for these components.	Based on industry feedback, the staff made this change because components that fall within this category do not have an in scope fire water function. The only intended functions, in brief, are to not leak, fall down, or cause the failure of an in scope portion of piping that has an in scope fire water function. This being the case, AMP XI.M36 and AMP XI.M38 are sufficient to manage the associated loss of material aging effects.
Detection of Aging Effects	Deleted deluge valve testing from the Valves and System-Wide Testing portion of Table XI.M27-1.	Deluge valve testing specified in NFPA 25 Sections 13.4.3.2.2 through 13.4.3.2.5, overlaps with the Operation test specified in Table XI.M27-1, Water Spray Fixed System for NFPA 25 Section 10.3.4.3. The testing scope for Section 10.3.4.3 includes the deluge valves cited in Section 13.4.3.2 and includes comparable test purposes. The consolidation to only cite Section 10.3.4.3 simplifies the recommendations without removing the recommendation to test deluge valves.
Detection of Aging Effects	Revised Table XI.M27-1 to change the periodicity of the water fixed spray strainer and foam water sprinkler strainer inspections from every refueling outage to after each system actuation.	The staff concluded that absent flow in the system, an inspection would not provide a meaningful indicator of potential flow blockage in the system.
Detection of Aging Effects	Revised Table XI.M27-1 footnote 4 by addressing acceptance criteria and corrective actions from AMP XI.M42 for degraded coatings; conducting wall thickness measurements when loss of material (due to pitting or general corrosion beyond minor surface rust) is detected, and; vacuum box testing when cracking or loss of material is detected in the immediate vicinity of welds. Relocated bottom-thickness measurement discussion to a prior paragraph in this program element.	The acceptance criteria and corrective action recommendations in GALL-SLR Report AMP XI.M42 in lieu of NFPA 25 Sections 9.2.7 (1), (2), and (4) (i.e., adhesion testing, dry film thickness measurements, spot wet-sponge testing) are appropriate for all internal coatings regardless of the intended function of the tank in which they are installed. The staff clarified the intent of NFPA 25, Section 9.2.7 (3) by adding "beyond minor surface corrosion" to "interior pitting or general corrosion." The staff concluded that it is not necessary to conduct wall thickness measurements when minor surface rust is detected. The NFPA 25 wording of "corrosion" could have led to unnecessary inspections. The staff clarified that vacuum box testing specified in NFPA 25, Section 9.2.7 (6) is only conducted when degradation is detected in the immediate vicinity of welds.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		NFPA 25, Section 9.2.6.4, which specifies testing in accordance with Section 9.2.7 could be interpreted to require vacuum box testing whenever any signs of interior pitting or corrosion is detected. NFPA 25, Section 9.2.7 (6) states that testing is at bottom seams; therefore, the clarification is consistent with the guidance. LR-ISG-2012-02 previously addressed NFPA 25, Section 9.2.7 (5) by including a statement in footnote 4 regarding the need for bottom-thickness measurements. The staff concluded that embedding this in a footnote was an error likely situation and relocated the recommendation to a prior paragraph in this program element.
Detection of Aging Effects	Added footnote 7, providing three options for sprinkler testing, based on their potential exposure to corrosive water supplies.	Various statements in NFPA 25, Sections 5.3.1.1.2, A.3.3.1.1.2, and D.2.6 appear to establish that all water environments are corrosive. However, NFPA 13, Section 24.1.5.2 establishes a position that not all water supplies are corrosive. Based on its review of these NFPA documents, the staff added footnote 7 to AMP XI.M27, Table XI.M27-1 by recommending three options to address potentially corrosive water supplies as related to sprinkler testing. The staff concluded that the first option (to provide a plant-specific evaluation) is acceptable because it will be reviewed by the staff during the SLRA process. The staff concluded that the second option (to perform a one-time test of sprinklers that have been exposed to water) is acceptable because it can demonstrate that aging has or has not affected sprinkler performance. The third option would result in the applicant testing a sample of the affected sprinklers every 5 years in accordance with NFPA 25, Section 5.3.1.1.2.
Detection of Aging Effects	Added footnote 8, to reflect alternative deluge valve testing interval criteria.	NFPA 25 Sections 13.4.3.2.2 through 13.4.3.2.5 state that deluge valve testing should be conducted annually; however, it provides a provision to conduct the testing at intervals not to exceed 3 years. The staff has concluded that the maximum interval of 3 years is acceptable for all water spray fixed system open nozzle testing as long as past testing results demonstrate that sufficient nozzles are not obstructed such

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		that full design flow could be achieved. The staff recognizes that a national consensus document allows a 3 year test interval; however, given the age of the plants, the staff has concluded that it is appropriate to integrate plant-specific inspection results into the allowance to extend the interval to 3 years. The staff does not take exception to NFPA 25, Section 13.4.3.2.2.3, which states, "[w]here the nature of the protected property is such that water cannot be discharged unless protected equipment is shut down (e.g., energized electrical equipment), a full flow system test shall be conducted at the next scheduled shutdown." If adverse plant-specific results exist and Section 13.4.3.2.2.3, is applicable, the staff has concluded that the applicable "next scheduled shutdown" is a refueling outage interval. Otherwise, if adverse plant-specific results exist, annual testing should be conducted.
Detection of Aging Effects	Added footnote 9, to state that calibration of measuring and test equipment (M&TE) is conducted in accordance with plant-specific procedures in lieu of NFPA 25 requirements.	The staff added this footnote based on the review of license renewal applications (LRAs) where applicants took exception to NFPA 25 M&TE calibration requirements. Calibration of M&TE equipment is not addressed in Part 54. The staff recognizes that the calibration of M&TE equipment is controlled by plant-specific procedures.
Detection of Aging Effects	Added footnote 10, to allow deferral of annual tests or inspections to a refueling outage interval depending on plant-specific operating experience.	The staff concluded that a refueling outage interval in lieu of annual tests or inspections is acceptable based on the availability of 60 years of plant operating experience. If plant-specific operating experience does not reveal a loss of intended function, a longer inspection interval would be warranted.
Monitoring and Trending	Revised to include additional inspection and test results to be monitored and trended.	The staff added that the results of flushes and wall thickness measurements are to be monitored and trended. Trending these inspection and test results can provide insight into projected system performance such that corrective actions could be implemented prior to a potential loss of fire water system intended functions.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Monitoring and Trending	Added standardized recommendations for projecting identified degradation and addressing the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, "Monitoring, and Trending," focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		sampling basis when it is anticipated that acceptance criteria would not be met.
Acceptance Criteria	Added flow blockage as a potential adverse consequence of fouling in sprinkler systems.	The staff concluded that fouling can be a significant contributor to flow blockage in sprinkler systems due to the narrow passages in sprinklers. The term “loose” was used because fixed fouling deposits will not block flow from sprinkler heads. Fixed fouling products are addressed in acceptance criteria related to obstructing piping or sprinklers.
Corrective Actions	Included recommendations for conducting a minimum of two additional tests for any flow tests (NFPA 25 Section 6.3.1) or main drain tests (NFPA 25 Section 13.2.5) that do not meet acceptance criteria due to current or projected degradation. Also included extent of condition and extent of cause analysis if subsequent tests do not meet acceptance criteria, and adjusting inspection frequencies if projected inspection results do not meet acceptance criterial prior to the next scheduled inspection.	Consistent with changes made to SRP-SLR, Appendix A.1.2.3.7.6, the staff determined that additional inspections are conducted when an inspection does not meet acceptance criteria, and the program specifies the number of additional inspections. Based on subsequent inspection results, an extent of condition and extent of cause analysis determines the final further number of inspections. The basis for citing two additional tests for each test that does not meet acceptance criteria is as follows. • For flow tests, NFPA 6.3.1 requires a single flow test at the most hydraulically remote hose connection of each zone of an automatic standpipe system. Doubling the number of tests, in conjunction with the other zone testing will provide sufficient data to determine whether flow blockage is a localized or wide spread issue. • For main drain tests, NFPA 25 Section 13.2.5 requires that a main drain test be conducted at each water-based fire protection system riser. At a typical plant, there are many risers and as a result many main drain locations. To date, applicants have either stated that they will conduct main drain tests at all main drain locations or conduct sampling-based main drain testing. For sampling-based programs, the staff has accepted either a 20% sample or a maximum sample size of 25 tests, whichever is less. In either case conducting two additional tests in conjunction with the other main drain tests will provide sufficient data

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		to determine whether flow blockage is a localized or wide spread issue. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.
Corrective Actions	Added a recommendation to state that an evaluation is conducted to determine if deposits need to be removed to determine if loss of material has occurred.	The staff concluded that in some instances, deposits would need to be removed in order to determine the extent of loss of material. Even minor deposits (e.g., small tubercles) can result in some loss of material. If the loss of material could be sufficient to result in a through wall leak that could result in the loss of a safety related function, the need to remove deposits to confirm the extent of loss of material is higher than if there would be no consequence due to leakage. Expanding on this example, if through wall leakage is not an issue and there are only isolated small areas of deposits, there is probably a low likelihood that these deposits would result in a loss of pressure boundary function. Likewise, if there are numerous deposits and they are all located in close proximity, the pressure boundary function might be challenged. The staff concluded that rather than recommending specific actions, the evaluation would better assess plant-specific functions and configuration. In addition, removal of deposits might not be necessary if external volumetric examinations could quantify the extent of loss of material.
Corrective Actions	Added a recommendation to conduct flushing if loose fouling products that could cause flow blockage in sprinklers are detected.	The staff added this recommendation due to the potential for loose fouling products to cause flow blockage in the narrow passages in sprinklers. NFPA 25 Appendix D.5 provides industry consensus methods for conducting flushes.
XI.M29 Outdoor and Large Atmospheric Metallic Storage Tanks		
Program Description Scope of Program	Revised the Program Description and Scope of Program to reflect that the aging effects associated with fire water storage tank interior	As stated in the bases for AMP XI.M27, "Detection of Aging Effects" revised footnote 4, aging effects associated with the fire water storage tank bottom surfaces exposed to soil or concrete are managed by AMP XI.M29 in lieu of AMP XI.M27.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	surfaces and exterior surfaces not exposed to soil or concrete are managed by AMP XI.M27.	The cross link between these two AMPs provides a consistent approach for managing aging effects for the bottom surfaces of tanks regardless of the service
Program Description Scope of Program	Revised the Program Description and Scope of Program to state that the scope of the program addresses only metallic tanks.	This revision reflects the GALL-SLR Report items in that all tanks that cite AMP XI.M29 are constructed of steel, stainless steel, aluminum, or nickel alloy. The GALL-SLR Report cites other AMPs for non-metallic tanks, for example aging effects associated with fiberglass and PVC tank internal surfaces are managed by AMP XI.M38.
Scope of Program	Added a provision to manage aging effects for coatings/linings in lieu of using AMP XI.M42.	During its review of several LRAs, the staff noted that some plants had a limited scope of coatings. As a result, it could be more efficient to manage loss of coating integrity for the internal coatings on a tank by augmenting the AMP XI.M29 program rather than developing a new standalone program to manage loss of coating integrity. The staff concluded that incorporation of all of the recommendations in AMP XI.M42, including the updated final safety analysis report (UFSAR) Supplement recommendations into the AMP XI.M29 program will result in a sufficient program to manage aging effects associated with internal tank coatings.
Scope of Program	Added indoor tanks exposed to or embedded in concrete where the tank-to-concrete interface is periodically exposed to moisture.	Although indoor tanks are less likely to be exposed to sources of moisture, age-related degradation of an indoor tank was caused by periodic wetting as a result of ground water intrusion. (RAI B2.1.16-3 response, ADAMS Accession No. ML14069A169). The staff made the change based on the potential for other comparable situation for indoor tanks.
Parameters Monitored or Inspected	Added a provision recognizing that some aging effects might not be applicable.	Table XI.M29-1, "Tank Inspection Recommendations," includes many recommended inspections. The staff recognizes that some of these may be demonstrated to be not applicable. For example, cracking or loss of material for stainless steel tanks exposed to outdoor air might be demonstrated to be not applicable based on further evaluations described in the SRP-SLR. The staff added this provision in order to avoid applicants developing exceptions for aging effects that are not applicable.
Detection of Aging Effects	Added a recommendation to physically manipulate sealant and caulking during visual inspections.	This recommendation was incorporated based on recommendations in GALL Report Revision 2 AMP XI.M36 and

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		AMP XI.M38. The staff has concluded that visually inspections alone of sealant or caulking are not adequate to confirm that hardening or loss of strength has not impacted the ability of the caulking or sealant to prevent moisture intrusion.
Detection of Aging Effects	Revised the recommendation for managing corrosion under insulation to cite Table XI.M29-1.	The citation to Table XI.M29-1 recognizes the revised and new further evaluation sections added to Table XI.M29-1 for stainless steel and aluminum tanks to determine whether cracking or loss of material need to be managed in the subsequent period of extended operation
Detection of Aging Effects	Added a clarification that corrosion under insulation for insulated tanks could alternatively be managed by AMP XI.M36.	Both AMP XI.M29 and AMP XI.M36 include recommendations to manage loss of material and cracking under insulation, so either AMP can be used.
Detection of Aging Effects	Revised to include standardized recommendations associated with qualifications to conduct inspections and examples of applicable inspection parameters.	Based on a review of multiple AMPs, the staff standardized inspector qualifications and inspection parameter recommendations for several balance-of-plant AMPs. While inspections required by ASME Code Section XI have adequately specified controls, the staff concluded that inspection parameters, such as lighting, distance, etc., should be defined in the plant-specific procedures.
Detection of Aging Effects	Revised Table XI.M29-1 to include a recommendation on the internal surfaces of steel tanks exposed to air or condensation.	The staff added this recommendation because AMP XI.M29 addresses aging effects associated with the inside and outside surfaces of tanks. Citing loss of material and periodic inspections for steel components exposed to an air environment is consistent with GALL-SLR items, such as E-44, A-77, and S-29. Conducting the inspections at 10-year intervals is consistent with other internal tank inspection frequencies.
Detection of Aging Effects	Revised Table XI.M29-1 to include treated borated water with treated water for stainless steel and aluminum tanks. It was also revised to include recommendations for stainless steel and aluminum tanks exposed to raw water and waste water.	The staff added treated borated water based on the review of LRAs. Citing loss of material and a one-time inspection for loss of material for stainless steel tanks is consistent with GALL-SLR items, such as EP-63, AP-79, and EP-41. Citing loss of material and a one-time inspection for loss of material for aluminum tanks is consistent with GALL-SLR items, such as EP-71, AP-130, and SP-90. The staff added raw water and waste water to reduce the number of material, environment, and aging effects that were

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		not identified in the GALL-SLR Report. Citing loss of material and periodic inspections for stainless steel tanks is consistent with GALL-SLR items, such as E-439, S-436, A-727, and AP-278. Conducting the inspections at 10-year intervals is consistent with other internal tank inspection frequencies. The staff concluded that based on the results of revised further evaluations conducted for aluminum tanks exposed to raw water and waste water, one-time or periodic inspections should be recommended. The basis for each specific change is documented in the tables for the associated GALL-SLR items (e.g., E-445).
Detection of Aging Effects	Revised Table XI.M29-1 for aluminum and stainless steel tanks exposed to air or condensation environments to cite the results of SRP-SLR further evaluation sections associated with loss of material and cracking due to stress corrosion cracking.	The staff concluded that based on the results of revised further evaluations conducted for stainless steel and aluminum tanks exposed to air or condensation environments, one-time or periodic inspections should be recommended. The basis for each specific change is documented in the tables for the associated GALL-SLR items (e.g., E-446, S-450).
Detection of Aging Effects	Revised Table XI.M29-1 to cite cracking in addition to loss of material for stainless steel and aluminum tank bottom external surfaces.	Cracking was added for stainless steel tank surfaces exposed to soil or concrete based on the potential for deleterious compounds (e.g., halogens) to be present in the soil or water intrusion between the bottom of the tank and the concrete foundation. Citing cracking and periodic inspections for stainless steel tank bottoms exposed to soil or concrete is consistent with GALL-SLR items, such as E-420, A-425, and S-420. Conducting the inspections at 10-year intervals is consistent with other internal tank inspection frequencies. The staff concluded that based on the results of revised further evaluations conducted for aluminum tanks exposed to soil or concrete, one-time or periodic inspections should be recommended. The basis for each specific change is documented in the tables for the associated GALL-SLR items.
Detection of Aging Effects	Revised Table XI.M29-1 footnote 1 to also address bottom thickness measurements of indoor fuel oil tanks.	This change to Table XI.M29-1 was incorporated to provide a cross link between AMP XI.M29 and AMP XI.M30. The recommendation for tank bottom inspections in Table AMP XI.M29 is to provide a consistent approach for managing

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		aging effects for the bottom surfaces of tanks regardless of the service.
Detection of Aging Effects	Revised Table XI.M29-1 footnote 7 to recommend inspection of a minimum of 20% of the tank's internal surface in lieu of 25%.	The inspection percentage was revised to 20% to be consistent with other AMPs (e.g., AMP XI.M32, AMP XI.M38).
Detection of Aging Effects	Deleted Table XI.M29-1 footnote 10.	Footnote 10 applied to managing cracking for stainless steel and aluminum tanks. The subjective criteria in footnote 10 (e.g., proximity to a saltwater coastline) was replaced by the new further evaluations cited in the table for each material, environment and aging effect combination. The new further evaluation sections recommend a search of plant-specific OE and a one-time inspection to determine if periodic inspections should be conducted.
Monitoring and Trending	Replaced the recommendation specific to trending of UT thickness measurements of inaccessible external surfaces of tank bottoms with a general recommendation. The revised program element addresses projecting identified degradation and addressing the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, "Monitoring and Trending," focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant--specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.
Acceptance Criteria Corrective Actions	Clarified the need to repair flaws in caulking or sealant and added the determination for the need to conduct follow-up examinations of the tank's surface when these flaws are detected.	Flaws in caulking or sealant can potentially allow intrusion of moisture and potential degradation. The staff has concluded that flaws in caulking or sealant should be repaired to prevent continued intrusion of moisture. The staff recognized that the decision as to whether or not to conduct follow-up examinations of the tank's surface is dependent on plant-specific configurations and weather conditions. As a result, the staff recommended that the corrective action should include a determination for the need for examinations and did not include a recommendation for specific examinations.
Corrective Actions	Added recommendations for increasing sample size if inspections do not meet acceptance criteria with a minimum threshold, and conducting extent of condition and extent of cause evaluations if subsequent examinations do not meet acceptance criteria. Added discussion for projected inspection results.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. The staff cited footnote 8 in Table AMP XI.M29-1, which allows for one tank to be inspected, where the potential for aging effects was expected to be low. For example, aluminum tanks exposed to treated water or treated borated water. If the inspection acceptance criteria are not met, it is appropriate to inspect all of the tanks in that material, environment, and aging effect combination.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05. GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32, XI.M38). If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.
XI.M30 Fuel Oil Chemistry		
Scope of Program	Clarified to eliminate unnecessary detail addressed in other program elements.	The clarification did not change the scope of the program.
Parameters Monitored or Inspected	Revised to include periodic visual inspections of tank internal surfaces and thickness measurements of the bottoms of the tanks as parameters to be monitored or inspected.	This was an editorial change as these inspections were already recommended in the "detection of aging effects" program element.
Detection of Aging Effects	Added a recommendation to conduct wall thickness measurements of the external tank bottom surface exposed to periodically-wetted concrete or soil for indoor tanks in accordance with AMP XI.M29 Table XI.M29-1, footnote 1.	GALL Revision 2 only recommended conducting volumetric examinations if evidence of degradation was detected during internal visual inspections or visual inspections are not possible. LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," incorporated a recommendation to conduct these thickness measurements for outdoor fuel oil storage tanks. Degradation on the external surfaces of the tank bottoms might be extensive before it is self-revealing on the inside surface of the tank regardless of

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		whether the tank is located outdoors or indoors. Based on this, the staff concluded that periodic tank bottom thickness measurements should also be conducted on indoor tanks. However, if the concrete is not periodically wetted, the staff concluded that there is reasonable assurance that aging effects will not occur. The basis for recommending tank bottom inspections in AMP XI.M29 is that Table XI.M29-1 provides a consistent approach for managing aging effects for the bottom surfaces of tanks regardless of the tank's intended function.
Detection of Aging Effects	Revised the one-time inspections of fuel oil system components (e.g., piping, piping components) to credit fuel oil storage tank inspections if the material and environment are the same.	The basis for this change is documented in GALL-SLR Report item AP-129.
Monitoring and Trending	Added standardized recommendations for projecting identified degradation and addressing the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, "Monitoring and Trending," focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		The staff incorporated the term “where practical” because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, “Masonry Walls,” recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff’s intent in relation to the term “where practical” is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.
Acceptance Criteria	Revised to recommend: (a) reporting and evaluation of degradation of tank internal surfaces in the corrective action program; and (b) evaluating tank bottom thickness measurements against design thickness and corrosion allowance.	The staff concluded that the evaluation of the degradation of tank internal surfaces is appropriately addressed in light of plant-specific considerations. For example, minor loss of material might not have any impact on the fuel oil quality or present a potential flow blockage concern if the suction piping is located an adequate height off the bottom of the tank and the flow velocities are low. It is appropriate to evaluate tank bottom thickness measurements against design thickness and

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		corrosion allowance. Even if the internal surfaces of the tank are coated a corrosion allowance for the external surfaces of outdoor tanks or internal tanks exposed to soil, or periodically wetted concrete is appropriate. Catholically protected tanks might not have as high a corrosion allowance as tanks that are not catholically protected.
Corrective Actions	Revised to include evidence of corrosion in the consideration of adding biocides to fuel oil.	The staff concluded that the addition of a biocide is appropriate if corrosion caused by MIC is observed during tank inspections.
XI.M31 Reactor Vessel Material Surveillance		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	GALL-SLR AMP XI.M31 was updated to provide additional programmatic changes to a plant's reactor pressure vessel (RPV) material surveillance program that are necessary during a subsequent period of extended operation. (a) Scope of Program: The scope of program element for GALL-SLR AMP XI.M31 was changed to provide updated scoping criteria for the AMP, including those whose current licensing basis (CLB's) rely on the implementation of integrated surveillance programs (ISPs). (b) Fluence ranges for capsules needed in support of SLR: The fluence range for at least one surveillance capsule was changed from 1–2 times the peak reactor vessel wall neutron fluence at the end of the period of extended operation to 1–2 times the peak neutron fluence of interest for the time-limited aging analysis (TLAA) that the data is used to address (c) Enhanced description of options for SLR surveillance capsules: The AMP was modified in various places to identify several	(a) Scope of Program: This change adds clarity on the scope of the program. (b) Fluence ranges for standby needed in support of SLR: This change provides clarity that the program provides surveillance data that is needed by the plant, which may not be the peak vessel wall fluence as stated in GALL, Revision 2. For PWR pressurized thermal shock analyses and BWR RPV circumferential weld and axial probability of failure analyses, the fluence of interest can be the peak neutron fluence associated with the insider surface location of the RPV. For upper shelf energy analyses and pressure-temperature (P-T) limit curves, the fluence of interest is associated with the one-quarter thickness (1/4T) location in the RPV. (c) Enhanced description of options for SLR surveillance capsules: This change provides a more complete description of the alternatives that an applicant can use to provide a capsule for SLR surveillance: 1. A capsule meeting the neutron fluence criterion that was tested prior to entering the subsequent period of extended operation. 2. Withdrawal and testing (or alternatively the retrieval from storage, reinsertion for additional neutron

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	alternatives an applicant can use to provide a capsule for SLR surveillance. (d) Not redirecting a license renewal capsule: The AMP was amended to note that it is not acceptable to redirect or postpone the withdrawal and testing of a license renewal capsule (one that was previously identified for withdrawal and testing to address the initial period of extended operation) in order to achieve a higher neutron fluence that meets the neutron fluence criterion for the subsequent period of extended operation.	fluence accumulation, if necessary, and testing) of one capsule. 3. Implementation of in-vessel irradiation of capsule(s) with reconstituted specimens from previously tested capsules and appropriate neutron fluence monitoring. (d) Not postponing or redirecting a license renewal capsule: This change ensures that the effectiveness of the surveillance program for the license renewal period of extended operation of 60 years will continue to provide data needed to ensure safe RPV operation during the subsequent period of extended operation, consistent with the applicant's current licensing basis.
XI.M32 One-Time Inspection		
Program Description Scope of Program	Revised to reflect that a one-time inspection is conducted prior to the upcoming period of extended operation.	The staff has concluded that it is appropriate to conduct a one-time inspection prior to the upcoming period of extended operation. The principles of the program are that an aging effect is not expected to occur or an aging effect is expected to progress slowly. It is appropriate to confirm these two principles because 20 years of operation would have occurred since the prior one-time inspection.
Program Description Scope of Program Detection of Aging Effects	Revised to recommend a one-time inspection of steel components exposed to environments that do not include corrosion inhibitors as a preventive action in order to verify that long-term loss of material due to general corrosion will not cause a loss of intended function (e.g., pressure boundary, leakage boundary (spatial), structural integrity (attached).	Based on a review of the GALL Report recommendations associated with managing loss of material for steel components exposed to environments that do not include corrosion inhibitors (i.e., treated water, reactor coolant, raw water, waste water), the staff has concluded that a one-time inspection for loss of material is appropriate. Original plant designs should have included at least a 40 year corrosion allowance for steel systems. Based on 60 years of operation, it is appropriate to confirm that the rate of loss of material will not challenge the structural integrity of these systems throughout an 80-year span of operation. Further details are provided in the staff's response to industry comment No. 017-022.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Scope of Program	Revised to state that the program cannot be used for aging effects that have not met acceptance criteria based on one-time inspections conducted during the prior operating period or based on the review of plant-specific or industry operating experience.	GALL Report Revision 2 states that the program cannot be used for structures or components subjected to known age related degradation mechanisms. The staff revised this statement to ensure that plant-specific and industry operating experience are reviewed to determine if age related degradation mechanisms have been occurring in a particular material and environment combination. The staff concluded that both plant-specific and industry operating experience are appropriate to review prior to determining if a given material, environment, and aging effect should be included in the scope of AMP XI.M32. The staff has concluded that it is not appropriate to conduct a one-time inspection for aging effects that have been demonstrated to not meet acceptance criteria. A periodic program should be proposed for material and environment combinations where the aging effect has not met acceptance criteria.
Parameters Monitored or Inspected	Revised the examples of parameters monitored or inspected in Table XI.M32 1, "Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component," to remove the term "or equivalent" in relation to VT-1 and VT-3.	The term "or equivalent" was removed because when used in conjunction with VT-1 and VT-3, it could be interpreted to conflict with the recommendation in the "detection of aging effects" program element associated with the qualification of procedures and personnel. The paragraph on the qualification of procedures and personnel states that inspections of Code components should follow procedures consistent with the ASME Code. Inspections of non-Code components are conducted in accordance with plant-specific procedures subject to having an appropriate level of detail as described in the AMP.
Parameters Monitored or Inspected	Removed galvanic corrosion from Table XI.M32-1, "Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component."	The term "galvanic corrosion" was removed from all GALL-SLR Report items. An explanation for its removed is included in GALL-SLR Report Chapter IX. F, in the description for the term "galvanic corrosion."
Parameters Monitored or Inspected	Added footnote 3 to Table XI.M32-1 to address visual inspections of stainless steel and aluminum alloy support members; welds; bolted	The staff added this footnote to make it clear that AMP XI.M32 does not recommend a VT-1, EVT-1, surface examination, or volumetric examination to conduct the one-time inspections for stainless steel (SS) and aluminum alloy support members;

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
	connections; support anchorage to building structure exposed to air or condensation. Editorially relocated Table XI.M32-1 to the "parameters monitored or inspected" program element from the "detection of aging effects" program element.	welds; bolted connections; support anchorage to building structure exposed to air or condensation. The staff recommended the use of AMP XI.M32 to conduct one-time inspections rather than incorporating a one-time inspection methodology into the structural AMPs for stainless steel and aluminum structural components exposed to air or condensation. The basis for the use of visual inspection techniques consistent with AMP XI.S6, as cited in the footnote, is as follows. • Piping, piping components and tanks are less flaw tolerant than supports in that minor through-wall loss of material or cracking will result in leakage. The leakage, in and of itself may not result in a loss of intended function; however, it could impact components in the vicinity of the flaw. In contrast, for a support, minor loss of material or cracking that might not be detectable during a walkdown inspection will likely not impact the intended function of the support. • Loss of material and cracking of aluminum and stainless steel will only occur in the presence of contaminants. These contaminants would likely result in water staining, which would be observable as a precursor to loss of material or cracking. • ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Table IWF-2500-1, "Examination Categories," for Class 1, Class 2, Class 3, and Supports other than piping supports requires that an owner conduct VT-3 inspections. The purpose of a VT-3, as stated in IWA-2213 is: VT-3 examination is conducted to determine the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements; and to detect

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		discontinuities and imperfections, such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion. VT-3 includes examination for conditions that could affect operability or functional adequacy of constant load and spring-type supports. In contrast, the purpose of VT-1 examinations, which are used to inspect pressure retaining components (e.g., nuts; bolts; flange surfaces; internal core support structures; welded attachments to Class 3 vessels, piping, pumps and valves) is: "VT-1 examination is conducted to detect discontinuities and imperfections on the surface of components, including such conditions as cracks, wear, corrosion, or erosion." This demonstrates the utilization of a more rigorous inspection methodology between piping and supports.
Detection of Aging Effects	Removed the reference to AMP XI.M2, AMP XI.M30, and AMP XI.M39 in conjunction with the recommended size of the representative. Revised to state that the representative sample is conducted at each unit.	The reference to the three AMPs was removed to clarify that the representative sample size of 20 percent of the population or a maximum of 25 components is applicable to all material, environment, and aging effects citing AMP XI.M32. The GALL Revision 2 version of AMP XI.M32 was silent on whether the representative sample should be conducted at each unit or on a site-wide basis. Whereas the staff has recommended alternatives to inspections on a unit or site basis for periodic programs, it has concluded that based on the one-time inspections only occurring once, both units should be inspected to ensure that an adequate sample population is inspected.
Detection of Aging Effects	Added distance offset and surface coverage to examples of inspection parameters during non-ASME Code inspections.	The staff incorporated this change because distance offset and surface coverage are critical inspection parameters regardless of whether the inspection is being conducted under the scope of ASME Code Section XI or not. During the conduct of some IP-71003 inspections the inspectors noted that some non-ASME Code inspection pre-job briefs did not cover all critical inspection parameters. The staff concluded that further

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		guidance on applicable inspection parameters for non-ASME Code inspections was appropriate.
Detection of Aging Effects	Added guidance on grouping aluminum materials for determining inspection populations.	The staff provided this guidance because certain alloys of aluminum have a relatively lower corrosion resistance than others. Inspection results for these lower corrosion resistant alloys (i.e., 2xxx and 7xxx series), if all aluminum materials were combined into a single population, could result in ambiguous results from one-time inspections. If the lower corrosion resistant alloys are present at a site, they should be in a separate population because their inspection could over predict degradation results as compared to other alloys. Likewise, if only the other alloys are inspected, degradation of the lower corrosion resistant alloys might be missed.
Detection of Aging Effects	Added guidance on inspecting internal surfaces of aluminum, stainless steel, and nickel alloy components exposed to air or condensation.	The staff concluded that if plant-specific OE and one-time inspections of the external surfaces of aluminum, stainless steel, and nickel alloy components demonstrate that an aging effect is not applicable (e.g., cracking, loss of material) there is reasonable assurance that the aging effects will also be not applicable on the inside surfaces.
Detection of Aging Effects	Deleted the phrase, "[t]he inspection and test techniques have a demonstrated history of effectiveness in detecting the aging effect of concern. Typically, the one-time inspections are performed as indicated in the following table."	The staff deleted this phrase because it was superfluous information. The inspection techniques cited as examples in Table XI.M32-1 would not have been cited unless they had a history of effectiveness.
Detection of Aging Effects	Revised to recommend that one-time inspections are completed no later than the end of the current operating term.	The staff recognized that the wording in GALL Report Revision 2 was ambiguous in regard to when one-time inspections had to be completed. The text, "the sample of components inspected before the end of the current operating term needs to be sufficient to provide reasonable assurance that the aging effect will not compromise any intended function during the period of extended operation" could lead a licensee to conclude that only a portion of the one-time inspections need to be completed. Given that AMP XI.M32 is a sampling-based program, the staff concluded that the entire sample must be completed prior to the end of the current operating term to provide reasonable assurance that aging effects will be appropriately managed.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Monitoring and Trending	Revised to state that inspection results for each material, environment, and aging effect combination should be compared to those obtained in previous inspections when available.	The staff concluded that given that a one-time inspection was conducted to support entry into the first period of extended operation, the results of the two inspections should be compared. The staff recognizes that plants that received earlier renewed licenses for the first period of extended operation may not have conducted one-time inspections for all material, environment, and aging effect combinations, and therefore the term “when available” was included.
Monitoring and Trending	Revised to addresses projecting identified degradation.	During the staff’s review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation, the end of the subsequent period of extended operation being applicable for results of AMP XI.M32 inspections. SRP-SLR Section A.1.2.3.5, “Monitoring and Trending,” focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term “where practical” because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” appropriately does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, “Masonry Walls,” recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff’s intent in

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		relation to the term "where practical" is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects.
Acceptance Criteria	Revised to provide recommendations related to acceptance criteria for projected degradation. Revised to state that if measurable degradation has occurred, but acceptance criteria have been met, the inspection results are entered into the applicant's corrective action program for future monitoring and trending.	The staff concluded that one-time inspections should have two acceptance criteria. The first acceptance criterion is for current inspection results. There were no changes from GALL Report Revision 2 for this acceptance criterion. In general, current inspection results should be evaluated against design criteria. The second acceptance criterion is for projecting observed degradation. To meet the acceptance criterion, the results should demonstrate that: • The projected degradation would not impact the function of the systems, structures, and components (SSCs). This criterion is based on the objective of 10 CFR 54.33 which states that SSCs, "will continue to perform their intended functions for the period of extended operation." • The projected degradation will not result in a leak. The staff recognizes that the pressure boundary intended function of an SSC can be met despite leaks occurring. However this acceptance criterion was added because degradation could occur more rapidly than projected and potentially result in failure of the SSC and leakage from nonsafety-related SSCs can affect safety-related SSCs. • The projected degradation will not result in heat transfer rates below that required by the current licensing basis to meet design limits. This criterion was added because degradation could occur more rapidly than projected and potentially result in the heat exchanger not meeting its intended function.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		The trending aspect of inspections that reveal measurable degradation; but the acceptance criteria is met, was added to ensure that even though the inspections are conducted on a one-time basis, measurable degradation results should be available if a future opportunistic inspection reveals continued degradation that could impact a SSC's intended function prior to the end of the subsequent period of extended operation.
Corrective Actions	Included recommendations for conducting extent of condition examinations when acceptance criteria are not met.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Changes to the Generic Aging Lessons Learned (GALL) Report Revision 2 Aging Management Program (AMP) XI.M41, Buried and Underground Piping and Tanks." The staff determined that recommending this methodology be applied to other AMPs was appropriate, each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections. The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05. GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		criterion is consistent with several sampling-based AMPs (e.g., XI.M38). Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term "for all components" to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria.
Corrective Actions	Added a recommendation that a periodic inspection program is recommended when an aging effect identified during an inspection does not meet acceptance criteria or projected results of the inspections of a material, environment, and aging effect combination do not meet the above acceptance criteria. The periodic inspection program is implemented at the all of the onsite units with same combination(s) of material, environment, and aging effect.	The basis of AMP XI.M32 is that: "(a) an aging effect is not expected to occur, but the data are insufficient to rule it out with reasonable confidence; or (b) an aging effect is expected to progress very slowly in the specified environment, but the local environment may be more adverse than generally expected." As a result, if an inspection result does not meet the acceptance criteria whether based on the current inspection result or projected degradation, it is appropriate to transition to a periodic program given the potential adverse impact to the SC's ability to meet its intended function.
XI.M33 Selective Leaching		
Program Description Scope of Program Detection of Aging Effects Acceptance Criteria	Deleted the phrase, "This program demonstrates the absence of selective leaching."	This phrase was deleted based on a review of industry operating experience. It is apparent that loss of material due to selective leaching has occurred and will continue to occur in susceptible components exposed to aqueous environments. As a result, the basis of the program has been changed to manage this aging effect rather than demonstrating that it is not occurring.
Program Description Scope of Program Detection of Aging Effects Acceptance Criteria	Revised to include ductile iron as an additional material susceptible to loss of material due to selective leaching.	The staff's basis for this change is documented in the GALL-SLR and SRP-SLR Supplemental Staff Guidance document issued on March 29, 2016, (ADAMS Accession No. ML16041A090).

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Program Description Scope of Program	Revised to include the waste water and soil environment. Deleted the water-contaminated lubricating oil environment.	Based on the review of commonly available documents and operating experience, the staff has concluded that the waste water and soil environment (as described in GALL-SLR Report Chapter IX.D the soil environment includes groundwater) can be conducive to loss of material due to selective leaching. The staff concluded that there is reasonable assurance that water contaminated lubricating oil would not result in loss of material due to selective leaching sufficient to result in a loss of intended function because it is unlikely that the predominate locations where water could accumulate would be constructed of a susceptible material (e.g., tanks, strainers).
Program Description Detection of Aging Effects	Revised to include one-time, opportunistic, and periodic inspections of selected components that are susceptible to selective leaching. Added destructive examinations to the program.	Based on the staff's review of several LRAs and plant-specific operating experience reviewed during AMP audits, three AMP effectiveness audits, and during license renewal 71003 inspections, "Post Approval Site Inspections for License Renewal," the staff has observed that selective leaching principally occurs in untreated water environments. The untreated water environments included within the scope of AMP XI.M33 are raw water, waste water, and soil. Based on a review of industry operating experience, it is apparent that components exposed to a treated water or closed-cycle cooling environment are less susceptible to loss of material due to selective leaching. However, the staff lacks sufficient information to conclude that loss of material due to selective leaching will not occur in these environments. The staff has therefore concluded that it is appropriate to conduct one-time inspections of susceptible components exposed to treated water or closed-cycle cooling environments. These inspections are conducted in the 10-year period prior to a subsequent period of extended operation to provide reasonable assurance that loss of material due to selective leaching will not cause an in-scope component to fail to perform its intended function. Periodic inspections should be conducted at plant sites where plant-specific operating experience demonstrates that loss of material due to selective

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		leaching has occurred in components exposed to treated water or closed-cycle cooling water. Destructive examinations were added to the program because they can be a highly effective means to detect the extent of loss of material due to selective leaching.
Program Description	Described the effect of dealloying in greater detail.	As a result of the staff's review of a proposed plant-specific AMP by an applicant and a relief request by a licensee (ADAMS Accession No. ML14182A634), the staff concluded that it was appropriate to state that as a result of selective leaching, the affected volume has a permanent change in density and does not retain mechanical properties that can be credited for structural integrity. The basis for the staff's determination is documented in the final safety evaluation report for South Texas Project, Section 3.0.3.3.3, "Staff's Conclusions in Regard to Percent Dealloying and Dealloyed Material Properties," (ADAMS Accession No. ML 17146B242)
Scope of Program	Revised to permit exclusion of certain susceptible components based on preventive actions associated with the component.	The allowance to remove certain components from the scope of AMP XI.M33 based on the efficacy of cathodic protection and coatings had been previously incorporated into AMP XI.M41 with the issuance of LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks.'" In conjunction with the development of the GALL Report SLR, these provisions have been editorially relocated to AMP XI.M33.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		In addition, with the issuance of AMP XI.M42 in LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," the staff incorporated new GALL Report AMR items (i.e., E-415, A-415, S-415) to address selective leaching of internally coated or lined components. Consistent with the change in LR-ISG-2011-03, Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, "Buried and Underground Piping and Tanks," the staff concluded that coatings can isolate the susceptible material from the adverse environment. In lieu of managing loss of material due to selective leaching with AMP XI.M33, the coatings are managed for loss of coating integrity.
Preventive Actions	Added water chemistry controls, coatings, and cathodic protection to the list of preventive actions.	Water chemistry controls were added based on the staff's research into causes of loss of material due to selective leaching. It is commonly recognized that pH, corrosive contaminants, and dissolved oxygen can promote selective leaching. Coatings and cathodic protection were already incorporated as effective preventive actions in LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks,." and LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks."
Parameters Monitored or Inspected	Revised to address specific parameters associated with destructive examinations.	The staff conducted extensive reviews of an LRA where the applicant proposed destructive examinations to in part manage loss of material due to selective leaching of aluminum bronze components. Based on these reviews, the staff concluded that when destructive examinations are conducted, the depth of dealloying through wall thickness of components can be observed.
Parameters Monitored or Inspected	Deleted monitoring of surface hardness.	Hardness testing was deleted based on the staff's review of license renewal applications (LRAs) and determining that conducting hardness testing of as found conditions of components was not viewed as practical.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects		
Detection of Aging Effects	Revised to recommend specific inspection sizes and to include destructive examinations.	The size of the representative sample recommended in the previous version of AMP XI.M33 was 20% of the population with a maximum of 25 components. In the Commission's Memorandum and Order of Entergy Nuclear Generation Company and Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station) CLI-10-14, 71 NRC 449, 465, 467 (2010), the Commission stated, "[i]n another license renewal case, we recently stated that 'reasonable assurance' is not quantified as equivalent to a 95% (or any other percent) confidence level, but is based on sound technical judgment of the particulars of a case and on compliance with our regulations," and "[n]or does any statute, regulation, or case law require the Commission to assign and apply a precise "level or degree" of confidence to the "reasonable assurance" standard. [ADAMS Accession No. ML101680369]. Based on the Commissioner's position, the staff can judge the sample size for each proposed AMP on its individual merits using sound technical judgment. The previous sample was consistent with other sampling-based AMPs (e.g., AMP XI.M32). For components exposed to raw water, waste water, soil, and groundwater environments, the staff established a sample size of 3% of the population or a maximum of 10 components per population for visual and mechanical (for gray cast iron and ductile iron components) inspections at each unit. In addition, two destructive examinations are performed for each material and environment population. Regional inspectors observed that at one station, visual inspections were conducted that resulted in no observable loss of material due to selective leaching. However, when some of the components were destructively examined, there was evidence of loss of material due to selective leaching. The basis for the staff's reduction in the number of visual examinations from that in the previous

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		version of AMP XI.M33 is documented in the response to industry comment No. 017-031. Based on the slow acting nature of the degradation mechanism and results of the licensee's one-time inspections conducted for the prior period of extended operation, the staff concluded that there is reasonable assurance that due to the size of the periodic samples (including both visual and destructive) starting 10 years prior to the period of extended operation and extending throughout the period of extended operation, loss of material due to selective leaching will be detected prior to a loss of intended function of in-scope components. In order to provide for a standardized inspection length when the component is a segment of piping, the AMP recommends that a 1-foot axial length section be examined. This is consistent with the sample length in other AMPs issued in LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation" (e.g., AMP XI.M36) and AMP XI.M42 issued with LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks." The basis for reducing the number of destructive examinations for smaller populations is documented in the staff response to industry comment No. 017-031.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Revised to address a potential reduction on the total number of inspections for a multi-unit site.	The staff has concluded that where the sample size is not based on the percentage of the population, rather than conducting the full representative sample size inspections at each site of a multi-unit site, reasonable assurance can be obtained with a lower sample set if the operating conditions of the units at a multi-unit site are similar. The staff has also concluded that each unit should have inspections conducted even though on the surface; the units appear to be identical with similar operating conditions. The staff used the inspection multipliers previously established in LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Pipe and Tanks'," AMP XI.M41 to derive the number of inspections per unit (i.e., one and a half times for a two-unit site and two times for a three unit site). As a result, at a two-unit site, eight visual and mechanical inspections and two destructive examinations are conducted at each unit. For three-unit sites, seven visual and mechanical and one destructive examination are conducted at each unit. In order to use the alternative inspection quantity, the applicant provides the basis for similarity in the LRA. The staff provided three examples of potential differences in operating conditions that could result in the full inspections being conducted at each unit.
Detection of Aging Effects	Revised to allow combining similar environments.	The staff concluded that the raw water and waste water populations are similar enough such that if the more severe environment is selected for inspections and examinations, there is reasonable assurance that potential selective leaching will be detected. As a backstop, the staff recommends that one inspection, but no more, be conducted in the less severe environment. The staff concluded that the severity of environments cannot always be exactly determined. As a result, the one inspection in the less severe environment might reveal a different result than that for the more severe environment.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Revised the guidance related to a reduced number inspections of buried components based on the efficacy of the coating system.	The concept of reducing the number of inspections based on the efficacy of the coating system for buried components is not a change from GALL Report Revision 2 because it was incorporated in LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41,'Buried and Underground Piping and Tanks.'" In LR-ISG-2011-03 the reduced number of recommended inspections, 25% of that cited in the AMP, that being 5% of the population in lieu of 20% with a maximum of 6 inspections in lieu of 25. Given the lower number of inspections cited in the SLR AMP (i.e., 3% or a maximum of 10 inspections), the staff reduced the inspections that met the criteria to 50% of that cited in the SLR AMP.
Detection of Aging Effects	Revised to include recommendations associated with examples of applicable inspection parameters.	The staff concluded that in order to provide reasonable assurance that inspections outside the scope of ASME Section XI are conducted in a manner to ensure that a potential aging effect is detected, inspection parameters such as lighting, distance offset, surface coverage, presence of protective coatings, and cleaning processes should be defined in the plant-specific procedures.
Detection of Aging Effects	Revised to address a reduction in the number of visual and mechanical inspections by two for each component that is destructively examined beyond the minimum number of destructive examinations recommended in each 10-year interval.	Visual and mechanical inspections predominantly provide qualitative data in regard to the extent of loss of material due to selective leaching. Destructive examinations provide quantitative results. As a result, the staff concluded that a reduced number of visual and mechanical inspections was warranted when destructive examinations beyond the baseline recommendation are conducted. Subsequent to the issuance of the GALL-SLR Report, the staff noted that the option to reduce the number of visual and mechanical inspections was only incorporated into the text addressing periodic inspections. It is the staff's intent that this same option can be incorporated into one-time inspections. Given that the one-time inspections did not incorporate a recommendation for a minimum number of destructive examinations, the first destructive examination (for example) would reduce the total number of visual and mechanical inspections by two.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
Monitoring and Trending	Revised to address projecting identified degradation and confirming the sampling basis.	The previous version of AMP XI.M33 did not include recommendations for monitoring and trending because it was a one-time inspection program. During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, Monitoring and Trending, focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original sampling basis when it is anticipated that acceptance criteria would not be met.
Acceptance Criteria	Revised to include new acceptance criteria.	The staff deleted the acceptance criteria related to hardness testing results based on reviewing LRAs and determining that conducting hardness testing of as found conditions of components was not viewed as practical. The basis for the new acceptance criteria is as follows: • Indications of green copper oxide was added to the appearance of a reddish copper color for copper based alloys based on staff field observations of dealloying in aluminum bronze components. • For gray cast iron, the staff concluded that the absence of a surface layer that can be easily removed by chipping or scraping or identified in the destructive examinations were the only practical criteria because loss of material due to selective leaching is not typically detectable by visual means. • There is reasonable assurance that a superficial layer of dealloying would not affect the intended function of a component. However, if the layer is more than superficial, corrective actions are appropriate. Given that the destructive examinations will be capable of quantifying the depth of dealloying, the staff concluded that an appropriate acceptance criterion would be that the components should meet system design requirements such as minimum wall thickness, extended to the end of the period of extended operation. The staff selected the end of the period of extended operation and not the next inspection because the particular degraded component would have been removed for destructive examination and the degree of degradation should

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		be used to inform the licensee about the potential condition of other similar components still installed in the plant.
Corrective Actions	Included recommendations for conducting extent of condition examinations when acceptance criteria are not met.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41," Buried and Underground Piping and Tanks.'" The staff determined that recommending this methodology be applied to other AMPs was appropriate, each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections. The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05. GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32, XI.M38). The basis for recommending a minimum of one additional destructive examination when destruction examination(s) did not meet acceptance criteria is because it is a reasonable

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		expansion quantity based on either one or two initial destructive examinations. Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term "for all components" to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria.
Corrective Actions	Revised to recommend that the program includes a process to evaluate difficult-to-access surfaces (e.g., heat exchanger shell interiors, exterior of heat exchanger tubes) if unacceptable inspection findings occur within the same material and environment population.	The staff included this new recommendation based on the review of several LRAs. In most of these LRAs, the AMR item tables listed components where it would be difficult to conduct visual inspections. For example, the inside of a heat exchanger shell. This is not an issue for the initial inspection scope because in all cases, the same materials in the same environment were present in configurations that could be inspected. However, the staff concluded that the program should include a process to evaluate difficult to access surfaces. The staff's concern is related to a scenario where the component inspections result in a condition where the acceptance criteria is not met such that affected components would have to be replaced prior to the end of the period of extended operation. Absent an in place process, it is not clear to the staff that all equally susceptible components could be identified in a timely manner.
Corrective Actions	Removed the terms "conditions adverse to quality" and "significant conditions adverse to quality."	In conjunction with standardizing the wording in the Corrective Actions, Confirmation Process, and Administrative Controls program elements, the staff deleted these two terms. The staff recognizes that inspection or test results might reveal degradation; however, the component might still meet all design basis and current licensing basis requirements. In this case, the inspection or test results would not typically be documented as a condition adverse to quality. An applicant would document the results in their corrective action program or another process in order to trend the results.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
XI.M35 ASME Code Class 1 Small-Bore Piping		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Operating Experience References	"One-Time Inspection of" was removed from the program title since this is a program for subsequent license renewal. All elements were rewritten for clarity. In Detection of Aging Effects, updated to include Table 1, Examinations. In Detection of Aging Effects and in Monitoring and Trending, added more specific guidance for plants that need periodic examinations.	For clarity, this update added Table 1, Examinations. This AMP contains guidance on examination schedules, sample sizes, and applicability. These entries are summarized and formatted in the table. There are no technical changes. Additionally, the Reference section was updated with more recent industry operating experience.
XI.M36 External Surfaces Monitoring of Mechanical Components		
Program Description Scope of Program Parameters Monitored or Inspected	Added cementitious materials to the scope of the program, including examples of inspection parameters associated with pertinent aging effects.	Although not previously discussed in the AMP, aging effects for cementitious materials were cited in GALL Report Revision 2 as being managed by AMP XI.M36. See the basis for changes to GALL-SLR Report, item AP-253 for a reference to cementitious inspection standards.
Program Description Detection of Aging Effects	Added HVAC closure bolting to components addressed by this AMP.	The staff recognizes that it would be difficult to use leakage as an indication for potential degradation of HVAC closure bolting exposed to air or condensation, as recommended in AMP XI.M18 for closure bolting. The air in HVAC ducts is only slightly pressurized. As a result, the staff has cited AMP XI.M36 to manage aging effects (i.e., loss of material, cracking, loss of preload) associated with HVAC closure bolting. HVAC leaks will typically be evident by changes in the capability of the system to cool or heat a room or enclosure, which if they are severe enough will be addressed in the corrective action program. This is in contrast to an instrument air system (another system that is air-filled) where although air compressor run times could be trended, it would be difficult to pin point the relative location of leaking flanges. In addition, most HVAC closure bolting is relatively short and thus the

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		potential for significant undetected corrosion to be occurring along the hidden portions of the shank is less. Most ducts have a significantly larger number of closure bolts than typical flanges and thus the joint is more tolerant of undetected aging effects occurring at a joint. As a result, the staff has concluded that the normal visual inspections conducted during personnel walkdowns as recommended by AMP XI.M36 can be capable of detecting loss of material, cracking, or loss of preload sufficient to provide reasonable assurance that the HVAC system can meet its intended function.
Program Description Parameters Monitored or Inspected Detection of Aging Effects	Added a recommendation to use physical manipulation to manage reduction of impact strength for polyvinyl chloride (PVC) components when exposed to sunlight.	The basis for inclusion of managing PVC piping for reduction of impact strength is documented in GALL-SLR Report, item A-458.
Program Description Parameters Monitored or Inspected Detection of Aging Effects	Revised to incorporate periodic visual or surface examinations for cracking of stainless steel and aluminum components.	The staff revised the SRP-SLR and GALL-SLR Report to include one-time and potentially periodic inspections for cracking of stainless steel and aluminum component external surfaces. AMP XI.M36 was revised to incorporate these inspections. The AMP recommends one of three methods to detect cracking. • Surface examinations because surface examinations are capable of detecting cracking. • ASME Code Section XI VT-1 examinations because VT-1 examinations, in contrast to VT-2 or VT-3 examinations, can be capable of detecting cracking. • Visual inspections for cracking are recommended if it can be analytically demonstrated that visual inspections will effectively detect cracks prior to challenging the structural integrity or intended function of the component. The staff used the term “intended function of the component,” because some components have a leakage boundary (spatial) function that could be more restrictive than satisfying structural integrity requirements. The staff

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		concluded that this method is acceptable because the plant-specific analysis will be reviewed by the staff during the SLRA process. The staff provided examples of recommended means for detecting cracking for gas-filled systems. These methods, detection of stains, trending accumulator pressures, and soap bubble testing have been demonstrated to be effective. The population size for surface examinations and VT-1 examinations and the frequency for all three methods is consistent with other sampling-based programs (e.g., AMP XI.M33, AMP XI.M38).
Scope of Program	Clarified to eliminate unnecessary detail addressed in other program elements.	The clarification did not change the scope of the program.
Parameters Monitored or Inspected	Included accumulation of debris on heat exchanger tube surfaces to address reduction of heat transfer.	Reduction of heat transfer for air-to-water heat exchangers is addressed for some components through NRC GL 89-13. Where heat transfer efficiency tests do not provide valid results, GL 89-13 allows visual inspections of the heat exchanger’s air side to verify cleanliness. The visual inspections conducted by AMP XI.M36 can effectively detect fouling on these heat exchanger surfaces to manage reduction of heat transfer.
Detection of Aging Effects	Revised to include standardized recommendations associated with qualifications to conduct inspections and examples of applicable inspection parameters.	Based on a review of multiple AMPs, the staff standardized inspector qualifications and inspection parameter recommendations for several balance-of-plant AMPs. While inspections required by ASME Code Section XI have adequately specified controls, the staff concluded that inspection parameters, such as, lighting, distance, etc., should be defined in the plant-specific procedures.
Detection of Aging Effects	Revised to clarify that considerations for crediting insulation protective outer layer (where jacketing is not installed) includes the protective outer layer being waterproof.	The clarification adds a third consideration for continuing periodic inspections under the insulation. If the jacketing is not waterproof, the insulation will have to be removed to determine whether there have been any aging effects under the insulation.
Monitoring and Trending	Revised to address projecting identified degradation and addressing the timing of future inspections.	During the staff’s review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR, Section A.1.2.3.5, Monitoring and Trending, focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term “where practical” because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, “Masonry Walls,” recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff’s intent in relation to the term “where practical” is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original sampling basis when it is anticipated that acceptance criteria would not be met.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Acceptance Criteria	Revised to remove specific examples of qualitative acceptance criteria and substituted generic wording. In addition, the AMP now recommends that the degree of observed degradation be evaluated to the end of the subsequent period of extended operation or the next scheduled inspection, whichever is shorter.	The staff removed the specific examples of qualitative acceptance criteria in recognition that for the range of inspections conducted in this program, acceptance criteria should be established based on plant-specific bases. The AMP recommends that acceptance criteria be quantitative; however, the staff recognizes that this may not be possible in all cases (e.g., flexibility of elastomeric sealant, level of debris on heat exchanger tubes). The staff recommends that when qualitative acceptance criteria are used, the criteria needs to be clear enough to result in a singular decision. If for the same degree of degradation, multiple conclusions as to acceptability of the degradation condition could be derived, there is a potential that a component with unacceptable degradation could remain in service. The staff concluded that in order to ensure that the intended function of components is met throughout the period of extended operation, indications of degradation need to be projected at least until the next planned inspection.
Corrective Actions	Added recommendations for additional inspections (minimum of 5 or 20%) if acceptance criteria are not met for inspections to detect cracking in aluminum and stainless steel components. Extent of condition and extent of cause evaluations are conducted, if subsequent inspections do not meet acceptance criteria. Added discussion for adjusting inspection frequencies if projected results will not meet acceptance criteria prior to next scheduled inspection.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks.'" The staff determined that recommending this methodology be applied to other AMPs was appropriate; each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		AMP XI.M36 is based on periodic walkdowns of all accessible components. However, sampling-based inspections are conducted for aluminum and stainless steel components to detect cracking. The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05, “Guidance for Performing Temporary Non-Code Repair of ASME Class 1, 2, and 3 Piping.” GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32, XI.M38). Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term “for all components” to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
XI.M37 Flux Thimble Tube Inspection		
There were no significant changes to this AMP.		
XI.M38 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components		
Program Description	Added a recommendation that elastomers and flexible polymeric components exposed to open-cycle, closed cycle cooling, and fire water are managed by this program. Added an option that aging effects associated with fire water system components with only a leakage boundary (spatial) or structural integrity (attached) intended function be managed by this program.	After considering changes to GALL-SLR Report, AMP XI.M20, AMP XI.M21A, and AMP XI.M27, the staff concluded that it would be more effective to manage elastomers with AMP XI.M38 rather than augmenting these three programs to address aging effects associated with elastomers. The basis for the inclusion of fire water system components with only a leakage boundary (spatial) or structural integrity (attached) intended function is documented in the bases for AMP XI.M27.
Program Description Scope of Program Parameters Monitored or Inspected Detection of Aging Effects	Revised to incorporate periodic visual or surface examinations for cracking of stainless steel and aluminum components.	The staff revised the SRP-SLR and GALL-SLR Report to include one-time and potentially periodic inspections for cracking of stainless steel and aluminum component external surfaces. AMP XI.M38 was revised to incorporate these inspections. The AMP recommends one of three methods to detect cracking. • Surface examinations because surface examinations are capable of detecting cracking. • ASME Code Section XI VT-1 examinations because VT-1 examinations, in contrast to VT-2 or VT-3 examinations, can be capable of detecting cracking. • Visual inspections for cracking are recommended if it can analytically demonstrated that visual inspections will effectively detect cracks prior to challenging the structural integrity or intended function of the component. The staff used the term "intended function of the component," because some components have a leakage boundary (spatial) function that could be more restrictive than satisfying structural integrity requirements. The staff concluded that this method is acceptable because the plant-specific analysis will be reviewed by the staff during the SLRA process. The staff provided examples of

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		recommended means for detecting cracking in gas-filled systems. These methods, detection of stains, trending accumulator pressures, and soap bubble testing have been demonstrated to be effective. The population size for surface examinations and VT-1 examinations and the frequency for all three methods is consistent with other sampling-based programs (e.g., AMP XI.M33).
Scope of Program	Revised to state that the program is not intended to be used to manage aging effects for components where loss of intended function has occurred due to age related degradation.	The staff replaced the term "failures" with the term "loss of intended function" to be in better alignment with the wording in 10 CFR Part 54. 10 CFR 54.33(b) states that, a renewed license will be issued in such form and contain such conditions and limitations, including technical specifications as the Commission deems appropriate and necessary to help ensure that systems, structures, and components subject to review in accordance with § 54.21 will continue to perform their intended functions for the period of extended operation. The rule does not use the term "failure."
Scope of Program Parameters Monitored or Inspected	Added cementitious materials to the scope of the program.	Cementitious materials were added to reduce the number of AMR items citing generic Note E. The applicable aging effects, loss of material and cracking are detectable by visual inspections recommended by this AMP. See the basis for GALL-SLR Report, item A-647 for a reference to cementitious inspection standards.
Parameters Monitored or Inspected	Revised to include reduction of heat transfer and flow blockage as aging effects.	Based on a review of several LRAs, the staff noted that applicants were citing AMP XI.M38 to manage reduction of heat transfer due to fouling on the external surface of heat exchanger tubes installed inside duct banks or other components. During each of these LRA reviews, the staff had concluded that visual inspections could be effective in detecting fouling on these heat exchanger surfaces. As a result, reduction of heat transfer due to fouling was added to AMP XI.M38. The staff also included an example of an indicator of this aging effect, "debris accumulation on heat exchanger tube surfaces."

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		The visual inspections recommended by the program are capable of detecting flow blockage.
Detection of Aging Effects	Revised to address a potential reduction on the total number of inspections for a multi-unit site.	The staff has concluded that where the sample size is not based on the percentage of the population, rather than conducting the full representative sample size inspections at each site of a multi-unit site, reasonable assurance can be obtained with a lower sample set if the operating conditions of the units at a multi-unit site are similar. The staff has also concluded that each unit should have inspections conducted even though on the surface the units appear to be identical with similar operating conditions. The staff used the inspection multipliers previously established in LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks,'" and AMP XI.M41 to derive the number of inspections per unit (i.e., 1.5 times for a two unit site and two times for a three unit site). In order to use the alternative inspection quantity, the applicant provides the basis for similarity in the LRA. The staff provided four examples of potential differences in operating conditions that could result in 25 inspections being conducted at each unit.
Detection of Aging Effects	Revised to include standardized recommendations associated with qualifications to conduct inspections and examples of applicable inspection parameters.	Based on a review of multiple AMPs, the staff standardized inspector qualifications and inspection parameter recommendations for several balance-of-plant AMPs. While inspections required by ASME Code Section XI have adequately specified controls, the staff concluded that where ASME Code does not apply, inspection parameters such as lighting, distance, etc., should be defined in the plant-specific procedures.
Parameters Monitored or Inspected Detection of Aging Effects	Revised to include a recommendation that follow-up volumetric wall thickness measurements are conducted for steel components exposed to raw water, raw water (potable), or waste water when internal visual inspections detect surface irregularities that could be indicative of an unexpected level of degradation due to corrosion and corrosion product deposition.	The staff added this recommendation based on its review of plant-specific operating experience. The staff noted that steel piping exposed to raw water is the main population for loss of material due to recurring internal corrosion. The recommended wording is consistent with that included in AMP XI.M27. The staff concluded that if the visual inspections detect surface irregularities that could be indicative of an unexpected level of degradation, it is appropriate to conduct

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		follow-up wall thickness measurements. The staff included the raw water (potable) and waste water environments because they are additional environments that could be aggressive for steel components.
Monitoring and Trending	Revised to address projecting identified degradation and the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR, Section A.1.2.3.5, Monitoring and Trending, focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example, a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant--specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original sampling basis when it is anticipated that acceptance criteria would not be met.
Acceptance Criteria	Revised to remove specific examples of qualitative acceptance criteria and substituted generic wording. In addition, the AMP now recommends that the degree of observed degradation be evaluated to the end of the subsequent period of extended operation or the next scheduled inspection, whichever is shorter.	The staff removed the specific examples of qualitative acceptance criteria in recognition that for the range of inspections conducted in this program, acceptance criteria should be established based on plant-specific bases. The AMP recommends that acceptance criteria be quantitative; however the staff recognizes that this may not be possible in all cases (e.g., flexibility of elastomeric sealant, level of debris on heat exchanger tubes). The staff recommends that when qualitative acceptance criteria are used, the criteria needs to be clear enough to result in a singular decision. If for the same degree of degradation, multiple conclusions as to acceptability of the degradation condition could be derived, there is a potential that a component with unacceptable degradation could remain in service. The staff concluded that in order to ensure that the intended function of components is met throughout the period of extended operation, indications of degradation need to be projected at least until the next planned inspection.
Corrective Actions	Included recommendations for performing additional inspections if acceptance criteria is not met (minimum of 5 up to 20%), conducting extent of condition and extent of cause evaluations if subsequent examinations do not meet acceptance criteria, and adjusting inspection frequencies if projected inspection results will not meet acceptance criteria.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks'." The staff determined that recommending this methodology be applied to other AMPs

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		was appropriate; each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections. The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05, “Guidance for Performing Temporary Non-Code Repair of ASME Class 1, 2, and 3 Piping.” GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of five could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32). Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term “for all components” to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	XI.M39 Lubricating Oil Analysis	
Program Description	Added hydraulic oils.	This change is consistent with the “scope of program” element in GALL Report Revision 2.
Scope of Program	Clarified to eliminate unnecessary detail addressed in other program elements.	The clarification did not change the scope of the program.
Detection of Aging Effects	Incorporated a recommendation for testing of old hydraulic fluid.	The staff concluded that if the hydraulic fluid is replaced as recommended by the manufacturer, equipment vendor, or plant-specific documents, there is reasonable assurance that the fluid has not degraded to the point where it would affect the intended function of an in-scope component. Alternatively, the recommendation to test for water content if the oil is not clear or bright, and for particulate count is based on the staff’s review of ASTM D6224-02, Standard Practice for In-Service Monitoring of Lubricating Oil for Auxiliary Power Plant Equipment, Table 2, Guidelines for Sampling and Testing In-Service Oils. This table recommends testing for viscosity and acid number in addition to appearance, water (recommended if the oil is not clear and bright) and particle counts. However, the staff concluded that, given the hydraulic fluid will not be remaining in-service, checking the oil’s appearance (to determine if the water content should be tested) and particulate count provides sufficient information to determine if the hydraulic oil could be impacting the passive portions of a component. This position is reinforced by the ASTM D6224-02, Section 8.2, Viscosity, which states, “[t]he main purpose for checking the viscosity of used oil is to determine if the correct oil is being used and to detect contamination.” Contamination would be evident during testing for water or particulates. Given the plant-specific controls during replacement and addition of hydraulic fluids, it is reasonable to conclude that contaminants other than particulates generated due to wear would not be present.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
XI.M40 Monitoring of Neutron-Absorbing Materials Other than Boraflex		
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria Corrective Actions Confirmation Process Administrative Controls Operating Experience References	In program description, modified to clarify the difference between XI.M22 and XI.M40. In Detection of Aging Effects, reworded for increased clarity and modified to include a discussion regarding Carborundum. The maximum interval between inspections for polymer-based materials (e.g., Carborundum, Tetrabor), regardless of operating experience, should not exceed 5 years. The maximum interval between inspections for non-polymer-based materials (e.g., Boral, Metamic, Boralcan, borated stainless steel), regardless of operating experience, should not exceed 10 years. In Operating Experience, updated to include relevant and new operating experience.	This AMP was updated to include a discussion regarding Carborundum. Operating experience suggests that Carborundum may be an issue due to the fact that it is a polymeric material that degrades similarly to Boraflex by breakdown of polymer chains. Because licensees don't have the benefit of monitoring silica, the NRC staff increased the surveillances of polymeric materials like Carborundum. There has been active degradation of polymeric materials which warrants the increased inspection frequency. Relevant operating experience was also included as part of this AMP.
XI.M41 Buried and Underground Piping and Tanks		
Program Description Scope of Program Parameters Monitored or Inspected Acceptance Criteria	Revised to remove managing changes in material properties for cementitious components. In addition, revised the term "spalling" to loss of material.	AMP XI.M41 predominately conducts visual inspections of buried and underground components to detect indication of degradation in either coatings or the base material. The staff reviewed Sections 21, Cracking, and 2.2, Distress, in ACI 201.1R-08, "Guide for Conducting a Visual Inspection of Concrete in Service," and Section 1.3, Cracking of Hardened Concrete, in ACI 224.1R-07, "Causes, Evaluation, and Repair of Cracks in Concrete Structures." Changes in material property were deleted because the recommended visual inspections of AMP XI.M41 would not be able to directly assess a change in material property. However, visual inspections can detect cracking and loss of material. These are the key inspection parameters to demonstrate that the component is capable of performing its intended function. The aging effect requiring management (AERM) cited for buried

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		and underground cementitious materials is cracking due to chemical reaction, weathering, or corrosion of reinforcement (reinforced concrete only) and loss of material due to delamination, exfoliation, spalling, popout, or scaling. Spalling was deleted because, based on a review of the above standards, spalling is only one form of loss of material. Other forms include, delamination, exfoliation, popout, and scaling.
Preventive Actions	Added a grace period for conducting cathodic system monitoring.	The recommendation was revised to allow a grace period of 1 to 2 months for conducting annual cathodic protection surveys. This change allows a licensee flexibility in scheduling that may be necessary due to weather conditions, etc. However, the intent is not changed because the recommendation still states that a survey has to be conducted on an annual basis.
Preventive Actions Parameters Monitored or Inspected	Revised to cite steel cracking only in a carbonate-bicarbonate environment.	This change was incorporated consistent with National Association of Corrosion Engineers (NACE) SP-0169, “Control of External Corrosion on Underground or Submerged Metallic Piping Systems,” 2013 Edition, Figure 2, SCC Range of Pipe Steel in Carbonate/Bicarbonate Environments.
Parameters Monitored or Inspected	Removed change in color due to water absorption as an aging effect.	Change in color was deleted as an aging effect in the GALL-SLR item tables because the staff has concluded that it has no impact on the intended function of the component.
Detection of Aging Effects	Added a recommendation to conduct opportunistic inspections of titanium alloy, super austenitic, and nickel alloy components.	While the staff recognizes that aging effects associated with buried titanium alloy, super austenitic, and nickel alloy components are unlikely, the potential is not nonexistent. As a result opportunistic inspections are recommended.
Detection of Aging Effects Acceptance Criteria	Added tanks, in addition to piping, to the components associated with exceptions to Table XI.M41-2, Inspections of Buried and Underground Piping and Tanks. Cited concrete in place of controlled low strength materials (CLSM) to address inspections of components embedded in concrete.	The staff added tanks because the potential for aging effects would be the same as for piping and as a result, the criterion for the number of inspections would be the same for those buried in CLSM. The basis for inspection of components embedded in CLSM or concrete, inspecting for cracks that would admit groundwater to the surface of the component, are the same. As a result, this change provides flexibility with no change in intent.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Monitoring and Trending	Revised to address projecting identified degradation and addressing the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, Monitoring and Trending, focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example, a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		sampling basis when it is anticipated that acceptance criteria would not be met.
Corrective Actions	Removed the terms “conditions adverse to quality” and “significant conditions adverse to quality.”	In conjunction with standardizing the wording in the Corrective Actions, Confirmation Process, and Administrative Controls program elements, the staff deleted these two terms. The staff recognizes that inspection or test results might reveal degradation; however, the component might still meet all design basis and current licensing basis requirements. In this case, the inspection or test results would not typically be documented as a condition adverse to quality. An applicant would document the results in their corrective action program or another process in order to trend the results.
XI.M42	**Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks**	
Program Description Scope of Program	Revised to include cracking as an aging effect for base materials.	AMP XI.M42 manages loss of coating integrity for internal coatings and linings on piping, piping components, heat exchangers and tanks. When AMP XI.M42 was issued by LR ISG-2013-01, “Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” the staff included new GALL Report AMR items (i.e., E-414, E-415, A-414, A-415, S-414, S-415) that cite metallic piping, piping components, heat exchangers and tanks being managed for loss of material and fouling that leads to corrosion, and loss of material due to selective leaching by AMP XI.M42. The staff incorporated loss of material AMR items into the loss of coating integrity as a result of responding to public comment No. 59 (Appendix E, LR-ISG-2013-01). The staff concluded that if the coating or lining surface is being managed for loss of coating integrity, there is no need to use other AMPs (e.g., AMP XI.M38) to manage the internal surfaces of the component. During its consideration of changes to the GALL Report for SLR, the staff concluded that cracking of base materials, as well as loss of material for components within the scope of AMP XI.M42 will be effectively managed by AMP XI.M42.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Scope of Program Preventive Actions Detection of Aging Effects	Revised to allow managing aging effects associated with external coatings.	The option to manage aging effects associated with external coatings was added to allow an applicant to credit these coatings as a preventive action for stainless steel, nickel alloy, and aluminum components exposed to an adverse environment (e.g., SRP-SLR Section 3.2.2.2.2). The use of coatings in this preventive function is cited in the applicable further evaluation sections.
Parameters Monitored or Inspected	Replaced “spalling” with “loss of material” for cementitious materials.	Spalling was replaced based on a review of ACI 201.1R-08. Spalling is only one form of loss of material. Other forms include, delamination, exfoliation, popout, and scaling.
Detection of Aging Effects	Revised to cite credit for baseline inspections conducted in the past.	The basis for this change is documented in the staff’s evaluation of industry comment No. 045-00078.
Detection of Aging Effects	Although not a change, this basis provides the staff’s position on the term “each coating/lining material.”	The use of the term “each” is related to the type of material or lining (e.g., acrylic, urethane, epoxy, polyester, cementitious, rubber materials). It is not related to a specific manufacturer of a coating. The staff recognizes that for the same material, manufacturers will employ unique manufacturing processes. However, in regard to the extent of inspections, the staff has concluded that when installed using manufacturer recommendations, each coating or lining should be subject to the same degradation mechanisms.
Detection of Aging Effects	Revised the description of inspection Category B and provided an alternative to inspections being conducted every 4 years.	Based on interactions with applicants, the staff recognized that the existing description of inspection Category B was subject to misinterpretation. The description stated, “[p]rior inspection results do not meet Category A; however, a coating specialist determined that no remediation is required.” Some applicants interpreted this to mean that if a degraded coating was repaired or replaced (i.e., remediation), there was no need to conduct inspections on a 4-year interval because the coatings specialist had concluded that remediation was required. The staff’s intent for inspection Category B was to increase the frequency of inspections in order to establish some measure of the potential extent of the degradation mechanism. The staff clarified its intent by revising inspection Category B to state, “[p]rior inspection results do not meet Category A.” In revising the description of inspection category B, the staff provided an alternative to conducting inspections on a 4-year interval. The

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		staff concluded that doubling the number of component inspections or conducting an additional 5 piping inspections (i.e., five 1-foot segments of piping) would provide reasonable input to understand the extent of condition of potentially degraded coatings. The expansion of inspection scope is consistent with that in AMP XI.M41. If the results of the additional inspections satisfy inspection Category A, inspection Category B is not entered.
Detection of Aging Effects	Revised Footnote 3b of Table XI.M42-1, "Inspection Intervals for Internal Coatings/Linings for Tanks, Piping, Piping Components, and Heat Exchangers," to clarify terms and add an example related to external coatings.	The use of the term "mechanical damage" was replaced with "erosion" because it more clearly conveys the staff's intent. Erosion results from changes in velocity or local high velocity locations, the mechanism of interest. Mechanical damage could be associated with causes other than aging effects. Given that aging effects associated with external coatings can be managed by the program and these coatings could be located in an outdoor high wind area, the term "wind-born erosion" was added.
Detection of Aging Effects	Revised Footnote 4 of Table XI.M42-1 to clarify re-inspection locations.	During the development of AMP XI.M42, the staff had concluded that it was not necessary to inspect recently repaired or replaced coatings because early coating failures are typically due to selection, or installation errors, not aging. See the staff's discussion in LR-ISG-2013-01, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," under, "OE Examples." However, the existing wording in footnote 4 could direct inspections to locations that had been recently repaired or replaced. The staff's intent was clarified by stating, "Subsequent inspections for Inspection Category B are re-inspections at the original location(s), when the coatings/linings have not been repaired, replaced, or removed, as well as inspections of new locations."

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Detection of Aging Effects	Revised to state that the extent of inspections recommended in the detection of aging effects program element are conducted at each unit on site. In conjunction with this change, the AMP was also revised to address a potential reduction on the total number of inspections for a multi-unit site.	The staff has concluded that where the sample size is not based on the percentage of the population, rather than conducting the full extent of inspections at each site of a multi-unit site, reasonable assurance can be obtained with a lower sample set if the operating conditions of the units at a multi-unit site are similar. The staff has also concluded that each unit should have inspections conducted even though on the surface; the units appear to be identical with similar operating conditions. The staff used the inspection multipliers previously established in LR-ISG-2011-03, "Aging Management of Loss of Coating or Lining Integrity for Internal Coatings/Linings on In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," AMP XI.M41 to derive the number of inspections per unit (i.e., one and a half time for a two unit site and two times for a three unit site). As a result, it is acceptable to reduce the total number of inspections at the site as follows. For two-unit sites, 55 one-foot axial length sections of piping (19 if manufacturer recommendations and industry consensus documents were complied with during installation) are inspected per unit, and for a three-unit site, 49 one-foot axial length sections of piping (17 if manufacturer recommendations and industry consensus documents were complied with during installation) are inspected per unit. In order to use the alternative inspection quantity, the applicant provides the basis for similarity in the LRA.
Detection of Aging Effects	Revised the reference to the grid dimensions for measuring wall thickness to not cite those for inspections for flow accelerated corrosion.	The staff removed the citation and as a result relies on the applicant's plant-specific procedures. The staff concluded that based on reviewing inspection results during AMP audits and IP-71003 inspections (buried pipe inspections in particular), applicants have been appropriately addressing grid spacing in their wall thickness inspections.
Monitoring and Trending	Revised to address projecting identified degradation and the timing of future inspections.	During the staff's review of several industry comments, it was recognized that the GALL-SLR Report AMPs were not consistent in regard to recommending that the degree of degradation detected during inspections be projected to the

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
		next inspection or end of the subsequent period of extended operation. SRP-SLR Section A.1.2.3.5, "Monitoring and Trending," focuses on using trending to provide a prediction of the future extent of degradation in order to ensure timely corrective or mitigative actions are taken. The staff incorporated the term "where practical" because in many AMPs the parameters monitored or inspected do not lend themselves to providing quantifiable data. Both SRP-SLR Sections A.1.2.3.5 and A.1.2.3.6 acknowledge that inspection results and corresponding acceptance criteria might be qualitative. For example a visual inspection conducted in accordance with AMP XI.M36 might detect light surface loss of material. AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," appropriately, does not recommend follow-up wall thickness measurements when light surface loss of material is detected. As a result, there is reasonably no potential to project future inspection results. Inspections continue on a refueling outage interval. In contrast, AMP XI.S5, "Masonry Walls," recommends visual inspections of masonry walls to detect degradation, including cracking. Lengths of cracks can and should be quantified when the periodic inspections detect crack growth. The staff's intent in relation to the term "where practical" is that unless plant-specific conditions require other actions, trending of inspection results should be based on established recommended inspection techniques cited in the AMP being used to manage aging effects. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original sampling basis, adjusting the sampling basis is appropriate. It would not be acceptable to maintain the original sampling basis when it is anticipated that acceptance criteria would not be met.

Table 2-29 GALL-SLR Differences from Chapter XI, Mechanical Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Corrective Actions	Revised to state that physical testing is performed where physically possible or examinations are conducted to ensure that the extent of repaired or replaced coatings/linings encompasses sound coating/lining material.	The staff concluded that there could be instances where physical testing could not be conducted because the size of the coated component may not permit entry of the test equipment. In this case, the only method would be visual inspections.
Corrective Actions	Revised to provide pull off testing and knife adhesion testing as examples of adhesion testing.	The staff added these examples of adhesion testing methods because they are cited as acceptable methods in RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," Revision 2. The referenced standards include ASTM D4541 09, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," ASTM D6677 07, "Standard Test Method for Evaluating Adhesion by Knife," and D7234 05, "Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers."
Corrective Actions	Revised to clarify that physical testing for blisters is conducted when acceptance criteria are not met.	The basis for this change is documented in the staff's evaluation of public comment No. 033-00012.
Corrective Actions	Included recommendations for conducting extent of condition examinations when acceptance criteria are not met.	For sampling programs, the staff recommends increasing the sample size in accordance with the applicant's corrective action program; however, the staff established a lower threshold for the number of inspections. If any of the inspections in the increased sample population do not meet acceptance criteria, an extent of condition and extent of cause evaluation is conducted to determine the need for further inspections. This updated recommendation was incorporated into AMP XI.M41 by LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report Revision 2 AMP XI.M41, 'Buried and Underground Piping and Tanks'." The staff determined that recommending this methodology be applied to other AMPs was appropriate; each AMP establishes the appropriate initial inspection sample size increase and then based on plant-specific results, the program will use the concept of extent of condition and extent of cause to determine the final further number of inspections.

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Location of Change	Summary of Significant Changes	Technical Bases for Changes
		The basis for the provision of a minimum sample size of 5 or 20% of each applicable material and environment combination is as follows. Although not directly applicable, the basis for the minimum sample size of 5 inspections is derived from GL 90-05. GL 90-05 addresses medium energy systems (e.g., service water) where leakage has occurred. The GL recommends inspecting five additional locations beyond the leaking location. The 20% criterion was incorporated to address limited population sizes where a minimum sample of 5 could result in all of the population being inspected. This criterion is consistent with several sampling-based AMPs (e.g., XI.M32, XI.M38). The basis for inspecting an additional 5% of the total length of pipe when inspections are based on pipe length is that it is a proportional increase as that for an increase in 5 inspections beyond 73 (7%) as compared to 55% of the pipe length as compared to 50% (10%). Extent of condition inspections are conducted unless the cause of the aging effect is corrected by repair or replacement for all components with the same material and exposed to the same environment. The staff inserted the term “for all components” to ensure that the statement would not be misinterpreted. The repair or replacement activity cannot be limited to only the component that did not meet acceptance criteria. If projected results indicate that acceptance criteria will not be met when conducting inspections in accordance with the original inspection schedule, adjusting the inspection frequency is appropriate. It would not be acceptable to maintain the original inspection schedule when it is anticipated that acceptance criteria would not be met.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
	XI.S1 ASME Section XI, Subsection IWE	
Program Description	Added language regarding a trigger for a one-time inspection based on plant-specific operating experience	There have been many instances of past operating experience of through-wall corrosion of containment liner initiated on the inaccessible concrete side of the liner. The staff considers that operating experience should be an important consideration in determining potential additional supplemental volumetric examinations for potential corrosion initiated on the inaccessible side of a containment metal shell or liner. Therefore, a provision for a one-time supplemental volumetric examination has been added based on a trigger of the plant-specific occurrence or recurrence of measurable corrosion of the containment metal shell or liner initiated on the inaccessible side or areas, since the date of issuance of the first renewed license. This examination, if triggered, will consist of a sample of both randomly-selected and focused locations most likely to experience degradation based on operating experience and other considerations such as environment. The sample size and locations are determined on a plant-specific basis to demonstrate statistically with 95 percent confidence that 95 percent of the accessible portion of the containment liner is not experiencing corrosion degradation with greater than 10 percent loss of nominal thickness.
Parameters Monitored or Inspected	Clarified that discernible bulges in containment metallic shells and liners are monitored as “signs of distress” or “signs of surface irregularities” described in IWE-2310.	Liner bulges can exist in both coated and non-coated liner surfaces and generally result from initial inward curvature of the liner between anchors from construction activities, and may grow due to additional compressive strains resulting from aging mechanisms such as creep of concrete under sustained post-tensioning and dead loads, concrete shrinkage, and temperature; and could cause unbalanced forces that may affect liner anchorage to concrete. Additionally, bulging is identified in Figure 5.3 of the EMDA Report (NUREG/CR–7153) as a degradation mechanism for containment steel liner with high susceptibility, high knowledge, and medium structural significance. IWE-2311 requires general visual examinations to be performed in accordance with IWE-2500 and Table IWE-2500-1 (E-A) to determine the general condition of containment surfaces and detect evidence of degradation. The staff is clarifying that liner bulges represent a “sign of distress” or

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		"signs of surface irregularities," described by the ASME Code Section XI, Subsection IWE, Paragraph IWE-2310, "Visual Examinations." As such bulges should be noted during the required general visual examinations and found acceptable in accordance with IWE-3122, and the acceptance standards in IWE-3511. The IWE Responsible Individual, in accordance with the responsibilities delineated in IWE-2320, should assess identified discernible bulges or discernible changes, and should have some form of evaluation that provides a determination that the component function is not impaired consistent with the CLB. The extent and form of that evaluation is the responsibility of the Responsible Individual.
Parameters Monitored or Inspected	Clarified wording that steel, stainless steel and dissimilar metal weld pressure-retaining components that are subject to cyclic loading but have no CLB fatigue analysis should be monitored for cracking	Monitoring of cracking for these components subject to cyclic loading with no CLB fatigue analysis was included in GALL Revision 2, but the sentence was restructured for better clarity and alignment with applicable SRP-LR Table 3.5-1 line items.
Detection of Aging Effects	Clarified that supplemental surface examinations (or other appropriate technique) should be performed in addition to visual examination to detect cracking in steel, SS, and dissimilar metal weld pressure-retaining components that are subject to cyclic loading but have no CLB fatigue analysis. Where feasible, Appendix J leak tests in AMP XI.S4 may be performed or credited in lieu of the supplemental surface examination.	If an Appendix J leak test is used in lieu of recommended surface examination, the technical basis justifying an appropriate Appendix J test capable of early detection of fine cracks is provided in NUREG–1950, specifically Table 2-11, items II.A3.CP 37 & II.B4.CP 37, II.A3.CP 38 & II.B4.CP 38 ; and Table 2-22, item XI.S1 ASME Section XI, Subsection IWE It is stated therein that visual examination may not detect fine cracks that may occur as a result of cyclic loading; therefore, supplemental surface examination is recommended. It is also stated therein that some penetration sleeves and bellows are not designed to allow for a local Type B pressure test, and that a Type A integrated leak rate test interval exceeding 10 years may not provide for early detection of cracking such that corrective actions are taken to prevent loss of primary containment leak-tightness. The related provision in the AMP that the type of leak test determined to be appropriate should be identified with the basis for components for which this option is used, is intended to avoid RAIs on this issue.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		The supplemental examination provision in AMP XI.S1 in GALL-SLR is intended to address the aging effect of cracking (cumulative fatigue damage) due to cyclic loading for applicable containment pressure-retaining components with no CLB fatigue analysis; SCC is addressed separately as a further evaluation in SRP-SLR Section 3.5.2.2.1.6. These are components listed in SRP-SLR Table 3.5-1, items 27 and 40, as applicable. The components listed in modified items 3.5.1-27 and -40 are collectively intended to be consistent with those listed in item 3.5.1-9, which addresses the same aging effect due to cyclic loading through CLB fatigue analysis TLAA in SRP-SLR Section 4.6 "Containment Liner Plate, Metal Containment, and Penetrations Fatigue Analysis." Components listed in modified item 3.5.1-9 are made consistent with those discussed in SRP-SLR Section 4.6 that are potentially subject to cyclic loading or displacements. The containment pressure-retaining components in the AMR items were modified for clarity and to address component inconsistencies/omissions in GALL Revision 2 between AMR items 3.5.1-9, -27 and -40 and SRP-LR Section 4.6, all of which address the same aging effect and mechanism so that there is a proper and consistent accounting of all components that may be subject to cyclic loading aging effect/mechanism. The components associated with the supplemental surface examination (or other applicable technique) provision explicitly includes the wording "as applicable to the plant." The applicant may determine non-applicability of the provision to one or more components listed as part of items 27 and 40 for reasons such as fatigue analysis exists, justifies that cyclic loading cycles on the component is not significant enough to require supplemental aging management, the specific component does not exist, or other considerations. Additionally, as in GALL Revision 2, the AMP provision allows appropriate Appendix J tests to be performed or credited in lieu of surface examination. Therefore, as in GALL Revision 2, the supplemental surface examination provision is intended to cover the aging effect of cracking for local

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		containment pressure-retaining components for which an appropriate Appendix J local leak rate test (Type B or Type C) is not or cannot be performed. A Type A test [integrated leak rate test (ILRT)] may be credited for global containment pressure-retaining components such as containment metallic shell or metallic liner plate. Thus, the modified supplemental examination provision in the AMP is essentially the same as that in GALL Revision 2.
Detection of Aging Effects	Added a provision that a one-time volumetric examination of metal shell or liner surfaces that are inaccessible from one side should be done if triggered by appropriate plant-specific operating experience, what the examination consists of, and acceptance criteria.	AMPs for a renewed license for long-term operations are primarily intended to address deltas in existing requirements such that aging effects on SSCs are adequately managed so that intended functions are maintained consistent with the CLB for the period of extended operation, and not meant to be an exact repetition of existing code requirements. Currently, there is no available operating experience of aging degradation of containment metal shell/liner for 60–80 years of plant operation. Most past cases of through-wall corrosion of the containment metal shell and liner have been attributed to the presence of foreign material due to inadequate practices/housekeeping at the time of construction, and there is no guarantee that such foreign material is not likely in other plants. Further plant aging degradation may be significant in the future from degradation processes such as cracking, carbonation, and chloride ingress and may contribute to the initiation and propagation of corrosion degradation of the containment shell/liner on the concrete side. Containment design and operation also could be a contributing factor. The containment metal shell or liner serves a very important safety function to provide structural and/or leak-tight integrity under design basis loads under normal operation and accident conditions. Corrosion that originates between the shell and/or liner and concrete is a greater concern because the IWE visual examinations typically identify the corrosion only after it has significantly degraded the shell/liner (e.g., through-wall), as has been indicated in several instances of past operating experience described in several NRC Information Notices and technical reports. It is recognized that operating experience is a very

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		important consideration for informing and enhancing AMPs. Based on review of past industry operating experience that addressed the cause and significance of localized through-wall or partial corrosion of containment metal shell or liner initiated on the inaccessible (shell/liner-concrete interface) side and considering the important safety function of the containment metal liner/shell, it is reasonable for the AMP for SLR to recommend a one-time supplemental volumetric examination that is based on a trigger of plant-specific occurrence or recurrence of measurable shell/liner corrosion (i.e., base metal material loss exceeding 10 percent of nominal plate thickness) initiated on the inaccessible side, identified since the date of issuance of the first renewed license (including the period of subsequent extended operation). Any further actions are determined, consistent with applicable provisions of the Subsection IWE AMP, based on the findings. The criteria provided for plant-specific determination of a statistically-based sample size and locations for this one-time trigger-based supplemental volumetric examination is consistent with that implemented by Beaver Valley, as part of its license renewal commitments to address their plant-specific operating experience of through-wall liner corrosion initiated on the inaccessible side. Additionally, the one-time trigger-based provision for supplemental volumetric examination provides a means of plant-specific verification that its operating experience of shell/liner corrosion initiated on the inaccessible surface, if observed in a later part of its service life, is not a larger issue beyond localized area(s), and a confirmation of the expected effectiveness of the AMP for long term operation to 80 years.
Monitoring and Trending	Clarified that consider both design and operating experience when following recommended actions in this section of the AMP for drywell inaccessible areas in BWR Mark 1 containments.	The language used in the AMP is intended to be consistent with that in the published LR-ISG-2006-001 that was incorporated into the XI.S1 AMP in Revision 2 of the GALL Report. Subparagraph (a) does provide alternatives for developing a corrosion rate.

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Location of Change	Summary of Significant Changes	Technical Basis for Change
		While the staff recognizes that some Mark I containment designs may not have been required to perform or may not have performed UT in response to GL 87-05, LR-ISG-2006-001 stated that the recommended actions should be considered based on plant design and operating experience. Therefore, for better clarity, the related statement in XI.S1 AMP is revised to include consideration of plant-specific design. Specific situations of Mark I containments should be addressed as applicable on a case-by-case basis. The staff also notes from past LRA reviews that some licensees that did not perform UT in response to GL 87-05 for justified reasons, have performed UTs at a later date in support of their license renewal application or other reasons such as operating experience.
Monitoring and Trending	Added statement with pointer to IWE-3120 that is relevant to this program element.	Pointer to relevant code paragraph IWE-3120, related to comparison and evaluation of examination results to prior recorded results, was added for completeness and clarity to the program element.
Acceptance Criteria	Clarified that cracking of steel, SS, and dissimilar metal weld pressure-retaining components that are subject to cyclic loading but have no CLB fatigue analysis is corrected by repair or replacement, or accepted by engineering evaluation.	ACI 349.3R is an industry report that provides appropriate acceptance criteria which the staff has reviewed previously. Applicants need not justify acceptance criteria that align with the second tier criteria in ACI 349.3R.
Operating Experience	Added relevant OE references described in several NRC Information Notices (INs), Technical Reports, and Inspection Reports.	Added OE relevant to the program that was not included in Revision 2 of the GALL Report due to the timing of its issuance.
References	Added References INs 2010-12, 2011-15, 2014-07, NUREG–1611, NUREG–7111, Inspection Report 05000302/2011009, and Technical Report "Containment Liner Corrosion Operating Experience Summary." Updated RCSC reference to 2014 Edition	Added references that describe relevant OE which were generally published since issuance of GALL Revision 2. The new edition of the RCSC deletes coating ASTM F1136 on ASTM F1852 from Table 2.1 because such coating has not been approved by ASTM for use on tension-controlled bolts. The AMPs listed in the comment make reference to F1852 and F2280 bolts, and Section 2 of the RCSC specification with regard to consideration of preventive actions for storage, lubricant selection, and bolting and coating material selection.

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Location of Change	Summary of Significant Changes	Technical Basis for Change
XI.S2 ASME Section XI, Subsection IWL		
Monitoring and Trending	Clarified that qualitative information should also be recorded and trended for findings that exceed acceptance criteria	The staff's intention was for monitoring and trending to occur for all significant findings, as described by the acceptance criteria outlined in Element 6. Element 5 was revised to clarify this expectation. Element 6 was also revised to indicate that indications below the second-tier of ACI 349.3R are acceptable for concrete.
Acceptance Criteria	Clarified that quantitative acceptance criteria for concrete surfaces based on second-tier evaluation criteria in Chapter 5 of ACI 349.3R are acceptable. Applicants who use plant-specific criteria should describe the criteria and provide a technical basis for deviations from ACI 349.3R. Inspection results should be evaluated by the responsible engineer.	The staff's intention was for monitoring and trending to occur for all significant findings, as described by the acceptance criteria outlined in Element 6. Element 5 was revised to clarify this expectation. Element 6 was also revised to indicate that indications below the second-tier of ACI 349.3R are acceptable for concrete.
References	Added Crystal River Inspection Report	To add relevant background information
FSAR Supplement	Change RG 1.35 to RG 1.35.1 and clarified that the Subsection IWL requirements are supplemented to include quantitative acceptance criteria for evaluation of concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R.	Lift off forces are calculated using RG 1.35.1.
XI.S3 ASME Section XI, Subsection IWF		
Program Description	Added a one-time inspection of additional supports.	The population of supports that are currently inspected in accordance with 10 CFR 50.55a and IWF-5000, "Inservice Inspection Requirements for Snubbers," of the ASME Code, Section XI, include the same supports each inspection interval. This nominal increase allows that supports that have never been inspected can be verified to be representative of the entire population of supports, or could identify aging that is occurring in supports that have never been inspected during the life of the plant. Although other programs, walkdowns, or inspections could potentially identify age-related degradation of IWF supports, they may not, or issues may not be dispositioned appropriately to the IWF AMP.

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Location of Change	Summary of Significant Changes	Technical Basis for Change
		Operating experience should be an important consideration in determining the need for additional activities for the 60–80 year period; however, the sample chosen at the time the IWF-5000, “Inservice Inspection Requirements for Snubbers,” of the ASME Code, Section XI, was implemented in accordance with 10 CFR 50.55a, the sample selection required by ASME did not necessarily consider different aging mechanisms and effects necessary to be covered by aging management under 10 CFR Part 54. Addition of a select number of random inspections and inclusive of aging effects or environment most susceptible to degradation allows for better assurance that the IWF aging management program sample will be representative of the aging of the entire component support population during the subsequent period of extended operation.
Scope of Program	Added welds to scope of program.	It is expected that welded connections will be inspected for general structural condition observable by general visual and VT-3 examinations.
Scope of Program	Added specifics related to bolts and inaccessible areas	Defined what is meant by “high-strength” bolting, and added anchor bolts so that it is clear that anchor bolts should be age-managed when used in applications defined in this program. An evaluation should be performed that assesses inaccessible areas for the potential to have the same aging effects as accessible areas. Age-related degradation could be occurring, possibly at an accelerated rate, in inaccessible areas that could impact the intended function(s) of the support. This does not mean that the program has to perform the periodic visual inspections of components that are exempt per ASME IWF. However, there should be an evaluation that assesses whether unacceptable aging could be occurring in inaccessible areas.
Parameters Monitored or Inspected	Delete cracking of welds and replace with general structural condition of weld joints and weld connections	IWF VT-3 examinations are not credited with detecting weld cracks. It is expected that welded connections will be inspected for general structural condition observable by general visual and VT-3 examinations.
	Clarify that cracking of concrete around anchor bolts is managed by the Structures Monitoring Program	Cracking of concrete is not included within the scope of IWF. Concrete examination qualification requirements and acceptance criteria are not addressed.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
Detection of Aging Effects	Added a one-time inspection of an additional 5 percent of supports. This inspection refers to 5 percent of the current inspection sample size, not an additional 5 percent of all IWF supports and is to be conducted within 5 years prior to entering the subsequent period of extended operation. . to be conducted within 5 years prior to entering the subsequent period of extended operation The inspection of additional supports should include components that are most susceptible to degradation Clarify that all high-strength bolting is subject to volumetric examination unless plant-specific justification is provided and remove specific mention of ASTM A325 bolting	The population of supports that are currently inspected in the ASME Code, Section XI, IWF-5000, "Inservice Inspection Requirements for Snubbers," was implemented in accordance with 10 CFR 50.55a, to include the same supports in each inspection interval. This nominal increase allows that supports that have never been inspected can be verified to be representative of the entire population of supports, or could identify aging that is occurring in supports that have never been inspected during the life of the plant. Although other programs, walkdowns, or inspections could potentially identify age-related degradation of IWF supports, they may not, or issues may not be dispositioned appropriately to the IWF AMP. Operating experience should be an important consideration in determining the need for additional activities for the 60-80 year period; however, the sample chosen at the time the IWF Code was implemented in accordance with 10 CFR 50.55a, the sample selection required by ASME did not necessarily consider different aging mechanisms and effects necessary to be covered by aging management under 10 CFR Part 54. Addition of a select number of random inspections and inclusive of aging effects or environment most susceptible to degradation allows for better assurance that the IWF aging management program sample will be representative of the aging of the entire component support population during the subsequent period of extended operation. SCC is an applicable aging effect for high-strength bolting (actual measured yield strength greater than or equal to 150 ksi or 1034 MPa) in sizes greater than 1-inch nominal diameter in ASME Code applications, and therefore retained in AMP XI.S3 (IWF). There is relevant OE in EPRI NP-5769, Volume 1 "Degradation and Failure of Bolting in Nuclear Power Plants," of brittle failure of nuclear steam supply system (NSSS) support bolting due to SCC, and the staff position is that for aging management, high strength bolts with the properties described above that are included in ASME IWF applications, volumetric examinations should be performed for a sample of the bolts to

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		determine whether cracking due to SCC has occurred. Note this is not a change from the previous recommendation, it is a clarification that bolts meeting the criteria are subject to volumetric examination. The staff removed specific mention of ASTM A325 bolts because it is not likely that ASTM A325 bolting meeting the criteria is used. Also note that volumetric examinations may be waived with adequate plant-specific justification. This plant-specific justification would need to consider the population of high-strength bolts in IWF supports and determine on a component basis whether SCC is a credible aging effect. An example could include a detailed evaluation of SCC susceptibility with verification of a non-corrosive environment, and/or a one-time volumetric examination to confirm SCC is not occurring. A490 bolts are not considered exempt from volumetric examination on a material basis alone.
Monitoring and Trending	Clarify how to address samples with a component support that is repaired to as-new condition	Wording was added because of relevant OE and associated RAIs – this reduces the likelihood of an RAI. If a component is repaired to as-new condition, it should no longer remain in the inspection sample because it is no longer representative of the remaining supports that were not repaired.
Operating Experience	Added Information Notice	Added OE relevant to the program that was not included in Revision 2 of the GALL Report due to the timing of its issuance.
FSAR Supplement	Add wording regarding one-time inspection of additional supports.	To align with the revisions made to AMP XI.S3.
	XI.S4 10 CFR Part 50, Appendix J	
Program Description	Added language to describe Type C testing	To provide more clarity in the AMP. The program, as revised, is effective in providing a periodic verification of the leakage integrity of the containment by measuring leakage rates of the containment pressure-retaining components at periodic intervals.
Scope of Program	Clarified that aging effects associated with containment pressure-retaining boundary components within the scope of subsequent license renewal but excluded from Type B and C testing must still be age-managed. Other programs can be credited to manage aging in these components.	There are a number of AMPs and/or TLAAs that could support the management of aging effects of the excluded pressure boundary components. However, it is important that the applicant identifies the basis for the exclusion and the applicable AMPs and/or TLAAs for the staff to evaluate the adequacy of these for reasonable assurance that the prevalent aging effects are

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		managed and the integrity of the containment pressure boundary is maintained during the subsequent period of extended operation
	XI.S5 Masonry Walls	
Monitoring and Trending	Noted that examination results should be trended.	Monitoring and trending should occur for all significant findings. Significance is described by appropriate acceptance criteria outlined in Element 6. The recommended periodic examination should lead to monitoring and trending and this element was revised to reflect that.
Acceptance Criteria	Added guidance explaining what is expected if identified degradation impacts the intended function of the wall.	The previous acceptance criteria noted that further evaluation was conducted if the degradation impacted the intended function. The expanded wording notes that the evaluation should provide adequate technical justification if degradation is accepted without repair or other corrective actions
	XI.S6 Structures Monitoring	
Program Description	Deleted language regarding high-strength bolts.	All bolts within the scope of structural AMPs XI.S6 and XI.S7 receive a general visual inspection. Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3 (IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity.
Scope of Program	Deleted language regarding high-strength bolts.	All bolts within the scope of structural AMPs XI.S6 and XI.S7 receive a general visual inspection. Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3 (IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity.
	Clarified expectations regarding coatings.	Coatings are generally only included in the program as an indicator of the condition of underlying materials.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
	Additional items are added to the list of examples of items within the scope of the program.	For clarification.
Parameters Monitored or Inspected	Clarified expectations regarding coatings.	Coatings are generally only included in the program as an indicator of the condition of underlying materials. Coatings are generally not within the scope of license renewal and do not serve an intended function. However, many structures within the scope of license renewal are coated and still require a visual inspection. The intent of the wording was to make it clear that coated structures within the scope of license renewal require a visual inspection regardless of whether or not the coatings are within scope. The staff did not intend for quantitative acceptance criteria to be developed for coatings, unless they have a license renewal intended function.
Parameters Monitored or Inspected	Deleted discussion of high-strength bolts.	All bolts within the scope of structural AMPs XI.S6 and XI.S7 receive a general visual inspection. Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3 (IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity.
Parameters Monitored or Inspected	New guidance on monitoring of through-wall leakage.	Based on past operating experience and RAIs issued during the initial license renewal reviews, through-wall leakage was an issue that did not always receive proper attention. This wording helps clarify the staff expectations
Detection of Aging Effects	Clarified frequency of groundwater chemistry evaluations and that seasonal variations should be considered.	A 5 year frequency is appropriate to monitor groundwater. However, seasonal variations should be accounted for on a plant-specific basis. All plants may experience seasonal variations in groundwater chemistry, and the sampling is used to identify the possible variation
	Added a discussion of actions to be taken with regard to groundwater or through-concrete leakage	Based on past operating experience and RAIs issued during the initial license renewal reviews, through-wall leakage was an issue that did not always receive proper attention. Requiring monitoring of volume and chemistry is not overly prescriptive. There is significant operating experience from recent license renewal

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		application reviews with licensees finding through-wall leakage acceptable as-is with little or no evaluation. The staff does not consider through-wall leakage acceptable and expects some form of assessment to be completed when leakage is identified. The new wording clarifies the staff's expectations in regards to through-wall leakage. Monitoring the leakage is feasible and provides useful data. Significant changes in the volume or chemistry data of the leakage could be a leading indicator of concrete or reinforcing steel degradation. The guidance allows licensees to determine the appropriate parameters monitored along with the frequency of the monitoring and to determine what additional actions need to be taken based on the results of monitoring.
	Added expectations when concrete is exposed to aggressive groundwater	The previous wording indicated that a plant-specific AMP was necessary for plants with aggressive groundwater. The new wording elaborates on what should be addressed within the AMP and provides licensees the flexibility to decide the best method for managing their inaccessible concrete...
	Statements added to indicate that visual inspections may need to be supplemented with NDE based on the observed aging degradation.	Based on operating experience and RAIs issued during the initial license renewal reviews.
	A statement was added to ensure the responsible engineer associated with this program was conducting the evaluation of groundwater samples.	This ensures the appropriate staff is aware of any trends in groundwater chemistry.
Monitoring and Trending	Added expectations for baseline inspections	Quantitative inspection criteria are necessary to ensure all indications are identified and treated similarly regardless of the inspector or reviewer. At least one inspection should be completed with these criteria prior to entering SLR so licensees can properly monitor and trend inspection results throughout the SLR period. Existing inspection data can be credited for this baseline if the inspections were conducted with appropriate SLR acceptance criteria.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
Monitoring and Trending	Noted that trending is expected and quantitative measurements should be recorded when possible. Noted that photography may be a useful technique for documenting and trending aging.	To clarify staff expectations for recording of quantitative data. The changes align with similar changes in the other structural programs. This change was necessary to ensure quantitative data was being recorded and trended during the subsequent license renewal period and to align the guidance in this element with the guidance that already exists in Element 6.
Acceptance Criteria	Clarified that quantitative second-tier evaluation criteria in ACI 349.3R are acceptable for concrete and applicants who use plant-specific criteria should describe the criteria and provide basis for deviations from ACI 349.3R.	ACI 349.3R was already identified as an acceptable basis document for acceptance criteria. This change clarified that indications below the second tier criteria in ACI 349.3R are acceptable.
Operating Experience	Added several Information Notices	Relevant information experience related to Alkali-Silica Reaction and spent fuel pool leakage
FSAR Supplement	Wording related to coatings was deleted	Coatings are generally only included in the program as an indicator of the condition of underlying materials. Therefore, it is unnecessary to include a discussion of coatings in the FSAR Supplement.
XI.S7 Inspection of Water-Control Structures Associated with Nuclear Power Plants		
Title and Program Description	Deleted Regulatory Guide (RG) 1.127 from the title and clarified that the AMP is independent of RG 1.127. The RG is still referenced in the AMP for additional guidance	RG 1.127 has been deleted from the title to disassociate from the AMP. Program Description: The program is revised to be self-sufficient irrespective of RG 1.127 commitment. RG 1.127 has been dissociated from program title but added as reference for additional guidance. Wordings added to clarify appropriate use of XI.S6.
Scope of Program	Deleted language regarding high-strength bolts.	All bolts within the scope of structural AMPs XI.S6 and XI.S7 receive a general visual inspection. Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
		(IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity.
Scope of Program	Clarified expectations regarding coatings	Coatings are generally not within the scope of license renewal and do not serve an intended function. However, many structures within the scope of license renewal are coated and still require a visual inspection. The wording makes it clear that coated structures within the scope of license renewal require a visual inspection regardless of whether or not the coatings are within scope. Coatings are generally only included in the program as an indicator of the condition of underlying materials
Scope of Program	Additional items added	For clarification
Parameters Monitored or Inspected	Clarified expectations regarding coatings.	The staff agrees that coatings are generally not within the scope of license renewal and do not serve an intended function. However, many structures within the scope of license renewal are coated and still require a visual inspection. The intent of the proposed wording was to make it clear that coated structures within the scope of license renewal require a visual inspection regardless of whether or not the coatings are within scope. Coatings are generally only included in the program as an indicator of the condition of underlying materials
Parameters Monitored of Inspected	Deleted language regarding high-strength bolts.	Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3 (IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity.
Detection of Aging Effects	Clarified expectations for qualifications for inspecting water-control structures	This was inappropriately added to the guidance. Requiring the inspections be conducted under the direction of a professional engineer is beyond the requirement in the other structural AMPs and beyond the guidance in RG 1.127
Detection of Aging Effects	Clarified frequency of groundwater chemistry evaluations and that seasonal variations should be considered.	A 5-year frequency is appropriate to monitor groundwater. However, seasonal variations should be accounted for on a plant-specific basis. All plants may experience seasonal variations in groundwater chemistry, and the sampling is used to identify the possible variation.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
Detection of Aging Effects	Clarified conditions for nonaggressive raw water.	The staff agrees that in order for groundwater to be considered non-aggressive it must meet all three of the requirements (i.e., "and") but for groundwater to be considered aggressive it just has to exceed one threshold value (i.e., "or").
	Deleted language related to high-strength bolting.	All bolts within the scope of structural AMPs XI.S6 and XI.S7 receive a general visual inspection. Common high-strength bolt materials have not been shown to be prone to SCC in standard civil structural applications; therefore, generic guidance on SCC for high-strength bolts in civil structural applications is unnecessary. SCC could still be a concern for high-strength bolting in ASME Code applications; therefore, the recommendation has been retained and clarified in AMP XI.S3 (IWF). Removing the guidance from the structural AMPs XI.S6 and XI.S7 improves clarity
Monitoring and Trending	Noted that trending is expected and quantitative measurements should be recorded when possible. Noted that photography may be a useful technique for documenting and trending aging. Clarified that documenting and comparing periodic inspection results should be done to identify changes over time.	These changes are clarifications only and require no further technical bases.
	Clarified expectations regarding trending results.	The staff's intention was for monitoring and trending to occur for all significant findings. Significance is described by appropriate acceptance criteria as outlined in Element 6.
	Clarified expectations for baseline inspections.	Existing inspection data can be credited for this baseline if the inspections were conducted with appropriate SLR acceptance criteria.
Acceptance Criteria	Clarified that quantitative second-tier evaluation criteria in ACI 349.3R are acceptable for concrete and applicants who use plant-specific criteria should describe the criteria and provide basis for deviations from ACI 349.3R.	The staff's intention was for monitoring and trending to occur for all significant findings. Significance is described by appropriate acceptance criteria as outlined in Element 6.
Corrective Actions	Deleted prescriptive requirements for assessing groundwater or through-wall leakage.	See staff response to comment 019-067, NUREG–2222.

Table 2-30 GALL-SLR Differences from Chapter XI, Structural Aging Management Programs, GALL Report Revision 2 and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Basis for Change
FSAR Supplement	Clarified expectations for recording quantitative measurements.	Not all parameters lend themselves to quantitative measurements or trending. To acknowledge that, “applicable” was included in the original wording. To clarify this further, “all” was deleted in the final document. However, quantitative measurements exceeding the acceptance criteria should be recorded and trended for all parameters that lend themselves to quantitative measurements
	XI.S8 Protective Coating Monitoring and Maintenance	
There were no significant changes to this AMP.		

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
XI.E1	**Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements**	
Program Description Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Acceptance Criteria	AMP was modified to provide additional guidance on the identification and verification of adverse localized environments that are one of the bases for the aging management program. Additional guidance is also provided concerning sampling, inspection, and evaluation of accessible in-scope cable insulation. The staff also concluded that it is appropriate to provide additional guidance on the detection of aging effects through testing based on the review of operating experience demonstrating age related degradation. Existing maintenance, calibration, or surveillance testing credit, was also incorporated into AMP XI.E1. Removed fuse holder electrical insulation visual inspection form XI.E1 and added the inspection to GALL-SLR Report AMP XI.E5, "Fuse Holders."	To demonstrate that adverse localized environments are identified, accurately characterized, and evaluated, such that the effects of electrical cable and connection electrical insulation aging will be adequately managed through the subsequent period of extended operation. The staff also concluded that fuse holder electrical insulation aging management should be relocated from GALL-SLR AMP XI.E1 to XI.E5. This change is intended to provide enhanced inspection and testing results by including both the metallic and insulation component parts under the same aging management program. Added testing (condition monitoring) is consistent with other GALL-SLR AMPs and provides additional means to trend and disposition insulation age degradation.
XI.E2	**Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits**	
Program Description	AMP was modified to provide additional guidance on the identification and verification of adverse localized environments based on plant-specific operating experience, environmental monitoring, and other techniques that are one of the bases for the aging management program.	The additional guidance on the identification and verification of adverse localized environments based on plant-specific operating experience, environmental monitoring, and other techniques provides additional clarification that the identification of an adverse localized environment may also involve previous dispositioned adverse localized environments for the electrical insulation age managed by this AMP. The additional guidance provides assurance that adverse localized environments will be identified, accurately characterized, and evaluated, such that aging of instrumentation circuit electrical insulation will be adequately age managed through the subsequent period of extended operation.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
XI.E3A	**Electrical Insulation for Inaccessible Medium-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements**	
New AMP Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Corrective Actions	XI.E3 was expanded with three new AMPs to address aspects of industry and NRC guidance related to potentially submerged cables: XI.E3A: Medium Voltage Power Cables XI.E3B: Instrument and Control Cables XI.E3C: Low Voltage Power Cables Provides inaccessible cable inspection and test method as applicable to each AMP cable type (adds in-situ or laboratory, electrical, physical, or chemical testing). Added limited test criterion statement [e.g., other testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation, and construction)]. Event driven inspections are separated from the periodic inspection discussion. The AMP is also revised to include testing of cables designed for continuous submergence.	The staff concluded that it is appropriate to provide additional guidance that addresses inaccessible (underground) medium voltage power cable aging mechanisms and effects. Therefore, this change is based on enhancements to address inaccessible (underground) medium voltage power cables for applicable aging mechanisms, effects, and tests respective to the category of cable. The revised AMPs incorporate aspects of recent industry and NRC operating experience and guidance related to cable submergence including the addition of one-time testing of medium voltage cables designed for continued submergence to AMP XI.E3A. A limiting test criterion statement was added to each AMP [(e.g., testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation material and construction)] instead of referencing specific tests to accommodate early SLR applications and accommodate the latest available information regarding applicable tests at the time of LRA-SLR submittal. Event driven inspections/testing was separated from periodic inspection/testing to clearly distinguish this as a separate inspection activity. This guidance ensures that inaccessible (underground) medium voltage power cables aging mechanisms and effects are identified and accurately characterized such that the effects of aging will be adequately managed through the subsequent period of extended operation.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
XI.E3B	**Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements**	
New AMP Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Corrective Actions	Provides inaccessible (underground) cable inspection and test method as applicable to each AMP cable type (adds in-situ or laboratory, electrical, physical, or chemical testing). This AMP incorporates periodic visual inspection with testing performed based on inspection results. Added limited test criterion statement [e.g., other testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation, and construction)]. Event driven inspections are separated from the periodic inspection discussion. Periodic visual inspection of cable designed for continuous submergence was also added to AMP XI.E3B. Credit is also given for existing applicable tests performed as part of a surveillance or calibration.	The staff concluded that it is appropriate to provide additional guidance that addresses inaccessible control and instrumentation cable aging mechanisms and effects. Therefore, this change is based on enhancements to address inaccessible (underground) instrument and control cables separately for applicable aging mechanisms, effects, and tests respective to the category of cable. The revised AMPs incorporate aspects of recent industry and NRC operating experience and guidance related to inaccessible instrumentation and control cable submergence. This AMP incorporates periodic visual inspection with testing performed based on inspection results. A limiting test criterion statement was added to each AMP [e.g., testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation material and construction)] instead of referencing specific tests to accommodate early SLR applications and accommodate the latest available information regarding applicable tests at the time of LRA-SLR submittal. Event driven inspections/testing was separated from periodic inspection/testing to clearly distinguish this as a separate inspection activity. This guidance ensures that inaccessible (underground) instrument and control cables aging mechanisms and effects are identified and accurately characterized such that the effects of aging will be adequately managed through the subsequent period of extended operation.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
XI.E3C Electrical Insulation for Inaccessible Low-Voltage Power Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements		
New AMP Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Monitoring and Trending Corrective Actions	Provides inaccessible (underground) cable inspection and test method as applicable to each AMP cable type (adds in-situ or laboratory, electrical, physical, or chemical testing). This AMP incorporates periodic visual inspection with testing performed based on inspection results. Added limited test criterion statement [e.g., other testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation, and construction)]. Event driven inspections are separated from the periodic inspection discussion. Periodic visual inspection of cable designed for continuous submergence was also added to AMP XI.E3C. Credit is also given for existing applicable tests performed as part of a surveillance or calibration.	The staff concluded that it is appropriate to provide additional guidance that addresses inaccessible low voltage power cable aging mechanisms and effects. Therefore, this change is based on enhancements to address inaccessible (underground) low voltage power cables separately for applicable aging mechanisms, effects, and tests, respective to the category of cable. The revised AMPs incorporate aspects of recent industry and NRC operating experience and guidance related to inaccessible low voltage power cable submergence. This AMP incorporates periodic visual inspection with testing performed based on inspection results. A limiting test criterion statement was added to each AMP [e.g., testing that is proven and shown to be applicable to the cable type (i.e., voltage, insulation material, and construction)] instead of referencing specific tests to accommodate early SLR applications and accommodate the latest available information regarding applicable tests at the time of LRA-SLR submittal. Event driven inspections/testing was separated from periodic inspection/testing to clearly distinguish this as a separate inspection activity. This guidance ensures that inaccessible (underground) instrument and control cables aging mechanisms and effects are identified and accurately characterized such that the effects of aging will be adequately managed through the subsequent period of extended operation.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
	XI.E4 Metal Enclosed Bus	
Parameters Monitored or Inspected	Guidance on the inspection and testing of inaccessible metal enclosed bus (MEB) sections was updated to demonstrate that the accessible MEB inspection and test together with inaccessible MEB section aging management evaluations continues to adequately manage MEB aging mechanisms and effects.	Depending on particular plant configurations, some segments of the MEB may be considered inaccessible due to close proximity to other permanent structures (e.g., nearby walls, ducts, cable trays, equipment, or other structural elements). For inaccessible segments the MEB internal or external segments are evaluated (e.g., through alternative analysis, inspection, test, or plant OE) and together with the accessible MEB inspection and test program, will continue to maintain the MEB consistent with the current licensing basis during the subsequent period of extended operation.
	XI.E5 Fuse Holders	
Program Description Scope of Program Preventive Actions Parameters Monitored or Inspected Detection of Aging Effects Acceptance Criteria	The staff concluded that fuse holder electrical insulation aging management should be relocated from GALL-SLR AMP XI.E1 to this AMP. This change is intended to provide enhanced inspection and testing results by including both the metallic and insulation component parts under the same aging management program. Item VI.A.LP-24 was modified to reflect this change. Item VI.A.LP-23 was modified and new item VI.A.L-07 was added to clarify and separate the aging mechanisms and effects due to fatigue from ohmic heating, thermal cycling, and electrical transients, from those of chemical contamination, corrosion, and oxidation.	This guidance ensures that the fuse holder (both metallic and electrical insulation portions) aging mechanisms and effects are identified and accurately characterized such that the effects of aging will be adequately managed through the subsequent period of extended operation.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
XI.E6	**Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements**	
Program Description	The staff has concluded, based on operating experience demonstrating age related degradation, that it is appropriate to provide additional guidance on the acceptance of the one-time test. A sample of cable connections within the scope of license renewal are tested on a one-time test basis or periodically once every 5 years, if only visual inspection is used to provide an indication of the integrity of the cable connections. Depending on the findings of the one-time test, subsequent testing may have to be performed within 10 years of initial testing.	The changes to GALL-SLR AMP XI.E6 emphasize operating experience feedback and more effectively age manages cable connections by adding a periodic inspection (at least once every 5 or 10 years depending on inspection type and result – visual or test).
XI.E7	**High Voltage Insulators**	
New AMP	New AMP	The staff concluded that the development of a high voltage insulator AMP was appropriate based on industry operating experience. The AMP was developed to provide an aging management program that specifically manages the effects of aging of high voltage insulators subject to environments conducive to accelerated aging as defined in this AMP... Previously, the GALL Report included high voltage insulators under further evaluation where applicants have included plant-specific aging management programs in license renewal applications, as applicable. The development of this aging management program was based on additional industry operating experience demonstrating age related degradation of high voltage insulators.

Table 2-31 GALL-SLR Differences from Chapter XI, Electrical Aging Management Programs, Revision 2 and Their Technical Bases

Changed Program Elements	Summary of Significant Changes	Technical Basis for Change
GALL-SLR Chapter VI	Added cable bus as a new further evaluation plant-specific item.	The GALL-SLR Report has been revised to include cable bus as a plant-specific further evaluation including further evaluations of associated AMPs (e.g., AMP XI.S6, “Structures Monitoring,” XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” and AMP XI.S6, “Structures Monitoring” as applicable). This guidance ensures that cable bus aging mechanisms and effects are identified and accurately characterized such that the effects of aging will be adequately managed through the subsequent period of extended operation.

3 SUBSEQUENT LICENSE RENEWAL CHANGES TO SRP-LR, REVISION 2 AND THEIR TECHNICAL BASES

There are many changes that have been made to the Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR), Revision 2 document. Some changes are the result of the drafting of the December 2015 draft version of NUREG–2192, Standard Review Plan for the Review of Subsequent License Renewal Applications for Nuclear Power Plants." Additional changes are the result of public comments that were received during the public comment period. The final version of NUREG–2192 has consolidated these changes. This section provides a summary of notable technical changes that were made in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) and provides the technical basis for each change.

- The introduction notes that the requirements for first license renewal in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54 apply to subsequent license renewal and that the U.S. Nuclear Regulatory Commission (NRC) has not adopted special provisions applicable to subsequent renewal(s).

- The SRP-SLR includes the NRC staff's resolutions of License Renewal Interim Staff Guidance (LR-ISG) from 2011 through 2016. During the development of the subsequent license renewal (SLR) guidance documents, the NRC issued LR-ISG-2015-01 "Changes to Buried and Underground Piping and Tank Recommendations" and LR-ISG 2016-01 "Changes to Aging Management Guidance for Various Steam Generator Components," which were incorporated into the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report.

- The alternative regulation, 10 CFR 50.61a, "Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," to 10 CFR 50.61 was added as a reference for applicable plants to the regulations specified in 10 CFR §54.4(a)(3).

- Chapter 3.0 was moved to Subchapter 1.2, and an explanation was added of each of the column headings in the tables in the SRP-SLR.

- A new column was added to the tables to designate whether an aging management review (AMR) item was new (N), modified (M), deleted (D), or edited (E).

- A new chapter was added to the SRP-SLR, Chapter 5, Technical Specifications Changes, to provide reviewers guidance on looking for technical specifications changes that may be required for aging management during the subsequent period of extended operation and guidance for reviewers for reviewing the changes in the proposed technical specifications changes in the license renewal application.

- Table 4.1-3 on potential plant-specific time-limited aging analyses (TLAAs) was moved to Chapter 4.7.

The specific changes to each SRP-LR chapter are discussed in Sections 3.1 through 3. 5 of this document. A summary of the changes to each chapter and their technical bases are presented in Tables 3-1 through 3-17.

3.1 SRP-SLR Chapter 1 – Administrative Information

There are no major technical changes in Chapter 1 of the SRP-SLR, other than the move of SRP-LR Subchapter 3.0 to Subchapter 1.2 of the SRP-SLR. Subchapter 1.2 of the SRP-SLR provides guidance to the staff conducting safety reviews of the aging management programs (AMPs) or AMRs. Other changes to Subchapter 1.2 are presented in Table 3-1.

The AMR items presented in the GALL-SLR Report tables are combined and grouped according to function or material, environment, aging effect, and AMP to better categorize the aging of certain systems in specific environments and to facilitate the review of AMRs when conducting safety reviews at plants applying for license renewal. The tables of these groupings are found in the SRP-SLR and are referred to as “AMR rollup tables.” New material, environment, aging effect, and AMP combinations are discussed in Section 3.1.1 below. The method for combining or “rolling up” these AMRs is discussed in Section 3.1.2 below.

In addition to a discussion of the rollup tables, this section presents the changes that were made in individual subchapters of the SRP-SLR and the technical bases for these changes. Subchapter 1.2 of the SRP-SLR provides guidance to the staff conducting safety reviews of the AMPs or AMRs. Other changes to Subchapter 1.2 are presented in Table 3-1. The changes and technical bases for these changes are shown in Table 3-1.

3.1.1 Discussion of New Material, Environment, Aging Effect, and Aging Management Program Combinations

New material, environment, aging effect, and AMP combinations in NUREG–2192 result from the addition of new AMR items in the GALL–SLR Report, Chapters II through VIII, as described in Section 2.1. New material, environment, aging effect, and AMP combinations are included in the rollup methodology described in Section 3.1.2 and may result in new items in the AMR rollup tables, or may be included in previously existing items if the new combination is closely related to a material, environment, aging effect, and AMP combination already in Revision 2 of the GALL Report.

3.1.2 Section 3.1.2.2.11, AMR Rollup Methodology

The methodology for developing the AMR rollup tables in the SRP-SLR is based on a principal of grouping together components, materials, and environments in which a single aging effect or a small group of closely related aging effects can be adequately managed by an AMP or by a combination of programs that is consistent with the AMPs described in Chapter XI of the GALL-SLR Report. The rollup tables are intended to (i) aid the applicant in preparation of the subsequent license renewal application (SLRA) by providing groups of component, material, environment, aging effect, and AMP combinations that have been previously reviewed and evaluated by the staff, and (ii) provide a process roadmap for the staff to follow in preparing its safety evaluation of a license renewal application.

The methodology used in the rollup tables is similar, but not identical, for all chapters in the GALL-SLR Report and the SRP-SLR.

- For AMR items in Chapters V, VI, VII, and VIII, a single rollup methodology is used. Within a single GALL-SLR chapter, AMR items with identical values for AMP, aging effect requiring management (AERM), further evaluation, and further evaluation reference are initially collected together in individual groups. The initial rolled-up component description is then reviewed to determine whether the initial grouping, based solely on AMP, AERM, and further evaluation, has resulted in a grouping in which the individual relationships of component, material, and environment are not clearly maintained. If, based on technical review, an initial grouping is found to result in an unacceptable rolled-up component description, the initial grouping is subdivided into smaller groupings with identical AMP, AERM, and Further Evaluation content, but with different component, material, and/or environment descriptions.

- For AMR items in the Chapters II, III, and IV, the rollup methodology differs from that of the previously described chapters by grouping on an AMP description that is consistent with, but not directly contained in, the underlying GALL-SLR Report AMR items. Also, the rolled up component description typically does not include the environment, and, for some rolled-up lines in Chapter III, the component description encompasses the components in the AMR items that are grouped together.

3.2 SRP-SLR Chapter 2 – Scoping and Screening

There were no major technical changes to SRP-LR Chapter 2 for subsequent license renewal except for the addition to one of the five regulated events under 10 CFR 54.4(a)(3). An alternative to the pressurized thermal shock rule, 10 CFR 50.61a, was approved since the publication of SRP-LR. Applicants who choose to use the alternative methods under 10 CFR 50.61a should review their structures and components that are relied on in the safety analyses under 10 CFR 50.61a to perform a function that demonstrates compliance with the pressurized thermal shock rule. The changes and technical bases for these changes are shown in Table 3-2.

3.3 SRP-SLR Chapter 3 – Aging Management Review

There are six subchapters to the SRP-SLR Chapter 3 on aging management review. Subchapter 3.1 discusses aging management of reactor vessel, internal, and reactor coolant system. Subchapter 3.2 deals with aging management of engineered safety features; Subchapter 3.3 covers auxiliary systems; Subchapter 3.4 discuses steam and power conversion system; subchapter 3.5 containments, structures, and component supports; and subchapter 3.6 discusses electrical and instrumentation and controls. The changes and technical bases for these changes are shown in Tables 3-3 through 3-8, respectively.

3.4 SRP-SLR Chapter 4 – Time-Limited Aging Analyses (TLAAs)

There are seven subchapters to the SRP-SLR Chapter 4 on generic and plant-specific TLAAs. Subchapter 4.1 discusses how to recognize when a TLAA may be appropriate, and changes to that subchapter are summarized in Table 3-9, along with the technical bases for these changes. Subchapter 4.2 deals with reactor vessel neutron embrittlement; subchapter 4.3 covers metal fatigue; subchapter 4.4 discusses the environmental qualification of electrical equipment; subchapter 4.5 presents a discussion of concrete containment tendon prestress; subchapter 4.6 discusses inservice local metal containment corrosion analyses; and subchapter 4.7 discusses other plant-specific safety analyses that may involve other time-limited assumptions. The changes and technical bases for these changes are shown in Tables 3-9 through 3-15, respectively.

3.5 SRP-SLR Appendices A.1, A.2, A.3, and A.4

Changes to the three appendices in the SRP-SLR and a new appendix on operating experience for AMPs are summarized in Table 3-17, along with the technical bases for these changes. These appendices are A.1 – Generic Aging Management Reviews, A.2 – Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1), A.3 – Generic Safety Issues Related to Aging (Branch Technical Position RLSB-2) and A.4, Operating Experience for Aging Management Programs. The changes and technical bases for these changes are shown in Table 3-17.

Table 3-1 SRP-SLR Chapter 1, Section 1.1, Administrative Information, Differences from SRP-LR Revision 2, and Their Technical Bases, and Section 1.2, Integrated Plants Assessments and Aging Management Reviews, Differences from SRP-LR, Revision 2, and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Section 1.1 Administrative Information		
Section 1.1.1 Areas of Review	Clarified that in cases of licensee in timely renewal, the applicant should request that the staff approve the aging management activities provided in the renewal application. If approved, the applicant may conduct aging management activities during the timely renewal period using the aging management programs (AMPs) included in the subsequent license renewal application (SLRA).	Clarify aging management activities during the timely renewal period.
Section 1.1.2.1 Docketing/Sufficiency of Application	Added that the U.S. Nuclear Regulatory Commission (NRC) staff determines acceptance for docketing and sufficiency on the basis of the required contents of an application, established in Title 10 of the *Code of Federal Regulations* (10 CFR) 2.101, 10 CFR 51.53(c), 54.17, 54.19, 54.21, 54.22, and 54.23.	Add references to the Code of Federal Regulations.
Section 1.2 Integrated Plant Assessments and Aging Management Reviews		
Section 1.2.1 – Background on the Types of Reviews	Augmented the discussion to describe the format and objectives of the aging management review (AMR) line items in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) and Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Reports.	The staff determined a more precise description of the format and objectives of AMR items was warranted in order to better described how these AMR items are to be used in proposed SLRAs. The updated guidance is intended to be more consistent with the corresponding guidance in the latest version of Nuclear Energy Institute (NEI) 95-10.
	Expanded the discussion of the GALL-SLR Report functions.	The staff determined that an improved discussion was warranted to better describe interrelationships between the criteria for AMRs and AMPs in the GALL-SLR and SRP-SLR reports, and to describe when plant-specific AMRs or AMPs may be necessary.
Section 1.2.2 – Applications With Approved Extended Power Uprates	Made administrative edits to the wording of the section and deleted the NOTE comment on the section.	The staff determined that the NOTE comment in Section 3.0.2 did not provide any added value for an applicant reviewing the criteria in SRP-SLR Section 3.0.2.

Table 3-1 SRP-SLR Chapter 1, Section 1.1, Administrative Information, Differences from SRP-LR Revision 2, and Their Technical Bases, and Section 1.2, Integrated Plants Assessments and Aging Management Reviews, Differences from SRP-LR, Revision 2, and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
Section 1.2.3 – AMPs that Rely on Implementation of NRC-Approved Technical or Topical Reports (TRs)	New section that describes the review process for AMPs that rely on the implementation of an NRC approved Technical or Topical Report (TR).	The staff determined that the program element criteria for AMPs that rely on TRs for implementing NRC-endorsed methodologies or NRC-endorsed industry initiatives differ from those AMPs that are based on compliance with specific NRC requirements or conformance with NRC positions in NRC-issued generic communications. Therefore, the staff created a new Section 3.0.3 to describe how implementation of such industry methodologies or initiatives would need to be implemented under the AMPs. The staff references NRC Office Instruction LIC-500 to clarify that implementation of NRC-endorsed methodologies in these TRs may be subject to specific condition, limitations, or NRC requests in applicant and/or licensee action items, and therefore, that the TR methodology activities may need to be adjusted based on such limitations, conditions, or action items.
Table 3.0-1, as previously given in Chapter 3.0, of NUREG–1800, Revision 2	Table 3.0-1, as included in NUREG–1800 Revision 2, provided a summary of the GALL AMPs listed in the NUREG–1801, Revision 2, and example Final Safety Analysis Report (FSAR) supplement summaries. The staff did not renumber this table and include it as an applicable table for listing GALL-SLR AMPs in Section 1.2 of NUREG–2192. Instead, the list of AMPs and the example FSAR Supplement summaries for the AMPs previously provided in Table 3.0-1, were updated and classified in those that apply to the specific system groupings for the light-water reactor designs, as delineated in Chapters 3.1 – 3.6 of the SRP-SLR. Thus, the AMPs and FSAR supplement examples for the specific systems have been incorporated to the designated Table 3.X-2 designated tables for these chapters, with the format of the new tables being identical the previous format of Table 3.0-1 in NUREG–1800, Revision 2. Therefore,	The staff updated the list of AMPs and the sample AMPs FSAR Supplements in Table 3.0-1 for consistency with the AMP updates in Chapters X and XI of the GALL-SLR Report, or with the FSAR supplement summary descriptions for these types of AMPs provided in past industry-submitted license renewal applications (LRAs). The AMPs and FSAR supplement examples for AMPs applying to the system groupings have been incorporated into the Table 3.X-2 -designated tables for these chapters, with the format of the new tables being identical the previous format of Table 3.0-1 in NUREG–1800, Revision 2. The new tables are broken down as follows: (a) <u>Table 3.1-2 in SRP-SLR Chapter 3.1</u>: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to reactor coolant system components. (b) <u>Table 3.2-2 in SRP-SLR Chapter 3.2</u>: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to emergency safety feature (ESF) system components.

Table 3-1 SRP-SLR Chapter 1, Section 1.1, Administrative Information, Differences from SRP-LR Revision 2, and Their Technical Bases, and Section 1.2, Integrated Plants Assessments and Aging Management Reviews, Differences from SRP-LR, Revision 2, and Their Technical Bases

Location of Change	Summary of Significant Changes	Technical Bases for Changes
	SLR-SLR Section 1.2 does not include any table containing FSAR supplement summary description examples for GALL-based AMPs in the GALL-SLR report.	(c) Table 3.3-2 in SRP-SLR Chapter 3.3: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to auxiliary (AUX) system components. (d) Table 3.4-2 in SRP-SLR Chapter 3.4: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to steam and power conversion (SPC) system components. (e) Table 3.5-2 in SRP-SLR Chapter 3.5: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to structures or structural components. (f) Table 3.6-2 in SRP-SLR Chapter 3.6: Contains a list of the GALL-based AMPs example FSAR supplement summaries for GALL-based AMPs that may apply to electric system or instrumentation and control system components. The FSAR supplement examples for AMPs listed in these tables may have been administratively edited to be more consistent with the updated bases for GALL-based AMPs provided in Chapters X or XI of the GALL-SLR Report, or the FSAR supplement summary descriptions for these types of AMPs in past LRAs. SLR-SLR Section 1.2 no longer includes any table containing FSAR supplement summary description examples for GALL-based AMPs in the GALL-SLR Report.

Table 3-2 SRP-SLR Chapter 2, Scoping and Screening, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 2.1.3	10 CFR 50.61a was added as a reference for applicable plants to the regulations specified in 10 CFR §54.4(a)(3).	Updated to conform to new regulations, an alternate to the pressurized thermal shock rule.
Section 2.1.5	Added that in cases in which the applicant proposes an alternative, the staff evaluates these alternatives and finds them acceptable if the staff determines that the alternatives provide reasonable assurance that the component's intended function will be maintained	Provides guidance to the staff in reviewing alternatives to the SLR guidance that is proposed in subsequent license renewal applications (SLRAs).
Table 2.1-3	In regard to the screening of packing, gaskets, seals, and O-rings, deleted the wording, "would generally be able to exclude these subcomponents using a clear basis, such as the example of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III not being relied on for pressure boundary."	Referencing ASME Code Section III (or other codes that address the pressure retaining function of a component as the basis for not addressing loss of leak tightness due to degraded packing, gaskets, seals, and O-rings), is not an adequate basis. The codes do not address loss of leak tightness due to degraded packing, gaskets, seals, and O-rings because they only address the structural integrity of the pressure boundary. For example, if a leak is detected from a gasket joint during an ASME Code Section XI pressure test, the test can be found acceptable. The only basis for failing a pressure test of this nature would be leakage through the metallic structure of the component. The staff has concluded that it is acceptable to not manage loss of leak tightness due to degraded packing, gaskets, seals, and O-rings, for the pressure boundary and leakage boundary (spatial) intended functions in an aging management program based on the following: • It is unlikely that leakage from packing, gaskets, seals or O-rings would result in failure of the system to deliver sufficient flow at adequate pressure. • In regard to leakage, which could affect either the pressure boundary (containment leak boundary) or leakage boundary (spatial) intended functions, licensees routinely conduct tours of the operating spaces. When leakage is detected it is typically promptly entered into the corrective action program. The leakage is corrected by replacing the packing, gaskets, seals, and O-rings as consumables.

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.1.2.2.1	The scope of this section was expanded to include other types of cyclical loading analyses that may qualify as TLAAs for these components, as defined in SRP-SLR Section 4.3. In addition, the further evaluation "acceptance criteria" and "review procedure" guidelines in SRP-SLR were amended to indicate that monitoring of cumulative usage factor (CUF) analyses for Class 1 components may be based on stress-based monitoring methods.	The expansion of the types of cyclical loading analyses that are within the scope of the further evaluation recommendations in SRP-SLR Section 3.1.2.2.1 were done consistent with the expanded scope of cyclical loading analyses in Section 4.3 of the SRP-SLR. Cyclic loading analyses that may qualify as TLAAs for these components include American Society of Mechanical Engineers (ASME) CUF or I_t analyses, environmentally-assisted fatigue analyses for ASME Class 1 components, cyclic load-based expansion stress analyses (maximum allowable stress range reduction analyses), fatigue waiver analyses, or cyclic-load based flaw growth, flaw tolerance, or fracture mechanics analyses. The staff determined that monitoring of metal fatigue analyses (i.e., CUF analyses or I_t analyses) for Class 1 components in the reactor coolant pressure boundary or reactor core support structure components may be done using plant-specific stress-based monitoring methods. The staff adjusted the criteria for AMP X.M1, Fatigue Monitoring, and associated FSAR supplement examples for the AMP in SRP-SLR Table 3.0-1 or the related TLAAs in SRP-SLR Table X-02 to reference stress-based monitoring methods for these TLAAs.
Section 3.1.2.2.3 , Subsection 2	Revised to cite both GALL AMP XI.M31, Reactor Vessel Surveillance, and the use the new developed GALL AMP X.M2, Neutron Fluence Monitoring as the basis for accepting the neutron embrittlement TLAAs in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c)(1)(iii).	For the update of AMP XI.M31, the staff removed capsule fluence monitoring bases out of AMP XI.M31 to incorporate them into a new AMP. Therefore, the staff developed GALL-SLR AMP X.M2, "Neutron Fluence Monitoring," that may also be used to accept vessel neutron embrittlement TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). AMP X.M2 is analogous to the manner that GALL AMP X.M1, "Fatigue Monitoring," is used to accept metal fatigue TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). If an AMP correlating to GALL-SLR AMP X.M2 is used as the basis for accepting the TLAAs under 10 CFR 54.21(c)(1)(iii), aging management use of the program element criteria in GALL-SLR AMP X.M2, "Neutron Fluence Monitoring," is conducted in conjunction with the implementation of program

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		and program elements in the AMP that correlates to GALL AMP XI.M31, "Reactor Vessel Surveillance," as both the neutron fluence monitoring basis and the results of the testing performed under the surveillance program yield appropriate evaluation inputs for the TLAAs defined in SRP-SLR Section 4.2.
Section 3.1.3.2.3 , Subsection 3	Section 3.1.3.2.3, Subsection 3 was revised to reflect BAW-2248 instead of MRP-227.	The staff determined that the applicable reduction of ductility analysis for B&W-designed PWRs was developed before the EPRI Materials Reliability Program (MRP) developed the MRP-227 guidelines. The applicable report is provided in Babcock and Wilcox Technical Report (TR) No. BAW-2248-A, as properly referenced in Section 3.1.2.2.3, Subsection 3 of NUREG–1800, Revision 2. The corresponding review procedures in Section 3.1.3.2.3, Subsection 3 of NUREG–1800, Rev. 2, improperly referenced the report as MRP-227, Rev. 0. TR No. BAW-2248-A was one of the B&W or AREVA reports for B&W designed reactors that AREVA reviewed when providing the EPRI MRP with AREVA's guidelines for B&W-designed reactor vessel internal components in EPRI TR No. MPR-227-A. SLR applicants operating these types of reactors are responsible for determining whether TR No. BAW-2248-A is part of the current licensing basis (CLB) and whether it is applicable for the CLB that is proposed for a subsequent period of extended operation. Thus, any NRC-issued applicant/licensee action items (A/LAI) on MRP-277-A do not have a direct bearing on whether TR No. BAW-2248-A will still be relied upon for the subsequent period of extended operation for B&W designed reactors. For B&W-designed PWRs that may still be relying on TR No. BAW-2248-A in the CLB, use of the TR is subject to specific applicant action items listed in the NRC safety evaluation for the report.
Section 3.1.2.2.4, Subsection 1	Revised to credit using either AMP XI.M32, "One Time Inspection," or AMP XI.M36, "Externals Surfaces Monitoring", with use of AMP XI.M36 being applicable if the plant has relevant operating experience with the occurrence of cracking in the lines.	The technical basis for the changes is documented in Table 2-17, items R-61a and R-61b.

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.1.2.2.6, Subsections 1 and Subsection 3	Relocated the new PWR reactor vessel flange leakage lines Subsection 1 to a new Subsection 3. Similar to the changes that were made to SRP-SLR Section 3.1.2.2.4, Subsection 1 for BWR reactor vessel flange leakage lines, the new sections for PWR reactor vessel leakage lines state that either AMP XI.M32, “One-Time Inspection,” or AMP XI.M36, “Externals Surfaces Monitoring,” may be used to manage cracking in these lines, with any use of AMP XI.M36 being applicable if the plant has relevant operating experience with the occurrence of cracking in the lines.	The technical basis for the changes is documented in Table 2-17, items R-74a and R-74b.
Section 3.1.2.2.9	Incorporated a new AMR further evaluation section to address PWR reactor vessel internals. .	The sampling-based augmented inspection criteria in EPRI Report MRP-227-A for Westinghouse, Combustion Engineering, and Babcock and Wilcox designed PWR reactor internals were reflected in the GALL Report Revision 2 with issuance of LR-ISG-2011-04, “Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors.” However, the staff noted that the sampling-based condition monitoring program in MRP-227-A was based on an assessment of 60-year loadings and fluences. The staff determined that the extension of time-dependent cyclical loads and neutron radiation exposures to an 80-year licensed operating term could potentially have an impact on the criteria for inspecting PWR vessel internal components, as defined in the MRP-227-A report. The staff therefore determined that it was appropriate to develop a new AMR further evaluation section to recommend that a PWR SLR applicant either uses AMP XI.M16A and MRP-227-A as a starting basis for aging management, with inclusion of a gap analysis for SLR, or develop a plant-specific AMP to manage aging of their PWR reactor vessel internals components. The basis for corresponding changes to AMP XI.M16A are described in Table 2-29.
Section 3.1.2.2.10, Subsection 1	Included a new AMR further evaluation section for PWR control rod drive (CRD) nozzles.	The new guidance criteria in Section 3.1.2.2.10, Subsection 1, are based on the staff’s resolution of specific PWR operating experience with wear in CRD nozzles adjoined to the reactor

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		vessel and past applicant-proposed AMP activities or analyses that were approved by the staff to manage loss of material due to wear in these components.
Section 3.1.2.2.10, Subsection 2	Included a new AMR further evaluation section for PWR CRD nozzles thermal sleeves.	The new guidance criteria in SRP-SLR Sections 3.1.2.2.10, Subsection 2, are based on the staff's resolution of specific PWR operating experience with wear in CRD nozzle thermal sleeves adjoined to the reactor vessel and past applicant proposed AMP activities or analyses that were approved by the staff to manage loss of material due to wear in these components.
Section 3.1.2.2.11, Subsections 1 and 2	These AMR further evaluation subsections provide the staff's acceptance criteria and review procedures for managing primary water stress corrosion cracking (PWSCC) in PWR steam generator (SG) divider plates and tube-to-tubesheet welds made from nickel alloy materials. Some changes were made to the previous versions of these further evaluation guidelines for these components in Section 3.1.2.2.11, Subsections 1 and 2 of NUREG–1800, Revision 2.	For the SRP-SLR Section 3.1.2.2.11, Subsection 1 guidelines that apply to PWR SG divider plates, the staff added additional paragraph guidance and criteria that clarified when a prospective SLR applicant for a PWR design with recirculating SGs would need to propose a plant-specific AMP for managing cracking due to PWSCC in their SG divider plates. For the SRP-SLR Section 3.1.2.2.11, Subsection 1 guidelines that apply to PWR SG tube-to-tubesheet welds, the staff made some minor technical adjustments of the previous guidelines for managing PWSCC in these weld in Section 3.1.2.2.11, Subsection 2, of the NUREG–1800, Revision 2 report. However, these changes do not alter the general approach for managing PWSCC in PWR tube-to-tubesheet welds.
Section 3.1.2.2.12	Included a new AMR further evaluation section for BWR vessel internals to address cracking due to irradiation-assisted stress corrosion cracking.	Similar to the staff's issue with PWR Vessel Internals Program, the staff determined that the augmented inspection recommendations stated in various EPRI BWRVIP reports only assessed aging based on 60-year loading and neutron fluence bases. Since the reports have yet to be updated to 80-year assessments, the staff determined that it would be appropriate for BWR subsequent renewal applicants to evaluate how an additional 20 years of operation (beyond the 60-year term) would impact the BWRVIP augmented inspection criteria stated in the BWRVIP reports that are referenced in GALL-SLR AMP XI.M9.

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		Neutron fluence and cracking susceptibility (i.e., applied stress, operating temperature, and environmental conditions) may affect the degradation due to IASCC in BWR vessel internals. Therefore, the staff determined that new SRP-SLR further evaluation criteria were needed to ensure that irradiation-assisted stress corrosion cracking would continue to be adequately managed by the BWRVIP inspection criteria for a cumulative 80 year operating period, or else appropriately consider for augmentation by the applicants. AMP XI.M9 recommends that supplemental inspections be implemented if the further evaluation determines that supplemental inspections are necessary for certain components based on neutron fluence, cracking susceptibility and fracture toughness. Program enhancements may be necessary based on these evaluations. The further evaluation guidelines in this section do not automatically result in a BWR license renewal applicant augmenting specified BWRVIP inspection and evaluation (I&E) criteria identified in these EPRI BWRVIP reports. Rather, the FE guidelines provide criteria for the review of the BWRVIP I&E criteria in those reports and to verify whether I&E criteria in the reports would remain valid for aging management of the RVI components during a subsequent license renewal period. For further information, see the response to industry comment 015-022, NUREG–2222.
Section 3.1.2.2.13	Included a new AMR further evaluation section for BWR vessel internals to address loss of fracture toughness due to neutron irradiation or thermal aging embrittlement.	The subsequent license renewal term beyond 60 years of operation increases neutron fluence levels imposed on the reactor vessel internals. These increases can promote loss of fracture toughness due to neutron irradiation or thermal aging embrittlement (as well as cracking due to IASCC). Therefore, the staff determined that an applicant should evaluate the need for supplemental inspections or program enhancements to manage these aging effects for the subsequent period of extended operation.

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		These evaluations should consider (a) neutron fluence levels, (b) cracking susceptibility (that is, applied stress, operating temperature, and environmental conditions), (c) thermal aging susceptibility, (d) fracture toughness, and (e) plant-specific neutron fluence calculation results for reactor vessel internals as projected at 80 years of operation. As part of the evaluations, the projected neutron fluence levels are used to determine component susceptibility to aging effects and the need for supplemental inspections of the components. Supplemental inspections are performed as needed based on these evaluations.
Section 3.1.2.2.14	Included a new AMR further evaluation section for BWR vessel internals to address loss of preload due to thermal or irradiation-assisted stress relaxation for BWR core plate rim-hold-down bolts.	This new further evaluation section is based on past license renewal application bases for managing loss of preload in these types of BWR bolted assemblies. It is also noted that Section 2.1.3 of BWRVIP-25 states that these bolts are susceptible to loss of preload due to thermal or irradiation-enhanced stress relaxation. Management of loss of preload in BWR core plate rim-hold-down bolts may be managed using either AMP condition monitoring or inspection bases, or through performance of a TLAA (or both). Since a TLAA might be the basis in the current licensing basis, the SRP-SLR further evaluation section needs to be applied to the applicable AMR items for BWR core plate rim hold-down bolts. If AMP XI.M9, “BWR Vessel Internals,” is used for aging management, the applicable BWRVIP inspection bases (e.g., BWRVIP-25) should be verified for acceptability. If a TLAA is used, the analysis methodology, results, and basis for accepting under 10 CFR 54.21(c)(1)(i), (ii), or (iii) should be discussed and justified in the SLRA.
Section 3.1.2.2.15	Incorporated a new AMR further evaluation section to address loss of material due to general (steel only), crevice, or pitting corrosion and cracking (SS	The technical basis for this change is documented in Table 2-17, items RP-06 and RP-353

Table 3-3 SRP-SLR Chapter 3.1, Reactor Vessels, Internals, Coolant System, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
	only) due to SCC for steel or SS components exposed to concrete.	
Section 3.1.2.2.16,	Incorporated a new AMR further evaluation to address loss of material due to pitting and crevice corrosion in stainless steel and nickel alloy components exposed to air, condensation, or the underground environment.	The technical basis for this change is documented in Table 2-3, item R-452.
Section 3.1.3.2.3 , Subsection 3	Section 3.1.3.2.3, Subsection 3 was revised to reflect BAW-2248 instead of MRP-227.	The staff determined that the applicable reduction of ductility analysis for B&W-designed PWRs was developed before the EPRI Materials Reliability Program (MRP) developed the MRP-227 guidelines. The applicable report is provided in Babcock and Wilcox Technical Report (TR) No. BAW-2248-A, as properly referenced in Section 3.1.2.2.3, Subsection 3 of NUREG–1800, Revision 2. The corresponding review procedures in Section 3.1.3.2.3, Subsection 3 of NUREG–1800, Rev. 2, improperly referenced the report as MRP-227, Rev. 0. TR No. BAW-2248-A was one of the B&W or AREVA reports for B&W designed reactors that AREVA reviewed when providing the EPRI MRP with AREVA’s guidelines for B&W-designed reactor vessel internal components in EPRI TR No. MPR-227-A. SLR applicants operating these types of reactors are responsible for determining whether TR No. BAW-2248-A is part of the current licensing basis (CLB) and whether it is applicable for the CLB that is proposed for a subsequent period of extended operation. Thus, any NRC-issued applicant/licensee action items (A/LAI) on MRP-277-A do not have a direct bearing on whether TR No. BAW-2248-A will still be relied upon for the subsequent period of extended operation for B&W designed reactors. For B&W-designed PWRs that may still be relying on TR No. BAW-2248-A in the CLB, use of the TR is subject to specific applicant action items listed in the NRC safety evaluation for the report.

Table 3-4 SRP-SLR Chapter 3.2, Engineered Safety Features, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.2.2.2.2	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite nickel alloy in addition to stainless steel; (c) cite a recommendation to conduct a review of plant-specific operating experience related to loss of material due to pitting and crevice corrosion; and (d) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-18, item EP-107.
Section 3.2.2.2.3	Revised the further evaluation for drywell and suppression chamber spray system nozzles and flow orifice internal surfaces exposed to indoor uncontrolled air to: (a) cite metallic components in lieu of steel components; (b) address wetting and drying of the components; (c) address plant-specific procedures related to the ability to drain the lines when periodically wetted; (d) cite a recommendation to conduct a review of plant-specific operating experience related to loss of material due to pitting and crevice corrosion; and (e) change the proposed AMPs. The further evaluation section was realigned from 3.2.2.2.5 to 3.2.2.2.3.	The technical basis for the changes is documented in Table 2-18, item EP-113.
Section 3.2.2.2.4	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite a recommendation to conduct a review of plant-specific operating experience related to cracking due to SCC; and (c) change the proposed AMPs. The further evaluation section was realigned from section 3.2.2.2.6 to 3.2.2.2.4.	The technical basis for the changes is documented in Table 2-18, item EP-103.
Section 3.2.2.2.7	Revised the further evaluation for recurring internal corrosion to cite a specific AMP versus a plant-specific AMP. The further evaluation section was realigned from section 3.2.2.2.9 to 3.2.2.2.7.	The technical basis for the changes is documented in Table 2-18, item E-400.
Section 3.2.2.2.8	Incorporated a new further evaluation to address cracking for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-4, item E-443.
Section 3.2.2.2.9	Incorporated a new further evaluation to address loss of material due to general (steel only), pitting, or crevice corrosion or cracking (SS only) due to SCC for steel or SS components exposed to concrete.	The technical basis for the changes is documented in Table 2-18, item EP-20.
Section 3.2.2.2.10	Incorporated a new further evaluation to address loss of material due to pitting or crevice corrosion for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-18, item EP-114.

Table 3-5 SRP-SLR Chapter 3.3, Auxiliary Systems, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.3.2.2.2	Revised the further evaluation for stainless steel PWR nonregenerative heat exchanger tubing exposed to treated borated water >60°C (>140°F) to: (a) cite a recommendation to conduct a review of plant-specific operating experience related to cracking due to SCC; and (b) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-20, item A-69.
Section 3.3.2.2.3	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite a recommendation to conduct a review of plant-specific operating experience related to cracking due to SCC; and (c) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-20, item AP-209.
Section 3.3.2.2.4	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite nickel alloy in addition to stainless steel; (c) cite a recommendation to conduct a review of plant-specific operating experience related to loss of material due to pitting and crevice corrosion; and (d) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-20, item AP-221.
Section 3.3.2.2.7	Revised the further evaluation for recurring internal corrosion to: (a) cite specific AMPs versus a plant-specific AMP; and (b) additional environments were included. .	The technical basis for the changes is documented in Table 2-20, item A-400.
Section 3.3.2.2.8	Incorporated a new further evaluation to address cracking for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-6, item A-482.
Section 3.3.2.2.9	Incorporated a new further evaluation to address loss of material due to general (steel only), pitting, or crevice corrosion or cracking (SS only) due to SCC for steel or SS components exposed to concrete.	The technical basis for the changes is documented in Table 2-20, item AP-19.
Section 3.3.2.2.10	Incorporated a new further evaluation to address loss of material due to pitting or crevice corrosion for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-6, item A-752.

Table 3-6 SRP-SLR Chapter 3.4, Steam and Power Conversion Systems, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.4.2.2.2	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite a recommendation to conduct a review of plant-specific operating experience related to cracking due to SCC; and (c) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-21, item SP-118.
Section 3.4.2.2.3	Revised the further evaluation for stainless steel piping, piping components, and tanks exposed to outdoor air to: (a) cite an air or condensation environment; (b) cite nickel alloy in addition to stainless steel; (c) cite a recommendation to conduct a review of plant-specific operating experience related to loss of material due to pitting and crevice corrosion; and (d) change the proposed AMPs.	The technical basis for the changes is documented in Table 2-21, item SP-127.
Section 3.4.2.2.6	Revised the further evaluation for recurring internal corrosion to cite specific AMPs versus a plant-specific AMP.	The technical basis for the changes is documented in Table 2-21, item S-400.
Section 3.4.2.2.7	Incorporated a new further evaluation to address cracking for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-7, item S-450.
Section 3.4.2.2.8	Incorporated a new further evaluation to address loss of material due to general (steel only), pitting, or crevice corrosion or cracking (SS only) due to SCC for steel or SS components exposed to concrete.	The technical basis for the changes is documented in Table 2-21, item SP-13.
Section 3.4.2.2.9	Incorporated a new further evaluation (3.4.2.2.9) to address loss of material due to pitting or crevice corrosion for aluminum piping, piping components, and tanks.	The technical basis for the changes is documented in Table 2-21, item SP-147.

Table 3-7 SRP-SLR Chapter 3.5, Containments, Structures, and Component Supports, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Sections 3.5.2.2.1.8, 3.5.2.2.2.1.2, and 3.5.2.2.2.3.2	Revised "Further Evaluation" for aggregate reactivity (plant-specific evaluation or aging management program (AMP) is needed if reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or visual inspections of accessible concrete have identified indications of aggregate reactions, such as "map" or "patterned" cracking or the presence of reaction byproducts (e.g., alkali-silica gel). Deleted references to American Society for Testing and Materials (ASTM) and American Concrete Institute (ACI) standards. Aligned Standard Review Plan for Subsequent License Renewal (SRP-SLR) Table 3.5-1 entries (ID 012, 043, and 050) and Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) items II.A1.CP-67, III.A1.TP-204, III.A6.TP-220 with the revised language	The references to ASTM and ACI standards were removed because it is commonly understood that these standards may not identify all types of reactive aggregate and this is supported by operating experience in the nuclear industry. The wording of the further evaluation was edited to make it clear that a plant-specific evaluation or AMP was necessary if plant-specific operating experience indicates reaction with aggregates may be a significant aging-effect. The updated wording included a more detailed list of aggregate reaction indications.
Section 3.5.2.2.1.5	Metal liner and metal plates, personnel airlock, equipment hatch, control rod drive (CRD) hatch are included as areas of review to SRP-SLR Section 3.5.2.2.1.5, "Cumulative Fatigue Damage," Table 3.5-1, item 009 and GALL-SLR items II.A3.C-13,	The SRP-SLR revised Section 3.5.2.2.1.5 "Cumulative Fatigue Damage," aligns the Further Evaluation with the revised SRP-SLR Section 4.6, Table 3.5-1, item 009 and GALL-SLR items II.A3.C-13, II.B4.C-13.
Sections 3.5.2.2.2.6	Added new Further Evaluation section to address reduction of strength and loss of mechanical properties in concrete due to irradiation.	Concrete structures in nuclear reactor containments located proximate to the reactor vessel can be subjected to high levels of neutron and gamma radiation under sustained elevated operating temperatures. The intensity of irradiation is typically characterized by the measure of its field or fluence. Prolonged exposure of concrete to irradiation can result in decreases in tensile and compressive strengths and modulus of elasticity. The most likely location for irradiation degradation exists in the primary biological and sacrificial shield walls, proximate to the reactor core, and reactor vessel support structures. These structures perform a structural support function of the reactor vessel

Table 3-7 SRP-SLR Chapter 3.5, Containments, Structures, and Component Supports, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		under design basis loads in addition to providing radiation shielding. To date, operating experience of concrete subjected to irradiation appears to be acceptable, but there is an absence of data on this topic for extended periods of operation such as 60 to 80 years. There is a lack of sufficient test data to support a clear evaluation of the significance of radiation in long-term operations which has contributed to the difficulty of quantifying the long term behavior of concrete that has experienced sustained irradiation and temperature. The current understanding of irradiation effects on concrete mechanical properties is primarily based on limited experimental data on plain concrete reviewed in the paper by Hilsdorf et al (1978). Based on current literature review (Hilsdorf et al (1978), NUREG/CR-7171 (2013), Field et al (2015)), a commonly adopted radiation fluence or field threshold limit considered to have a detrimental effect on concrete mechanical properties (e.g., strength, modulus of elasticity) is 1×10^{19} neutrons/cm^2 for neutron radiation (fluence cutoff energy E > 0.1 MeV) and 1×10^{10} rad for gamma dose. These threshold limits for concrete degradation due to irradiation appear to be conservative for nuclear power reactor structures because they are based on tests of plain concrete at temperatures exceeding 100^o C (212^o F). However, there is the potential that the radiation fluence or dose experienced by the concrete of the primary and sacrificial shield walls and reactor vessel supports may exceed the above threshold limits during operations to 80 years. The EMDA Report (NUREG/CR-7153), Volume 4, identified concrete irradiation effects as an area where there is a knowledge gap and the structural significance could

Table 3-7 SRP-SLR Chapter 3.5, Containments, Structures, and Component Supports, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		be high because of its potential effect on supporting function of the reactor vessel. To address the above concerns for SLR, a new AMR line item has been added to the GALL-SLR Report for loss of strength and mechanical properties of concrete (primary and sacrificial shield walls, reactor vessel support structures) due to irradiation degradation. This AMR line item requires further evaluation to analytically determine plant-specific fluence levels or dose from neutron and gamma radiation experienced by the affected concrete for 80 years of operation. If the above specified threshold limits are exceeded or if there is plant-specific operating experience of significant irradiation damage that could impact intended functions, then a plant-specific AMP is required to manage irradiation effects. The technical basis of the further evaluation (including operating experience) and the plant-specific AMP (if required) will be reviewed on a case-by-case basis to provide reasonable assurance that the affected concrete will perform its intended functions consistent with the CLB during the period of extended operation to 80 years.
Section 3.5.2.2.2.4	Revised "Further Evaluation" to address loss of material due to pitting and crevice corrosion and cracking due to SCC for aluminum and stainless steel support members; welds; bolted connections; and support anchorage to building structure exposed to air or condensation.	The SRP-SLR revised Section 3.5.2.2.2.4. The technical basis for the changes is addressed in Table 2-2, "New AMR Items Added in GALL-SLR Report, Chapter III, Structures and Component Supports," GALL-SLR items T-36 and T-37.

Table 3-8 SRP-SLR Chapter 3.6, Electrical and Instrumentation Controls, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 3.6.2.2.2	The standard review plan (SRP) was revised to implement generic changes described in Section 3. Subchapter titles were revised to reflect changes in aging management review (AMR) items, operating experience or editorial changes.	Changes reflect AMR line item revisions and subsection titles were revised. See Sections 2 and 3 for generic changes and AMR item revisions.

Table 3-9 SRP-SLR Chapter 4.1, Identification of TLAA, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Chapter 4.1 Title	"Exemptions" was added to the title of the chapter.	Section includes criteria in Title 10 of the *Code of Federal Regulations* (10 CFR) 54.21(c) (2) for identifying those exemptions that were granted under 10 CFR 50.12 and are based on a time-limited aging analyses (TLAA). Therefore, exemptions have been added to the title.
Review Responsibilities Section	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Section 4.1.1 Areas of Review	The change to this section deleted the sentence that states: "However, the initial license renewal applicants have found no such exemptions for their plants."	The staff determined that this sentence is no longer true, as some past license renewal applications (LRAs) have included specific exemptions that were previously granted under 10 CFR 50.12 and are based on a TLAA, which is in compliance with the requirement in 10 CFR 54.21(c)(1). For example, some LRAs have identified that exemptions granted for application of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) N-514 for PWR low pressure temperature overpressure protection (LTOP) system analyses or exemptions on 10 CFR Part 50, Appendix J, requirements were granted under 10 CFR 50.12 and based on a TLAA. Instead, the section has been amended to cite the ASME Code Case N-514 exemptions as exemptions that are in compliance with the exemption identification requirements in 10 CFR 54.21(c)(1).
Section 4.1.2 Acceptance Criteria	Three changes were made to this section: (a) Amended the section to clarify that TLAAs may be applicable to active components that are scoped in for license renewal in 10 CFR 54.4 but are not subject to an aging management review in 10 CFR 54.21(a)(1). (b) Amended the section to better define when an analysis would need to be identified as a TLAA and to indicate that the Federal Register Notice on Part 54 provides additional criteria on this matter.	(a) The TLAA identification criterion in Criterion 1 of 10 CFR 54.3(a) is based only on a comparison to the scoping requirements in 10 CFR 54.4 and therefore does not limit the applicability of TLAAs only to those components that would be required to be screened in for an aging management review in accordance with the requirement in 10 CFR 54.21(a)(1). Thus, the possibility exists that, for a given current licensing basis (CLB), a TLAA may need to be identified for a given active component if the analysis in the CLB is determined to be in conformance with all six of

Table 3-9 SRP-SLR Chapter 4.1, Identification of TLAA, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
	(c) Amended the section to clarify that some analyses not conforming to the definition of a TLAA in an initial license renewal could meet the definition of a TLAA in 10 CFR 54.3(a) for a subsequent license renewal application.	the criteria in 10 CFR 54.3(a) for identifying an analysis as a TLAA. Fatigue flaw growth analyses of pressurized water reactor (PWR) coolant pump flywheels are examples of plant-specific analyses that apply to an active component type and may need to be identified as a TLAA for a given application. (b) Federal Register Notice (FRN) No. 95-11136, Volume 60, Number 88, “Nuclear Power Plant License Renewal; Revisions” (pages 22461 – 22495, May 8, 1995), provides additional clarifications on when an analysis of record would conform to the six criteria for defining TLAAs in 10 CFR 54.3(a) and would need to be identified as a TLAA in 10 CFR 54.21(c)(1). The new material in Section 4.1.2 was added to be consistent with basis in the FRN. (c) As stated in the revision to SRP-SLR Section 4.1.2, the applicant’s FSAR (as updated) identifies evaluations, calculations, or analyses that were incorporated by reference into the CLB and may qualify as TLAAs. In addition, for subsequent license renewal applications, there may be situations where an analysis of record was not required to be identified as a TLAA for the current operating period (as approved in the renewed operating license for the facility), but will need to be identified as a TLAA for a proposed subsequent period of extended operation, as required by the regulation in 10 CFR 54.21(c)(1). Specifically, criterion 3 for TLAAs in 10 CFR 54.3(a) establishes that, to be a TLAA, the analysis has to Involve time-limited assumptions defined by the current operating term. In FRN No. 95-11136, Volume 60, Number 88, dated May 8, 1995, the NRC identified that

Table 3-9 SRP-SLR Chapter 4.1, Identification of TLAA, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		TLAAs are those analyses with (i) time-related assumptions, (ii) utilized in determining the acceptability of systems, structures, and components, within the scope of license renewal (as defined in 10 CFR 54.4), (iii) which are based upon a period of plant operation equal to or greater than the current license term, but less than the cumulative period of plant operation (viz., the existing license term plus the period of extended operation requested in the renewed application). For example, an existing analysis that is part of the CLB and is based on a 60-year time assumption, the analysis would not necessarily have to be identified as a TLAA for the initial license renewal application request because it would not conform to the definition of a TLAA, as clarified in FRN No. 95-11136; however, if the same analysis was left unchanged in the CLB and was going to be relied upon for a proposed subsequent license renewal period, the analysis would conform to the third criterion for TLAAs in 10 CFR 54.3(a) because the 60-year assumed life would form the updated current operating term basis for the proposed subsequent license renewal period.
Section 4.1.3 Review Procedures	Edited review procedures section of Chapter 4.1 to be consistent with changes made to Subsection 4.1.2, Acceptance Criteria.	Edited review procedures section of Chapter 4.1.3 to be consistent with changes made to Subsection 4.1.2, Acceptance Criteria.
Section 4.1.4 Evaluation Findings	The staff only made administrative changes to the previous section provided in NUREG–1800, Revision 2.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.1.5 Implementation	The staff only made administrative changes to the previous section provided in NUREG–1800, Revision 2.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.1.6 References	The staff administratively updated the references in Section 4.1.6 from those previously given Section 4.1.6 of NUREG–1800, Revision 2.	The staff's update of the references in Section 4.1.6 is based only on minor administrative edits of the references that were previously provided in Section 4.1.6 of NUREG–1800, Revision 2.

Table 3-9 SRP-SLR Chapter 4.1, Identification of TLAA, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Table 4.1-1 Sample Process for Identifying Potential Time-Limited Aging Analyses (TLAA) and Basis for Disposition	For this section, Table 4.1-1 in NUREG–1800, Revision 2, was replaced with a new version of the table that: (a) Provides a better example of an analysis that would meet the all six of the criteria in 10 CFR 54.3(a) that would define a plant analysis as a TLAA (b) Provides six examples of analyses that would not conform to the six definition criteria for TLAAs in 10 CFR 54.3(a), with one example given in comparison to each TLAA definition criterion stated in the regulation.	(a) The staff used past TLAAs on PWR reactor coolant pump flywheels as the basis for the example. The reactor coolant pump (RCP) flywheels, which are active components, are within the scope of license renewal applications because they provide a safe shutdown function in accordance with 10 CFR 54.4(a)(1). The example provides the basis why the flaw analysis for the RCP flywheels meets each of the criteria for TLAAs in 10 CFR 54.3(a). (b) The staff included one example of a hypothetical analysis of record (six in total) that would not conform to each of the criteria (six in all) for defining TLAAs in 10 CFR 54.3(a). The basis on why the analysis does not meet the specific criterion in 10 CFR 54.3(a) is provided in the example.
Table 4.1-2 Generic Time-Limited Aging Analyses	Administratively changed this table to include typical TLAA subsections that apply to the categories of TLAAs that are listed in the table as generic TLAAs and that are defined in Chapters 4.2 – 4.6 of the SRP-SLR report.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Table 4.1-3 Examples of Potential Plant-Specific TLAAs	Deleted this table from the scope of Chapter 4.1 in the SRP-SLR report, renumbered it to Table 4.7-1, and moved it to SRP-SLR Chapter 4.7, Other Plant-Specific Time-Limited Aging Analyses. For the relocated table, the staff administratively amended the TLAA examples in the table to better define which types of plant designs (PWRs versus boiling water reactors (BWRs)) applied to the TLAA categories listed in the table.	The staff determined that it would be more appropriate to include this table in SRP-SLR Chapter 4.7, Other Plant-Specific Time-Limited Aging Analyses, which provides the staff's guidance for identifying that plant analyses, assessments, calculations, evaluation that qualify as plant-specific TLAAs and dispositioning them in accordance with the requirements in 10 CFR 54.21(c)(1)(I), (ii), or (iii). The administrative changes to the table should include better clarity on the applicability of the types of plant-specific TLAAs that are listed in the relocated table.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
Chapter 4.2 Title	The prior title for this section was listed as "Reactor Vessel Neutron Embrittlement Analysis." The staff administratively edited the title to include the word "Pressure."	Administrative changes were made in a generic effort to list the components as reactor pressure vessels and abbreviate the terminology as reactor pressure vessels (RPVs).
Review Responsibilities Section	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Section 4.2.1 Areas of Review	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2. The administrative edits includes an edit to reference to NRC Regulatory Issue Summary (RIS) No. 2014-11, as the basis for defining beltline locations in the RPVs.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section. RIS No. 2014-11, "Information on Licensing Applications For Fracture Toughness Requirements For Ferritic Reactor Coolant Pressure Boundary Components," was issued on October 14, 2014 (ADAMS ML14149A165) and provides guidance to addressees on the scope and detail of information that should be provided in reactor vessel fracture toughness and associated pressure-temperature (P-T) limits licensing applications.
Section 4.2.2 Acceptance Criteria	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Section 4.2.2.1 Time-Limited Aging Analysis	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Section 4.2.2 Acceptance Criteria Section 4.2.2.1.1 Neutron Fluence This includes changes to Subsections 4.2.2.1.1.1, 4.2.2.1.1.2, and 4.2.2.1.1.3, which provide the basis for accepting these types of TLAAs in accordance with	Changes to Sections 4.2.2.1.1 and 4.2.3.1.1 The staff included new acceptance criteria guidance and review procedures in the Standard Review Plan for Subsequent License Renewal (SRP-SLR) report for plant neutron fluence analyses that conform to the definition of a time-limited aging analysis (TLAA) in 10 CFR 54.3(a) and need to be identified as TLAAs in accordance with 10 CFR 54.12(c)(1).	Reactor pressure vessel (or reactor vessel) neutron fluence analyses have been identified as a TLAA in past license renewal applications. As addressed in SRP-SLR Section 4.2.2.1.1, the following generic attributes of reactor vessel fluence analyses are consistent with criteria in 10 CFR 54.3(a) that define an analysis as a TLAA. Neutron fluence is the number of neutrons accumulated per unit area during a certain period of neutron irradiation. Therefore, a reactor vessel fluence analysis involves time-limited assumptions (e.g., 40 years of original design life). In addition, reactor vessels analyzed in neutron fluence analyses

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
10 CFR 54.21(c)(1)(I), (ii), or (iii). Section 4.2.3.1.1 Neutron Fluence (Review Procedures) This includes changes to Subsections 4.2.3.1.1.1, 4.2.3.1.1.2, and 4.2.3.1.1.3, which provide the review procedures for evaluating these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).		are the components susceptible to loss of fracture toughness. As such, reactor vessels may require adequate aging management. A reactor vessel fluence analysis is also used to determine loss of fracture toughness in reactor vessels resulting from the irradiation embrittlement mechanism. Appendix H to 10 CFR Part 50 (Ref. 4) requires that an applicant must implement a reactor vessel material surveillance program if the peak neutron fluence at the end of the design life of the reactor vessel exceeds a neutron fluence of 10^{17} n/cm^2 (E > 1 MeV). Therefore, the analysis considers the effect of aging. In addition, the fluence analysis is integral to other neutron embrittlement TLAAs because neutron fluence is a fundamental parameter which is used to determine the level of neutron irradiation embrittlement of a reactor vessel. As such, a neutron fluence analysis is important in making a safety determination for a reactor vessel in terms of loss of fracture toughness due to neutron irradiation embrittlement. Reactor vessel fluence analyses are typically documented in the Final Safety Analysis Report (FSAR) as part of the current licensing basis. The FSAR also describes a neutron fluence calculational method that has been incorporated into the current licensing basis. The new acceptance criteria for the evaluation of neutron fluence TLAAs are in SRP-SLR Section 4.2.2.1.1. The staff's new guidance provides the basis for identifying these types of analyses as TLAAs and the acceptance criteria based on

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
		consistency with the guidance in Regulatory Guide (RG) 1.190, "Calculational, and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence" (ADAMS Accession No. ML010890301).
	Changes to Subsections 4.2.2.1.1.1 and 4.2.3.1.1.1, 10 CFR 54.21(c)(1)(i) The staff included new acceptance criteria in the SRP-SLR Section 4.2.2.1.1.1 for accepting neutron fluence TLAAs in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(i). The staff also included new review procedures in SRP-SLR Section 4.2.3.1.1.1 for evaluating these types of TLAAs against the acceptance criterion stated in 10 CFR 54.21(c)(1)(i);	The new acceptance criteria in SRP-SLR Subsection 4.2.2.1.1.1 state that the "existing RPV neutron fluence analysis in the current licensing basis (CLB) is re-evaluated to demonstrate that the existing neutron fluence values remain valid during the subsequent period of extended operation." The new procedures in SRP-SLR Subsection 4.2.3.1.1.1 state that "the "reviewer confirms that the applicant's existing RPV neutron fluence analysis remains valid during the subsequent period of extended operation. The new guidance section also states that the "reviewer also confirms that the applicant identifies: (a) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (b) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (c) whether the methodology is consistent with the guidance in NRC RG 1.190 (Ref. 5)." The new acceptance criteria in Subsection 4.2.2.1.1.1 and the new review procedures in Subsection 4.2.3.1.1.1 are based on demonstration of compliance with the criteria and requirements in 10 CFR 54.21(c)(1)(i), which requires demonstration that the analysis will remain valid for the period of extended operation.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
	Changes to Subsections 4.2.2.1.1.2 and Section 4.2.3.1.1.2, 10 CFR 54.21(c)(1)(ii) The staff included new acceptance criteria in the SRP-SLR Section 4.2.2.1.1.2 for accepting neutron fluence TLAAs in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii). The staff also included new review procedures in SRP-SLR Section 4.2.3.1.1.2 for evaluating these types of TLAAs against the acceptance criterion stated in 10 CFR 54.21(c)(1)(ii);	The new acceptance criteria in SRP-SLR Subsection 4.2.2.1.1.2 state that the “RPV neutron fluence analysis is re-evaluated to consider the subsequent period of extended operation in accordance with NRC RG 1.190 or a NRC staff-approved methodology.” The new review procedures in SRP-SLR Subsection 4.2.3.1.1.2 state that “the reviewer confirms that the applicant adequately re-evaluated its RPV neutron fluence analysis for the subsequent period of extended operation.” The guidance also states that, as part of its review, “the reviewer confirms that the applicant identifies that (a) the neutron fluence for each beltline material at the end of the subsequent period of extended operation, (b) the NRC staff-approved methodology used to determine the neutron fluence or submits the methodology for NRC staff review, and (c) whether the methodology is consistent with the guidance in NRC RG 1.190.” The new acceptance criteria in Subsection 4.2.2.1.1.2 and the new review procedures in Subsection 4.2.3.1.1.2 are based on demonstration of compliance with the criteria and requirements in 10 CFR 54.21(c)(1)(ii) and conformance with NRC-endorsed methodologies for performing neutron fluence projections and calculations, such as those in RG 1.190 or other NRC-approved fluence methodologies. The staff will use conformance with the approved methodologies as the basis for evaluating the acceptability of the

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
		neutron fluence values that are projected to the end of the subsequent period of extended operation.
	Changes to Subsection 4.2.2.1.1.3 and Section 4.2.3.1.1.3, 10 CFR 54.21(c)(1)(iii) The staff included new acceptance criteria in the SRP-SLR Section 4.2.2.1.1.3 for accepting neutron fluence TLAAs in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii). The staff also included new review procedures in SRP-SLR Section 4.2.3.1.1.3 for evaluating these types of TLAAs against the acceptance criterion stated in 10 CFR 54.21(c)(1)(iii);	The new acceptance criteria in SRP-SLR Subsection 4.2.2.1.1.3 state that the "NRC staff has evaluated an aging management program (AMP) for projecting and monitoring neutron fluence for the subsequent period of extended operation in AMP X.M2, "Neutron Fluence Monitoring," of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," and that "this program is acceptable for projecting and monitoring neutron fluence in order to monitor loss of fracture toughness due to neutron irradiation embrittlement of RPVs in accordance with 10 CFR 54.21(c)(1)(iii)." The new review procedures in SRP-SLR Subsection 4.2.3.1.1.3 state that the staff will review the applicant's proposed neutron fluence monitoring methodology to confirm that the effects of aging on the intended function(s) of the reactor pressure vessels will be adequately managed during the subsequent period of extended operation. The new acceptance criteria in Subsection 4.2.2.1.1.3 and the new review procedures in Subsection 4.2.3.1.1.3 are based on demonstration of compliance with the criteria and requirements in 10 CFR 54.21(c)(1)(iii), which requires the applicant to demonstrate the effects of aging (loss of fracture toughness for this) on the intended functions of reactor pressure vessels will be adequately managed during the subsequent period of extended operation. As explained in Section 3.1.2.2.3, Subsection 2 of the SRP-SLR, the staff developed AMP X.M2, "Neutron Fluence Monitoring," which provides an acceptable

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
	SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis	
		basis for accepting RPV neutron embrittlement TLAAs in accordance with 10 CFR 54.21(c)(1)(iii). The use of this AMP, when coupled to an applicant's use of its Reactor Vessel Material Surveillance Program (AMP XI.M31 of the GALL-SLR), provides an acceptable basis for managing (through analysis) the impact of loss of fracture toughness of the intended functions of the RPVs during the subsequent period of extended operation. The use of a program correlating to GALL-SLR AMP X.M2 is analogous to use of GALL-SLR AMP X.M1, Cyclic Load Monitoring (the new Fatigue Monitoring Program) used to manage fatigue-induced cracking or cumulative fatigue damage in fatigue or cycle-based TLAAs.
Section 4.2.2.1.2 Upper Shelf Energy (Acceptance Criteria) This includes changes to Subsections 4.2.2.1.2.1, 4.2.2.1.2.2, and 4.2.2.1.2.3, which provide the basis for accepting these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). Section 4.2.3.1.2 Review Procedures This includes changes to Subsections 4.2.3.1.2.1, 4.2.3.1.2.2, and 4.2.3.1.2.3, which provide the review procedures for	Changes to Section 4.2.2.1.2 and its Subsections and Section 4.2.3.1.2 and its Subsections. These sections (as renumbered in the SRP-SLR Report), including the stated subsections in the "Location of Change" column continue to provide the staff's acceptance criteria and review procedures for RPV upper shelf energy (USE) analyses that qualify as TLAAs in accordance with the criteria in 10 CFR 54.3(a) and need to be identified and evaluated in accordance with 10 CFR 54.21(c)(1). The staff only made administrative edits of the previous versions of these sections in NUREG–1800, Revision 2, including administrative renumbering of the sections on USE. Section numbers for sections identified in the "Location of Change" column entry are based on the current numbering scheme in SRP-SLR Chapter 4.2.	The sections continue to provide appropriate guidance for dispositioning these types of TLAAs in accordance with the requirements in 10 CFR 54.21(c)(1)(i), (ii), or (iii). The guidelines continue to include appropriate references and discussions on how these types of analyses are performed in accordance with the requirements for USE evaluations in Section IV.A.1 of 10 CFR Part 50, Appendix G, including those requirements for performing supplemental equivalent margins analyses when the projected values of USE cannot be demonstrated to be in compliance with the acceptance criteria for USE values stated in the rule. The staff made administrative edits to improve the grammar, clarity, and formatting of these sections.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
evaluating these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).		
Section 4.2.2.1.3 Pressurized Thermal Shock (Acceptance Criteria) This includes changes to Subsections 4.2.2.1.3.1, 4.2.2.1.3.2, and 4.2.2.1.3.3, which provide the basis for accepting these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). Section 4.2.3.1.3 Pressurized Thermal Shock (Review Procedures) This includes changes to Subsections 4.2.3.1.3.1, 4.2.3.1.3.2, and 4.2.3.1.3.3, which provide the review procedures for evaluating these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).	Changes to Section 4.2.2.1.3 and its Subsections and Section 4.2.3.1.3 and its Subsections These sections continue to provide the staff's acceptance criteria and review procedures for pressurized water reactor (PWR) pressurized thermal shock (PTS) analyses that qualify as TLAAs in accordance with the criteria in 10 CFR 54.3(a) and need to be identified and evaluated in accordance with 10 CFR 54.21(c)(1). In addition to minor administrative edits to the previous versions of these sections in NUREG–1800, Revision 2, the staff amended the sections to acknowledge that some PWR current licensing bases may have PTS analyses that are based on the alternative PTS requirements in 10 CFR 50.61a. Section numbers for sections identified in the "Location of Change" column entry are based on the current numbering scheme in SRP-SLR Chapter 4.2.	The sections continue to provide appropriate guidance for dispositioning these types of TLAAs in accordance with the requirements in 10 CFR 54.21(c)(1)(i), (ii), or (iii). However, the Commission's final approval of the alternative PTS rule in 10 CFR 50.61a was issued in the Federal Register (75 FR 23, as amended later in 75 FR 5495, 75 FR 10411, and 75 FR 72653) on January 4, 2010. The approval of the alternative PTS rule was done prior to the staff's approval of previous guidelines in NUREG–1800, Revision 2. The staff's amendment of Sections 4.2.2.1.3 and 4.2.3.1.3, and their subsections, which now reference 10 CFR 50.61a requirements, brings the sections up to date with current PTS requirements, which are either those in 10 CFR 50.61 or 10 CFR 50.61a. The PTS rule that will be followed for a subsequent period of extended operation will depend on the applicant's CLB for its PWR facility.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
Section 4.2.2.1.4 Pressure-Temperature (P-T) Limits (Acceptance Criteria) This includes changes to Subsections 4.2.2.1.4.1, 4.2.2.1.4.2, and 4.2.2.1.4.3, which provide the basis for accepting these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii). Section 4.2.3.1.4 Pressure-Temperature (P-T) Limits (Review Procedures) This includes changes to Subsections 4.2.3.1.4.1, 4.2.3.1.4.2, and 4.2.3.1.4.3, which provide the review procedures for evaluating these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), or (iii).	Changes to Section 4.2.2.1.4 and its Subsections and Section 4.2.3.1.4 and its Subsections These sections continue to provide the staff's acceptance criteria and review procedures for PWR (P-T limit) analyses that qualify as TLAAs in accordance with the criteria in 10 CFR 54.3(a) and need to be identified and evaluated in accordance with 10 CFR 54.21(c)(1). In addition to minor administrative edits to the previous versions of these sections in NUREG–1800, Revision 2, the staff amended the sections to provide guidance to better define how these types of TLAAs would be accepted in accordance with the requirements in 10 CFR 54.21(c)(1(i), (ii), or (iii), plant technical specifications, and the regulatory requirements in Section IV.A.2 of 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements." Section numbers for sections identified in the "Location of Change" column entry are based on the current numbering scheme in SRP-SLR Chapter 4.2.	The sections continue to provide appropriate guidance for dispositioning TLAAs on P-T limits in accordance with the requirements in 10 CFR 54.21(c)(1)(i), (ii), or (iii). The guidelines continue to include appropriate references and discussions on how these types of analyses are performed in accordance the requirements for P-T limit evaluations in Section IV.A.2 of 10 CFR Part 50, Appendix G. The staff made administrative edits to improve the grammar, clarity, and formatting of these sections. Additional changes were made to these sections that were directed at providing improved regulatory clarifications and discussions on how these type of TLAAs would be accepted under the criteria of 10 CFR 54.21(c)(1)(i), (ii), or (iii), which depend on whether the P-T limit curves are controlled and located by applicable provisions in the Limiting Conditions of Operations (LCOs) of the plant's Technical Specifications (TS) or by a pressure-temperature limits report (PTLR) process that is controlled in accordance with the Administrative Controls Section requirements of the plant's TS. For licensing bases that include the P-T limit curves in the TS LCOs, the guidance includes discussions reminding applicants that updates of the P-T limits must be submitted as a 10 CFR 50.90 license amendment request. If the P-T limits are being updated as part of the license renewal application (LRA) in accordance with 10 CFR 54.21(c)(1)(ii), the TS change request should be contained in a LRA to be processed (as a license amendment request) pursuant to the requirements of 10 CFR 54.22.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
		For licensing bases that perform updates of the P-T limits using an approved PTLR process, the updates of the P-T limit curves are done in accordance with the TS Administrative Controls Section requirements for implementing the PTLR process. This basis is consistent with the NRC's position stated in Generic Letter (GL) No. 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," which was issued on January 31, 1996, and is available at the following address on the world-wide-web: http://www.nrc.gov/reading-rm/doc-collections/gen-comm/gen-letters/1996/gl96003.html GL No. 96-03 includes the NRC's position that: (a) proposed changes to a previously NRC-approved methodology for calculating P-T limit curves and PWR low temperature overpressure protection (LTOP) system setpoints, as referenced in the TS Administrative Controls Section governing the PTLR process must be submitted and approved as a facility license amendment, and (b) process requirements in 10 CFR 50.59 do not apply to such methodology changes. Examples of licensing basis or design basis changes that may result in the need for license amendments of the previously approved PTLR methodologies referenced in the TS may include (but are not limited to):

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
		• application of ASME Code, Section XI repair/replacement criteria or ASME Code, Section XI Code Cases that result in changes to minimum temperature requirements for the RPV or lowest service temperature requirements for operating the reactor, • exemptions granted from 10 CFR Part 50, Appendix G or H requirements since the time of the PTLR license amendment approval that are different from those stated in TS-approved PTLR methodology for meeting such requirements, or • vendor changes to the approved methodologies referenced in the plant-specific TS made after the license amendment approval of the PTLR process. P-T limit related technical specification task force (TSTF) criteria may apply, depending of the licensing basis for the facility.
Section 4.2.2.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspections (Acceptance Criteria) Section 4.2.3.1.5 Elimination of Boiling Water Reactor Circumferential Weld Inspections (Review Procedures) NOTE: These TLAAs relate to EPRI BWRVIP	Changes to Sections 4.2.2.1.5 and 4.2.3.1.5 The staff changed these sections to state that TLAAs associated with probability of failure (PoF) and mean adjusted reference temperature (mean RT_{NDT}) analyses used to justify 10 CFR 50.55a relief for boiling water reactor (BWR) RPV circumferential weld inspections will be reviewed on a case-by-case basis.	The PoF and mean RT_{NDT} analyses for BWR RPV circumferential welds in the BWRVIP-05 report were based on the limiting RPV inside neutron fluence projected for the welds through 80 years operations at an assumed 80 percent capacity factor for full power operations (i.e., for 64 effective full-power year (EFPY). Since the NRC's approval of the BWRVIP-05 guidelines, many license renewal applicants have indicated that the cumulative capacity factors for full power operations are higher than 80 percent. However, the BWRVIP-05 guidelines have yet to be updated for 80 year fluence projections at the high capacity factors experienced by licensees in the U.S. BWR nuclear power industry. Therefore, the staff

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
probability of failure (PoF) and mean RT_{NDT} analyses that are used by licensees owning BWR plants to request NRC approval of 10 CFR 50.55a relief requests for eliminating inservice inspections of BWR RPV circumferential welds. The methods for performing these analyses are given in Proprietary EPRI Report No. TR-105697, "BWR Vessel, and Internals Project [BWRVIP], BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations (BWRVIP-05)," which was approved by in a NRC safety evaluation dated July 28, 1998. Under the BWRVIP methods, several criteria must be met by a BWR licensee to justify submittal of relief requests for BWR RPV circumferential welds under the requirements in 10 CFR 50.55a, Paragraph §(a)(3): (a) PoF and mean RT_{NDT} analyses would need to be performed for both BWR RPV circumferential welds and		have amended the acceptance bases in SRP-SLR Section 4.2.2.1.5 and review procedure bases in SRP-SLR Section 4.2.3.1.5 to indicate that any BWRVIP-05 related TLAAs that apply to the CLBs for BWR circumferential weld inspections will be reviewed on a case-by-case basis.

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
for BWR RPV axial welds, (b) the mean RT_{NDT} and PoF analysis results for the BWR axial welds would have to be demonstrated to be greater than those for the BWR RPV circumferential welds by an order of magnitude of 102 - 103, and (c) mean RT_{NDT} values for both the BWR RPV circumferential welds and axial welds would have to be bounded by those approved to the limiting case studies in the BWRVIP-05 report.		
Section 4.2.2.1.6 BWR Axial Welds (Acceptance Criteria) Section 4.2.3.1.6 BWR Axial Welds (Review Procedures) NOTE: The note given in the “Location of Change” entry for Sections 4.2.2.1.5 and 4.2.3.1.5 also applies to SRP-SLR Sections 4.2.2.1.6 and 4.2.3.1.6. Updated PoF and mean RT_{NDT} analyses for BWR RPV axial welds were provided in a supplement to the BWRVIP-05 report	Changes to Sections 4.2.2.1.6 and 4.2.3.1.6. The staff changed these sections to state that TLAAs associated with PoF and mean adjusted reference temperature (mean RT_{NDT}) analyses for BWR RPV axial weld inspections will be reviewed on a case-by-case basis.	The PoF and mean RT_{NDT} analyses for BWR RPV axial welds in the BWRVIP-05 report were based on limiting RPV inside neutron fluence projected for the welds through 80 years operations at an assumed 80 percent capacity factor for full power operations (i.e., for 64 EFPY). Since the NRC’s approval of the BWRVIP-05 guidelines, many license renewal applicant have indicated that the cumulative capacity factors for full power operations are higher than 80 percent. However, the BWRVIP-05 guidelines have yet to be updated for 80-year fluence projections at the higher capacity factors experienced by BWR reactors in the U.S. nuclear power industry. Therefore, the staff have amended the acceptance bases in SRP-SLR Section 4.2.2.1.5 and review procedure bases in SRP-SLR Section 4.2.3.1.5 to

Table 3-10 SRP-SLR Chapter 4.2 (Neutron Irradiation Embrittlement) Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
SRP-SLR Section 4.2: Reactor Pressure Vessel Neutron Embrittlement Analysis		
dated December 15, 1998, and were approved in a supplemental NRC safety evaluation dated March 7, 2000.		indicate that any BWRVIP-05 related TLAAs for that apply to the CLBs for BWR RPV axial welds will be reviewed by the staff on a case-by-case basis.
Section 4.2.2.2 Final Safety Analysis Report Supplement (Acceptance Criteria) Section 4.2.3.2 Final Safety Analysis Report Supplement (Review Procedures)	Changes to Sections 4.2.2.2 and 4.2.3.2 For the GALL-SLR/SRP-SLR update, the staff continued its practice of including aging management review (AMR) acceptance criteria and review procedure sections for updated final safety analysis report (UFSAR), updated safety analysis report (USAR), or Final Safety Analysis Report (FSAR) Supplement summary description sections that apply to AMPs and TLAAs, as required to be included in LRAs by the requirement in 10 CFR 54.21(c)(1) The staff only made administrative edits of the previous guidelines provided in Sections 4.2.2.2 and 4.2.3.2 of NUREG–1800, Revision 2.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.2.4 Evaluation Findings	The staff only made administrative changes to the previous section provided in NUREG–1800, Revision 2.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.2.5 Implementation	The staff only made administrative changes to the previous section provided in NUREG–1800, Revision 2.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.2.6 References	The staff administratively updated the references in Section 4.2.6 from those previously given Section 4.2.6 of NUREG–1800, Revision 2.	The staff updated the references to include applicable references from past LRA reviews of AMRs, AMPs, and TLAAs performed by the NRC staff.
Table 4.2-1 Examples of FSAR Supplement for Reactor Vessel Neutron Embrittlement Analyses	The staff made administrative edits of the previous versions of the FSAR Supplement examples for these TLAAs that were previously provided in Table 4.2-1 of NUREG–1800, Revision 2.	The administrative changes to the FSAR supplement examples in the table are consistent with changes or clarifications made in SRP-SLR Section 4.2 or its subsections.

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Overview of changes	For the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) update, the NRC made a major overhaul of the version of SRP-SLR Section 4.3, Metal Fatigue, as previously written in Section 4.3 of NUREG–1800, Revision 2, in order to be consistent with those types of time-limited aging analysis (TLAAs) that were identified in past license renewal applications (LRAs) as cycle-based analyses involving design transient assumptions. The major change was to redefine these types of analyses as fatigue parameter evaluations and to group them into one of two general categories: (a) cycle-based analyses that do not involve environmental adjustment assessments (i.e., TLAAs not involving CUF_{en} calculations), and (b) cycle-based analyses that involve environmental adjustment assessments (i.e., TLAAs that involve CUF_{en} calculations) The staff then renumbered and reformatted the acceptance criteria and review procedure guidance sections accordingly, and developed the updated criteria based on past applicant practices that were generic to these types of fatigue parameter analysis categories and that were commonly accepted by the staff in the safety evaluation reports that were issued on the past LRAs. Non-CUF_{en} fatigue parameter analyses covered by the updated guidelines now include: (a) design basis cumulative usage factor (CUF) or I_t analyses, (b) fatigue waiver analyses involving cyclic loadings, (c) maximum allowable stress range reduction analyses/expansion stress analyses for American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 2 and 3 components or United States of American Standard (USAS) American National Standards Institute (ANSI) B31.1 components, (d) flaw growth analyses involving cyclic loading assumptions, and (e) flaw tolerance or fracture mechanics analyses involving cyclic loadings assumptions.	The staff's rewrite of SRP-SLR Section 4.3, and its subsections was done to update acceptance criteria and review procedure guidance consistent with past LRA practices, especially for LRAs that were accepting these types of TLAAs using the criterion in 10 CFR 54.21(c)(1)(iii), and where an AMP correlating to GALL AMP X.M1, "Fatigue Monitoring," is used as the basis for accepting the TLAA in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii). Specifically, in NUREG–1800, Revision 2, the scope of AMP X.M1 was limited only to those fatigue parameter evaluations involving design basis cumulative usage factor (CUF or I_t) calculations or metal fatigue analyses for environmentally-assisted fatigue (i.e. $CUF_{en)}$ analyses. Many past applicants had extended use of this AMP to other types of fatigue parameter analyses, such as fatigue waiver analyses or cycle-based flaw growth, flow tolerance, or fracture mechanics analyses, without identifying the appropriate exceptions to the GALL Report. This resulted in numerous administrative requests for additional information during the staff's previous reviews of those LRAs. In a related action, the staff amended GALL-SLR AMP X.M1, "Fatigue Monitoring," to extend the scope of the AMP to all types of fatigue parameter analyses that are defined in the rewrite of SRP-SLR Section 4.3. The changes will permit SLRA applicants to credit their Fatigue Monitoring Programs as the basis for monitoring all types of fatigue analyses defined in SRP-SLR Chapter 4.3 and for demonstrating acceptance of the TLAAs under 10 CFR 54.21(c)(1)(iii), without having to identify the type of administrative exception that had previously been needed for some past license

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		renewal applicants. The intent is to reduce the number of RAIs that may need to be issued relative to these types of TLAAs or to the use of an applicant's Fatigue Monitoring Program in relation to these TLAAs.
Review Responsibilities Section	The staff only made administrative edits of the previous version of this section in NUREG–1800, Revision 2.	The staff made administrative edits to improve the grammar, clarity, and formatting of the section.
Section 4.3.1, Areas of Review	The staff rewrote the "Areas of Review" sections consistent with changes described in the "overview" of changes. Specifically, the staff also updated the section to provide an improved discussion of the types of design codes or standards that may to these analyses. The staff updated also this section to define the types fatigue parameter analyses that may qualify as TLAAs, including: (a) cyclic loading analyses including cumulative usage factor or I_t calculations and fatigue waiver analyses involving cyclic loading assumptions, (b) cyclic loading analyses involving maximum allowable stress range reduction calculations (i.e., expansion stress analyses for ASME Code Class 2 or 3 or USAS ANSI B3.1.1 components), (c) usage factor calculations that involve evaluation of environmental effects (CUF_{en} analyses), and (d) flaw growth, flaw tolerance, or fracture mechanics analyses involving cyclic loading assumptions.	The changes to the "Areas of Review" are intended to provide a more consistent basis for identifying those types of cyclic loading analyses that may need to be identified as TLAAs for Section 4.3 of a subsequent license renewal application. The types of metal fatigue or cyclic loading analyses that may qualify as potential TLAAs in a subsequent license renewal application are consistent with those identified in past LRAs.
Section 4.3.2, Acceptance Criteria, and Subsection 4.3.2.1, Time-Limited Aging Analyses Section 4.3.3, Review Procedures, and Subsection 4.3.3.1,	<u>Changes to Sections 4.3.2. and 4.3.3</u> The staff only made administrative changes to the previous sections provided in NUREG–1800, Revision 2. The final versions of these sections are given in the "Technical Bases for Changes" column entry for this line item.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections and to be consistent with the types of changes made for the rewriting and reformatting of Section 4.3, as discussed in the overview.

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Time-Limited Aging Analyses		
Section 4.3.2.1.1 including Subsections 4.3.2.1.1.1, 4.3.2.1.1.2, and 4.3.2.1.1.3, Components Evaluated for Fatigue Parameters Other Than CUF_{en} (Acceptance Criteria) Section 4.3.3.1.1, Including Subsections 4.3.3.1.1.1, 4.3.3.1.1.2, and 4.3.3.1.1.3, Components Evaluated for Fatigue Parameters Other Than CUF_{en} (Review Procedures)	The staff rewrote the acceptance criteria and review procedures for accepting and reviewing those cyclic loading TLAAs that do not involve environmental-fatigue adjustment factors (i.e., cyclic loading TLAAs not involving CUF_{en}). The changes include amended criteria for accepting and reviewing the following types of fatigue analyses under 10 CFR 54.21(c)(1)(i), (ii), or (iii): (a) design basis metal fatigue analyses involving usage factor calculations (i.e., CUF or I_t analyses), (b) fatigue waiver analyses involving cyclic loading assumptions, (c) maximum allowable stress range calculation analyses (i.e., expansion stress analyses) for ASME Code Class 2 and 3 components or USAS ANSI B31.1 components, and (d) fatigue flaw growth, flaw tolerance of fracture mechanics analyses that are based on cyclic loading assumptions. The final versions of these sections are given in the "Technical Bases for Changes" column entry for this line item.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections and to be consistent with the types of changes made for the rewriting and reformatting of Section 4.3, as discussed in the overview. SRP-SLR Section 4.3.2.1.1, as included in the final NUREG–2192 report, now states: *"For metal components evaluated for fatigue parameters other than CUF_{en}, the acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:"* SRP-SLR Section 4.3.3.1.1, as included in the final NUREG–2192 report, now states: *"For metal components evaluated for fatigue parameters other than CUF_{en}, the review procedures, depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii), and are as follows:"*
Sections 4.3.2.1.1.1 and 4.3.3.1.1.1 – 10 CFR 54.21(c)(1)(i)	The staff administratively edited the previous versions of these sections to clarify that verifications of the existing analyses of record are to include both a review of both the number of accumulated cycles and the assumed severity for each of the cyclic loadings evaluated in the previous evaluations calculations are not projected to exceed the limits evaluated for these loadings. The new section also states that revised cycle projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The final versions of these sections are given in the "Technical Bases for Changes" column entry for this line item.	The criterion in 10 CFR 54.21(c)(1)(i) requires demonstration that the previous analysis of record for the current licensing basis (CLB) or current design basis will remain valid for the subsequent period of extended operation. The staff determined that, for acceptance under the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(i), both a check of the accumulated number of transient cycles and the severity of the past design transient occurrences would need to be performed to ensure that the past analyses would remain valid for the subsequent period of extended operations.

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Location of Change	Summary of the Change	Technical Basis for Change
		The acceptance criteria in SRP-SLR Section 4.3.2.1.1.1, as included in the final NUREG–2192 report, now state: *"The existing fatigue parameter calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles and the assumed severity of each of the cyclic loadings evaluated in the calculations are not projected to exceed the limits evaluated for these loadings. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation."* The review procedures in SRP-SLR Section 4.3.3.1.1.1, as included in the final NUREG–2192, now state: *"The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations is reviewed for the current operating term to ensure that the projected number of transient occurrences during the subsequent period of extended operation will not exceed the assumed number of transient occurrences in the existing fatigue parameter calculations. The projected number of occurrences for each transient is verified to be consistent with historical plant operating characteristics and anticipated future operation. In addition, a comparison of the operating cyclic load severity to the severity for each transient assumed in the existing fatigue parameter calculations is made to demonstrate that the cyclic load severity for each transient used in the fatigue parameter calculations remains bounding. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and current licensing basis (CLB) information."*

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Location of Change	Summary of the Change	Technical Basis for Change
Sections 4.3.2.1.1.2 and 4.3.3.1.1,2 – 10 CFR 54.21(c)(1)(ii)	The staff administratively rewrote the previous versions of these sections to provide the bases for projecting all types of non-CUF_{en} fatigue parameter analyses to the end of the subsequent period of extended operation. The final versions of these sections are given in the "Technical Bases for Changes" column entry for this line item.	The staff's rewrite of the previous acceptance criteria and review procedure guidelines do not change the staff's previous technical bases for accepting non-CUF_{en} types of fatigue analyses in accordance with 10 CFR 54.21(c)(1)(ii) and projecting the analyses to the end of the subsequent period of extended operation. However, the updated guidelines will allow subsequent license renewal applicants to apply the guidelines to all types of non-CUF_{en} fatigue parameter analyses that have been previously identified as non-CUF_{en} fatigue parameter analyses in past LRAs. The acceptance criteria in SRP-SLR Section 4.3.2.1.1, Subsection 2, as included in the final NUREG–2192, now state: *"The fatigue parameter calculations are revised and shown to remain acceptable throughout the end of the subsequent period of extended operation based on a revised projection of the cumulative number and assumed severity of each of the cyclic loadings to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting fatigue parameter values are verified to remain less than or equal to their respective allowable value for the subsequent period of extended operation."* The review procedures in SRP-SLR Section 4.3.3.1.1, Subsection 2, as included in the final NUREG–2192, now state:

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Location of Change	Summary of the Change	Technical Basis for Change
		"The operating cyclic load experience is reviewed to ensure that the increased number of cyclic load occurrences and their severity for each transient used for any re-analysis remain within the number of transient occurrences and severity for each transient projected to the end of the subsequent period of extended operation. The revised fatigue parameter calculations are reviewed to ensure that the fatigue parameter remains less than or equal to the allowed value at the end of the subsequent period of extended operation. The revised fatigue parameter calculations are shown to remain acceptable based on revised projections of the cumulative number of occurrences and the assumed severity of each transient to the end of the subsequent period of extended operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. For consistency purposes, the review also includes an assessment of the TLAA information against relevant design basis information and CLB information."
Sections 4.3.2.1.1.3 and 4.3.3.1.1.3 – 10 CFR 54.21(c)(1)(iii)	The staff rewrote the previous versions of these sections to provide the bases for accepting non-CUF_{en} types of fatigue parameter analyses in accordance with 10 CFR 54.21(c)(1)(iii) and using an aging management program or activities to ensure the effects of fatigue-induced cracking or cumulative fatigue damage will be adequately managed during the subsequent period of extended operation. The updated guidelines include provisions for using GALL-SLR AMP X.M1 or a plant-specific AMP to manage non-CUF_{en} types of fatigue parameter analyses. These sections have been revised to include criteria for use of an inspection-based AMP as the basis for managing fatigue-induced cracking or cumulative fatigue damage.	The updated guidelines now allow an AMP corresponding to GALL-SLR AMP X.M1, "Fatigue Monitoring," to be applied to all types of non-CUF_{en} analyses that may be identified as a TLAA in subsequent license renewal application and to use this as the basis for accepting these types of TLAAs under 10 CFR 54.12(c)(1)(iii), such that the impacts of cumulative fatigue damage or cracking due to fatigue or cyclical loading on the intended functions of the components will be adequately managed during the subsequent period of extended operation. The guidelines have also been updated to include new criteria for accepting these types of TLAA under 10 CFR 54.21(c)(1)(iii) using AMPs or aging management activities other than those given in GALL-SLR AMP X.M1, "Fatigue Monitoring."

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Location of Change	Summary of the Change	Technical Basis for Change
		The first of these additional criteria establishes that, if a plant-specific AMP is proposed as the basis for aging management of fatigue-induced cracking or cumulative fatigue damage, the AMP should be defined in terms of the 10 program elements defined in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Appendix A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10. The second of these additional criteria establishes that, if an inspection-based AMP is used as the basis for managing fatigue-induced cracking or cumulative fatigue damage, the applicant should ensure that: (a) the applicant will be performing actual inspections of the specific components that have been evaluated in the fatigue parameter evaluations during the subsequent period of extended operation, and (b) the applicant has justified that the inspection methods and frequencies applied to the component(s) are sufficient to detect cracking in the components, such that they may be used to demonstrate that, consistent with the requirement in 10 CFR 54.21(c)(1)(iii), the impacts of cumulative fatigue damage or cracking due to fatigue on the intended function of the components will be adequately managed during the subsequent period of extended operation. The updated guidelines are consistent with past aging management bases that have been proposed to accept non-CUF_{en} fatigue parameter analyses in past LRAs using the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(iii) and to manage the impacts of cumulative fatigue damage or fatigue-induced or

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		cyclic loading-induced cracking on the intended functions of plant components in these types of analyses. The acceptance criteria in SRP-SLR Section 4.3.2.1.1.3, as included in the final NUREG–2192 report, now state: “*The applicant proposes an aging management program (AMP) as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluations will be adequately managed during the subsequent period of extended operation. The AMP in Section X.M1, “Fatigue Monitoring,” of the Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report provides one method that may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).* *An applicant may also propose another AMP to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If the basis for aging management is a plant-specific AMP, the AMP is described in terms of the 10 program elements defined in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Appendix A.1, “Branch Technical Position, Aging Management Review—Generic,” Sections A.1.2.3.1 through A.1.2.3.10.* *If an inspection program is proposed as the basis for aging management, the applicant should ensure that: (a) inspections will be performed for the specific component(s) or structure(s) in the evaluation and (b) applicant has justified that the*

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Location of Change	Summary of the Change	Technical Basis for Change
		inspection methods and frequencies in the proposed inspection program are applicable to the component(s), such that they may be used to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii).” The review procedures in SRP-SLR Section 4.3.3.1.1.3, as included in the final NUREG–2192, now state: “*Pursuant to 10 CFR 54.21(c)(1)(iii), the applicant proposes an AMP or aging management activities as the basis for demonstrating that the effect or effects of aging on the intended function(s) of the structure(s) or component(s) in the fatigue parameter evaluation will be adequately managed during the subsequent period of extended operation. If Section X.M1, “Fatigue Monitoring,” of the GALL-SLR Report is used as the basis for managing cumulative fatigue damage or cracking due to fatigue or cyclical loading in the structure(s) or component(s), the reviewer reviews the applicant’s AMP against the program elements defined in GALL-SLR Report Section X.M1.* *An applicant also has the option of proposing another GALL-based AMP, a plant-specific AMP, or plant-specific activities, or combination of, to demonstrate compliance with the requirement in 10 CFR 54.21(c)(1)(iii). If another GALL-based AMP is proposed as the basis for aging management, the reviewer reviews the applicant’s AMP against the program element criteria defined in the applicable AMP section in Chapter XI of the GALL-SLR Report. If the basis for aging management is a plant-specific AMP or plant-specific aging management activities, the reviewer reviews the program element criteria for the AMP or*

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Location of Change	Summary of the Change	Technical Basis for Change
		activities against the program element criteria defined in this SRP-SLR, Appendix A.1, "Branch Technical Position, Aging Management Review—Generic," Sections A.1.2.3.1 through A.1.2.3.10. *If a sampling based inspection program (a type of condition monitoring program) is proposed as the basis for aging management, the reviewer ensures that the AMP actually performs inspections of the specific component(s) or structure(s) in the evaluation at each unit in a multiunit site and that the applicant has appropriately justified that the inspection methods and associated frequencies are capable of managing cumulative fatigue damage or cracking by fatigue or cyclical loading in the component(s) or structure(s), such that the TLAA may be accepted in accordance with 10 CFR 54.21(c)(1)(iii).*"
Section 4.3.2.1.2, Including Subsections 4.3.2.1.2.1, 4.3.2.1.2.2, and 4.3.2.1.2.3, Components Evaluated for CUF_{en} (Acceptance Criteria) Section 4.3.3.1.2, Including Subsections 4.3.3.1.2.1, 4.3.3.1.2.2, and 4.3.3.1.2.3, Components Evaluated for CUF_{en} (Review Procedures)	The previous acceptance criteria and review procedures that were given in Sections 4.3.2.1.2 and 4.3.3.1.2 (and their subsections) of NUREG–1800, Revision 2, and apply to the evaluation of maximum allowable stress calculations analyses (i.e., expansion stress analyses) for ASME Code Class 2 and 3 components or USAS ANSI B31.1 components, have been revised and incorporated into the revisions to SRP-SLR Sections 4.3.2.1.1 and 4.3.3.1.1, and their subsections. The previous acceptance criteria and review procedures that were given in Sections 4.3.2.1.3 and 4.3.3.1.3 (and their subsections) of NUREG–1800, Revision 2, and apply to the evaluation of environmentally-assisted fatigue analyses for ASME Code Class 1 components, have been revised, numerically reformatted, and incorporated into the revisions to SRP-SLR Sections 4.3.2.1.2 and 4.3.3.1.2, and their subsections. The updated and numerically reformatted sections have been technically revised to reference the new technical positions for	The sections were revised to reference the most typical positions that have been used in Revision 1 of RG 1. 207y. The staff also made the administrative edits to improve the grammar, clarity, and formatting of the sections and to be consistent with the types of changes made for the rewriting and reformatting of Section 4.3, as discussed in the overview. The staff determined that wording in SRP-SLR Sections 4.3.2.1.2 and 4.3.3.1.2 for environmentally-assisted fatigue calculations (i.e., CUF_{en} value calculations for Class 1 reactor coolant pressure boundary components) might be overly restrictive. The staff determined that subsequent renewal applicants may not need to use NUREG–6260 for component selection if more limiting components in the RCPB were evaluated for CUF_{en} in the CLB. The staff also agreed that the methodology for performing the CUF_{en} calculations for these

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Location of Change	Summary of the Change	Technical Basis for Change
	performance of environmentally-assisted fatigue analyses (i.e., CUF_{en} analyses) stated in Regulatory Guide (RG) 1.207, Revision 1, "Guidelines for Evaluating the Effects of Light-Water Reactor Coolant Environments in Fatigue Analyses of Metal Components." The RG identifies the NUREG reports that may be applied to these types of analyses. The staff amended Sections 4.3.2.1.2 and 4.3.3.1.2, and their subsections, to provide additional clarifications on use of NUREG–6260 or alternative bases for selecting the Class 1 reactor coolant pressure boundary components that will be the subject of environmentally-assisted fatigue calculations. The staff also provided improved clarifications on the specific NUREG reports or regulatory guide criteria that may be used as the methodologies for performing environmentally-assisted fatigue calculations.	components could be based on the use of earlier reports (i.e., NUREG–6583 for steel components in the RCPB or NUREG–5704 for stainless steel components in the RCPB) if that was the basis for past environmentally-assisted fatigue calculations (i.e., CUF_{en} calculations) in the CLB. The acceptance criteria in SRP-SLR Section 4.3.2.1.2, as included in the final NUREG–2192 report, now state: *For metal components evaluated for CUF_{en}, the acceptance criteria depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).* *Applicants should also include CUF_{en} calculations for additional component locations if they are considered to be more limiting than those previously evaluated. This sample set includes the locations identified in NUREG/CR–6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260. Plant-specific justification can be provided to demonstrate that calculations for the NUREG/CR–6260 locations do not need to be included. Environmental effects on fatigue for these critical components can be evaluated using the positions described in Regulatory Guide (RG) 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.*

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Location of Change	Summary of the Change	Technical Basis for Change
		Similarly, the review procedure criteria in SRP-SLR Section 4.3.3.1.2, as included in the final NUREG–2192 report, now state: "*For metal components evaluated for CUF_{en}, the review procedures depend on the applicant's choice of 10 CFR 54.21(c)(1)(i), (ii), or (iii).* *Applicants should include CUF_{en} calculations for the limiting component locations exposed to the reactor water environment. This sample set includes the locations identified in NUREG/CR–6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260. Plant-specific justification can be provided to demonstrate that calculations for the NUREG/CR–6260 locations do not need to be included. Environmental effects on fatigue for these critical components may be evaluated using the guidance in RG 1.207, Revision 1; 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.*" These revisions should address and resolve the industry's reservations on limiting the staff's environmentally-assisted fatigue calculation criteria only to those contained in the most recently issued NUREG reports or NRC regulatory guides for performing the calculations (i.e., NUREG–6909, Revision 1, or RG 1.207, Revision 1).
Sections 4.3.2.1.2.1, 4.3.3.1.2.1 – 10 CFR 54.21(c)(1)(i)	The staff took the past acceptance criteria in Section 4.3.2.1.3.1 and review procedures in Section 4.3.3.1.3.1 of NUREG–1800, Revision 2, and rewrote and renumbered them to provide the bases for verifying that the past CUF_{en} analyses of record would remain valid for the	The updated guidelines provide the types of technical verifications that the staff would expect to be done to verify and demonstrate that the existing environmentally-assisted fatigue analyses (i.e., CUF_{en} analyses) of record for the licensing

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Location of Change	Summary of the Change	Technical Basis for Change
	subsequent period of extended operation in accordance with 10 CFR 54.21(c)(1)(i). The updated guidelines call for verification that the number of cycles projected to the end of the subsequent period of extended operation for transients and the severity of past occurrence of these transients during past operations are bounded by the assumptions for transients, as defined in the CUF_{en} analyses of record. The guidelines also state that a comparison of the water chemistry conditions to those assumed in the existing environmental multiplier (F_{en}) calculations should be made to demonstrate that the water chemistry conditions used in the F_{en} calculations remain appropriate and that an assessment of the TLAA information against relevant design basis information and CLB information should be done. For stainless steel and nickel alloy materials, or any location where average temperature was used in the calculation, or where a constant F_{en} value of 1.49 was used for nickel alloy materials, the guidelines state that the verification that the methods have been updated to use the positions described in RG 1.207, Revision 1 under the provisions of 10 CFR 54.21(c)(1)(ii).	basis will remain valid during the subsequent period of extended operation, consistent with the previous basis for performing these types of calculations in the CLB. The updated regulatory position for performing environmentally-assisted fatigue analyses in RG 1.207, Revision 1, may be used to as part of bases for performing these types of verifications. The staff determined that the earlier NRC topical reports in NUREG/CR–6583 for carbon steel or stainless steel reactor coolant pressure boundary (RCPB) components or NUREG/CR–5704 for austenitic stainless steel RCPB components could be used for performing CUF_{en} calculations of these components, but only for the case when the prior calculations used for the initial period of extended operation were being demonstrated as being valid and acceptable for implementation during the subsequent period of extended operation under the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(i). The staff added the sentence below to the end of SRP-SLR Section 4.3.2.1.2.1 such that Section 4.3.2.1.2.1 now reads: "*The existing CUF_{en} calculations remain valid for the subsequent period of extended operation because the number of accumulated cycles, the assumed severity of the cyclic loadings, and the assumed water chemistry conditions evaluated in the calculations are not projected to exceed the limits evaluated for these ~~loading~~ parameters. The revised projections for the number of accumulated cycles are verified to be consistent with historical plant operating characteristics and anticipated future operation. A plant-specific justification can be provided to demonstrate that existing CUF_{en}*

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Location of Change	Summary of the Change	Technical Basis for Change
		calculations performed using guidance in Section 4.3.2.1.3 of NUREG–1800, Revision 2 will remain valid for the subsequent period of extended operation and are sufficiently conservative when compared to those CUF_{en} calculations that would be generated using the guidance in Regulatory Guide 1.207, Revision or in NUREG/CR–6909, Revision 0 (with "average temperature" used consistent with the clarification that was added to NUREG/CR–6909, Revision 1)." The staff also determined that the reference to "Section 4.3.1.2.3" in the second to last sentence of SRP-SLR Section 4.3.3.1.2.1 has transposed digits in the number and should be changed to Section 4.3.2.1.3. Therefore, the staff incorporated the editorial change to the referenced sentence such that SRP-SLR Section 4.3.3.1.2 now reads: "*The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations are reviewed for the current operating term to ensure that the number of assumed occurrences of each transient would not be exceeded during the subsequent period of extended operation. A comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient should be made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, a comparison of the water chemistry conditions to those assumed in the existing environmental multiplier (F_{en}) calculations should be made to demonstrate that the water chemistry conditions used in the F_{en} calculations remain appropriate. For consistency purposes, the review also includes an assessment of the TLAA information against*

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		relevant design basis information and CLB information. A plant-specific justification can be provided to demonstrate that the guidance in Section ~~4.3.1.2.3~~4.3.2.1.3 of NUREG–1800, Revision 2, is applicable to the existing CUF_{en} calculations. Considering the evaluations above, verify the existing CUF_{en} calculations remain valid for the subsequent period of extended operation."
Sections 4.3.2.1.2.2 and 4.3.3.1.2.2 – 10 CFR 54.21(c)(1)(ii)	The staff took the past acceptance criteria in Section 4.3.2.1.3.2 of NUREG–1800, Revision 2, and the review procedures in Section 4.3.3.1.3.2 of NUREG–1800, Revision 2, and rewrote and renumbered them to provide the bases for projecting the CUF_{en} analyses of record to the end of the subsequent period of extended operation, as performed to demonstrate compliance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii).	The updated guidelines provide the bases for updated the environmentally-assisted fatigue analyses (i.e., CUF_{en} analyses) to the end of the subsequent period of extended operation and that they will remain acceptable when evaluated against the acceptance criteria for these analyses, as defined in applicable Codes or Standard, NRC regulatory guides, or NRC-issued NUREG reports for environmentally-assisted fatigue calculations. The updated regulatory position for performing environmentally-assisted fatigue analyses in RG 1.207, Revision 1, may be used to as part of bases for performing these types of verifications. These changes reflect the staff's anticipation that, if an applicant was to update its CLB to perform 80-year CUF_{en} calculations for its limiting reactor coolant pressure boundary components under the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(ii), the criteria in RG 1.207, Revision 1 would be used for the updated CUF_{en} calculations that would be provided in the SLRA. Otherwise, the applicant would need to justify any alternative methodology for performing its updated, 80-year CUF_{en} calculations in the SLRA. Specifically, the acceptance criteria in SRP-SLR Section 4.3.2.1.2.2, as included in the final NUREG–2192 report, now state:

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Location of Change	Summary of the Change	Technical Basis for Change
		"The CUF_{en} calculations are revised and shown to remain acceptable throughout the subsequent period of extended operation based on a revised projection of the cumulative number of occurrences, the assumed severity of cyclic loadings, and the assumed water chemistry conditions to the end of the extended subsequent period of operation. The revised projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. The resulting CUF_{en} values are verified to remain less than or equal to unity for the subsequent period of extended operation. Specifically, the review procedure criteria in SRP-SLR Section 4.3.3.1.2.1, as included in the final NUREG–2192 report, now state: *"The operating cyclic load experience and a list of the assumed transients used in the existing fatigue parameter calculations is reviewed for the current operating term to ensure that the number of assumed occurrences for each transient are projected to the end of the subsequent period of extended operation. The reviewer verifies that a comparison of the operating cyclic load severity to the severity assumed in the existing fatigue parameter calculations for each transient has been made to demonstrate that the cyclic load severities used in the fatigue parameter calculations remain bounding. In addition, the reviewer verifies that a comparison of the water chemistry conditions to those assumed in the F_{en} calculations has been made to demonstrate that the water chemistry conditions used in the F_{en} calculations are appropriate. For consistency purposes, the review also includes an assessment of the TLAA*

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Location of Change	Summary of the Change	Technical Basis for Change
		information against relevant design basis information and CLB information. The review includes verification that the positions described in RG 1.207, Revision 1 are used for all component evaluations as a part of revising the calculations. *The Code of Record should be used for the reevaluation, or the applicant may update to a later Code edition pursuant to 10 CFR 50.55a using an appropriate Code reconciliation. In the latter case, the reviewer verifies that the requirements in 10 CFR 50.55a are met.*"
Sections 4.3.2.1.2.3 and 4.3.3.1.2.3 – 10 CFR 54.21(c)(1)(iii)	The staff changed these sections to provide the bases for accepting CUF_{en} analyses in accordance with 10 CFR 54.21(c)(1)(iii) by using an aging management program or activities to ensure the effects of fatigue-induced cracking or cumulative fatigue damage will be adequately managed during the subsequent period of extended operation. The updated guidelines include provisions for using GALL-SLR AMP X.M1 or a plant-specific AMP to manage CUF_{en} analyses. These sections have been revised to include criteria for use of an inspection-based AMP as the basis for managing fatigue-induced cracking or cumulative fatigue damage.	The changes to these sections provide additional alternatives for applications to manage their CUF_{en} analyses in ways that are technically acceptable and in accordance with 10 CFR 54.21(c)(1)(iii). The added provisions for plant-specific AMPS with 10 program elements in accordance with the guidance of Appendix A.1 of SRP-SLR ensure that such programs will be properly defined with all necessary information. For applicants who choose to use an inspection-based AMP, the provisions to perform inspections of the specific components to be managed, and the use of justified inspection methods ensure that the components included will be adequately age managed by the proposed inspection methods. The updated guidelines are also consistent with past aging management bases that have been proposed to accept CUF_{en} analyses in past LRAs in accordance with 10 CFR 54.21(c)(1)(iii).
Section 4.3.2.2, Final Safety Analysis Report Supplement (Acceptance Criteria)	The staff made administrative edits.	The staff made administrative edits to improve the grammar, clarity, and formatting of the sections. The scope of the statement in SRP-SLR Section 4.3.2.2 should not have been limited to acceptance

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 4.3.3.2, Final Safety Analysis Report Supplement (Review Procedures)		of the TLAAs under 10 CFR 54.21(c)(1)(ii), and instead should have been broader to discuss acceptance of the TLAAs under either 10 CFR 54.21(c)(1)(i), (ii), or (iii). Thus, the staff decided that an editorial change to SRP-SLR Section 4.3.2.2 was needed. The staff amended SRP-SLR Section 4.3.2.2 such that it now reads: *"The specific criterion for meeting 10 CFR 54.21(d) is that the summary description of the evaluation of TLAAs for the subsequent period of operation in the FSAR Supplement is sufficiently comprehensive, such that later changes can be controlled by 10 CFR 50.59. The description should contain sufficient information such as source of the data, references to the methodology used, and parameters used. The basis for demonstrating acceptance of the TLAA under 10 CFR 54.21(c)(1)(i), (ii), or (iii) should be included in the FSAR supplement summary description for the TLAA and demonstrated in the SLRA."*
Section 4.3.4, Evaluation Findings	The staff made administrative changes.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Section 4.3.5, Implementation	The staff made administrative changes. The staff determined that the draft "Implementation" section in SRP-SLR Section 4.3.5 was not appropriate for inclusion in SRP-SLR 4.3. Therefore, the staff deleted Section 4.3.5, "Implementation," from the scope of Chapter 4.1 in the finalized version of the SRP-SLR report.	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections. The staff determined that such alternative basis criteria do not have any relevancy to an applicant's bases for identifying fatigue or cyclical loading TLAAs under the requirements of 10 CFR 54.21(c)(1) and the criteria for identifying analyses, calculations, or evaluations as TLAAs under the TLAA identification criteria in 10 CFR 54.3(a). However, the staff deleted Section 4.3.5, "Implementation," from the scope of the Section 4.3 in the SRP-SLR report (NUREG–2192) because the

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		implementation criteria in the report really pertain to the implementation of AMPs and TLAAs once an LRA has been approved. Since Chapter 4.3 deals with the need for identifying fatigue-related TLAAs or cyclical loading TLAAs in an LRA, an implementation section is not appropriate Chapter 4.3 of the SRP-SLR. Hence, upon the deletion of Section 4.3.5, “Implementation” from the scope of SRP-SLR Chapter 4.3, SRP-SLR Section 4.3.5 has been reformatted to contain the reference section and references for Chapter 4.3.
Section 4.3.6, References	The staff administratively updated the references in Section 4.3.6. The reference section has been renumbered to 4.3.5.	The staff update includes applicable references from past LRA reviews of AMRs, AMPs, and TLAAs performed by the NRC staff. Upon the deletion of Section 4.3.5, “Implementation” from the scope of SRP-SLR Chapter 4.3, SRP-SLR Section 4.3.5 has been reformatted to contain the reference section and references for Chapter 4.3.
Table 4.3-1, Stress Range Reduction Factors	This table has been deleted from the scope of the SRP-SLR report.	The previous version of Table 4.3-1, as given in the SRP-LR Revision 2 applies the expansion stress and maximum allow stress range reduction analyses (i.e., TLAAs) for either piping or piping components that are designed to ANSI USAS B31.1 design code requirements or ASME Code Class 2 or 3 piping or piping components that are designed to ASME Section III NC or ND requirements. The Codes and Standards that apply to these types of analyses have been referenced in the revisions to SRP-SLR Section 4.3.1, “Areas of Review.” The acceptance criteria bases for evaluating expansion stress and maximum allowable stress range reduction analyses and dispositioning these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), and (iii) have been revised and updated in the revision to SRP-SLR Sections 4.3.2.1.1 and its subsections.

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		The review procedures for evaluating expansion stress/maximum allowable stress range reduction analyses and dispositioning these types of TLAAs in accordance with 10 CFR 54.21(c)(1)(i), (ii), and (iii) have been revised and updated in the revision to SRP-SLR Sections 4.3.3.1.1 and its subsections. The previous version of Table 4.3-1 in the SRP-LR Revision 2 report provided the stress range reduction factor for performing these types of analyses. However, since the Codes and Standards referenced in SRP-SLR 4.3.1 for these analyses contain the maximum allowable stress range reduction factors that analyses, Table 4.3-1 is no longer necessary for inclusion in NUREG–2192 (i.e., the SRP-SLR report). Therefore, Table 4.3-1 has been deleted from the scope of SRP-SLR Chapter 4.3.
Table 4.3-2, Examples of FSAR Supplement for Metal Fatigue TLAA Evaluation	The staff made administrative edits to renumber this table as Table 4.3-1 and to update the previous versions of the FSAR Supplement examples for fatigue parameter TLAAs that were previously provided in Table 4.3-2 of NUREG–1800, Revision 2.	The administrative changes to the FSAR supplement examples in the table are consistent with changes or clarifications made in SRP-SLR Section 4.3 or its subsections. The previous table in NUREG–1800, Revision 2, only provided a single example of a FSAR Supplement summary description for an environmentally-assisted fatigue analysis that was dispositioned in accordance with the TLAA acceptance criterion 10 CFR 54.12(c)(1)(iii) using an AMP corresponding to GALL AMP X.M1, “Fatigue Monitoring.” Consistent with the rewriting and reformatting of SRP-SLR Chapter 4.3 and its subsections, the table now provides one example each for accepting both non-CUF_{en} and CUF_{en} fatigue parameters analyses in accordance with 10 CFR 54.21(c)(1)(i), (ii) and (iii).

Table 3-11 SRP-SLR Chapter 4.3, Metal Fatigue, Differences from SRP-LR Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
		The staff has deleted Table X-02 from the scope of the GALL-SLR report. A minor editorial change was incorporated for the FSAR Supplement example in the numbered SRP-SLR Table 4.3-1 for accepting environmentally-assisted (i.e., CUF_{en}) TLAAs in accordance with the TLAA acceptance criterion in 10 CFR 54.21(c)(1)(i).

Table 3-12 SRP-SLR Chapter 4.4, Environmental Qualification of Electrical Equipment, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Table 4.4-1 Section 4.4.1 Areas of Review Section 4.4.2.1 Time Limited Aging Analysis	Expanded general discussion on the subsequent license renewal (SLR) extension of a component's environmental qualification (qualified life). Additional guidance on environment monitoring data collection, duration, and analysis. Incorporated adverse localized environment inspection and/or walk down for environmental qualification (EQ) equipment. Clarification added to EQ re-analysis on maintaining adequate Title 10 of the *Code of Federal Regulation* (10 CFR) 50.49 EQ margins, conservatisms, and uncertainties. Additional guidance is provided on application of ongoing qualification.	The staff concluded that additional guidance was needed in the identification, verification, evaluation of adverse localized environments, environmental monitoring, and visual inspection as part of an applicant's EQ of electric equipment aging management program. The staff also concluded that it was appropriate to provide additional guidance on on-going qualification (e.g., condition based EQ) as an alternative to analysis when assessed margins, conservatisms, or assumptions may not support an analysis to extend qualified life. 10 CFR 50.49(e) states that electric equipment qualification programs must include and be based on temperature, pressure, humidity, chemical effects, radiation, aging, submergence, and synergistic effects. The requirements of 10 CFR 50.49(e) state that environmental qualification of electric equipment must apply margins to account for unquantified uncertainties, including production variations, and inaccuracies in test instruments. These margins are in addition to any conservatism applied during the derivation of local environmental conditions of the equipment.

Table 3-13 SRP-SLR Chapter 4.5, Concrete Containment Unbonded Tendon Prestress Analysis, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Review Procedures Acceptance Criteria	Title 10 of the *Code of Federal Regulation* (10 CFR) 54.21(c)(1)(ii) of time-limited aging analysis (TLAA). Consistent with regulations, reevaluation of unbonded tendon prestressed forces are performed to ensure prestressed concrete containment design remains valid. Deleted from NUREG–1800, Revision 2, Section 4.5.2.1.2: "If this cannot be done, the applicant should develop a systematic plan for retensioning selected tendons so that the trend lines will remain above the minimum required prestress force specified at anchorages for each group of tendons during the period of extended operation, or perform a reanalysis of containment to demonstrate design adequacy." Deleted from NUREG–1800, Revision 2, Section 4.5.3.1.2: "if the trend lines fall below the minimum required prestressing forces during this period, the reviewer verifies that the applicant has a systematic plan for retensioning the tendons to ensure that the trend lines will return to being, and remain, above the minimum required prestressing forces for each group of tendons during the period of extended operation.	Aligned review procedures fully with 10 CFR 54.21(c)(1). The removed language was included in error in NUREG–1801, Revision 2.
Areas of Review	TLAA reviews for predicted lower limit (PLL) lines for bonded tendons are performed under Standard Review Plan (SRP) Chapter 4.7, "Other Plant-Specific Time Limited Aging Analyses"	The PLL lines are plant-specific. The SRP redirects staff to Standard Review Plan for Subsequent License Renewal (SRP-SLR) Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." The change is made for clarity, completeness and to better support staff's review. Applicant's conformance with SRP is articulated in 10 CFR 50.34(h)(3). The regulatory evaluation of the predicted tendon prestress force lower limit (predicted lower limit) is clearly expressed in SRP-SLR TLAA Section 4.7.

Table 3-13 SRP-SLR Chapter 4.5, Concrete Containment Unbonded Tendon Prestress Analysis, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 4.5.1, Areas of Review	This section was changed to state that predicted lower limit (PLL) lines for bonded tendon TLAAs are performed under Standard Review Plan (SRP) Chapter 4.7, "Other Plant-Specific Time Limited Aging Analyses." Supplementary "aging effects" (e.g., breakage of tendon wires, effects of stress corrosion cracking (SCC), improper anchorages, tendon relaxation when replacing existing inservice tendons with new, sustained elevated temperatures) can contribute to loss of tendon prestress (Areas of Review).	The PLL lines are plant-specific, and as such they belong in Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses." The change is made for clarity, completeness and to better support staff's review. The SRP-SLR TLAA Section 4.5 addresses concrete containments' unbonded tendon prestress force losses over time Areas of Review have been augmented to indicate in addition to creep, shrinkage, and relaxation of tendon steel, losses can also be due to potential supplementary "aging effects." The contribution of such supplementary "aging effects" to loss of tendon prestress will be manifested during tendon prestress lift off force measurements and evaluations Consistent with 10 CFR 54.21(c)(1)(iii), Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) aging management program (AMP) X.S1, provides reasonable assurance of the adequacy of the measured prestressing forces.
Table 4.5-1	Added TLAA Final Safety Analysis Report (FSAR) supplement for 10 CFR 54.21(c)(1)(ii).	The FSAR supplement for 10 CFR 54.21(c)(1)(ii) was inadvertently omitted from NUREG 1800 (SRP-LR) Revision 2; the new FSAR supplement properly addresses 10 CFR 54.21(c)(1)(i), (ii), and (iii).

Table 3-13 SRP-SLR Chapter 4.5, Concrete Containment Unbonded Tendon Prestress Analysis, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Review Procedures Acceptance Criteria	Title 10 of the *Code of Federal Regulation* (10 CFR) 54.21(c)(1)(ii) of time-limited aging analysis (TLAA). Consistent with regulations, reevaluation of unbonded tendon prestressed forces are performed to ensure prestressed concrete containment design remains valid. Deleted from NUREG–1800, Revision 2, Section 4.5.2.1.2: “If this cannot be done, the applicant should develop a systematic plan for retensioning selected tendons so that the trend lines will remain above the minimum required prestress force specified at anchorages for each group of tendons during the period of extended operation, or perform a reanalysis of containment to demonstrate design adequacy.” Deleted from NUREG–1800, Revision 2, Section 4.5.3.1.2: “if the trend lines fall below the minimum required prestressing forces during this period, the reviewer verifies that the applicant has a systematic plan for retensioning the tendons to ensure that the trend lines will return to being, and remain, above the minimum required prestressing forces for each group of tendons during the period of extended operation.	Aligned review procedures fully with 10 CFR 54.21(c)(1). The removed language was included in error in NUREG–1801, Revision 2.
Areas of Review	TLAA reviews for predicted lower limit (PLL) lines for bonded tendons are performed under Standard Review Plan (SRP) Chapter 4.7, “Other Plant-Specific Time Limited Aging Analyses”	The PLL lines are plant-specific. The SRP redirects staff to Standard Review Plan for Subsequent License Renewal (SRP-SLR) Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses.” The change is made for clarity, completeness and to better support staff’s review. Applicant’s conformance with SRP is articulated in 10 CFR 50.34(h)(3). The regulatory evaluation of the predicted tendon prestress force lower limit (predicted lower limit) is clearly expressed in SRP-SLR TLAA Section 4.7.

Table 3-14 SRP-SLR Chapter 4.6, Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 4.6.1 Areas of Review	Clarified: Fatigue parameters (fatigue analyses, fatigue waivers) for metal containments, metal liners, penetrations (mechanical, electrical) are reviewed. Review also includes personnel airlock, equipment hatch, and control rod drive (CRD) hatch. Added: Type and number of occurrences for cyclic loads for fatigue parameter evaluations, are stated. Electric Power Research Institute (EPRI) reference technical report (TR)-1003456) on aging management of mechanical and electrical penetrations.	Fatigue evaluation is clarified to include the review of fatigue analyses or fatigue waivers of stated structures or components, as applicable. The severity and number of cycles of actual loadings for each cyclic load assumed in the analyses are added to eliminate this type of request for additional information. The Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) Section 4.6 time-limited aging analysis (TLAA), as revised, provides the necessary staff guidance for the review and acceptance of subsequent license renewal applications (SLRAs). The EPRI TR-1003456 reference is added as a reference for the staff to consider when reviewing this TLAA.
Sections 4.6.2 and 4.6.3, Acceptance Criteria Review Procedures	<u>10 CFR 54.21(c)(1)(i) or (ii)</u> The staff changed these sections to add American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III fatigue waiver evaluations for liners. In addition, the changes clarify that verifications of the existing analyses of record include a review of both the number of accumulated cycles and the assumed severity for each of the cyclic loadings evaluated in the previous evaluations calculations to ensure they are not projected to exceed the assumptions for these loadings. This section also states that revised cycle projections are verified to be consistent with historical plant operating characteristics and anticipated future operation. <u>10 CFR 54.21(c)(1)(iii)</u> The staff changed these sections to provide the bases for accepting these fatigue analyses in accordance with 10 CFR	<u>10 CFR 54.21(c)(1)(i) or (ii)</u> Checks of the accumulated number of transient cycles and there projections for the subsequent period of extended operation, and the severity of the past design transient occurrences need to be performed to ensure that either the past analyses will remain valid for the subsequent period of extended operations (10 CFR 54.21(c)(1)(i)) or t the calculated fatigue parameters remain less than the allowed values at the end of the subsequent period of extended operation(10 CFR 54.21(c)(1)(ii)). <u>10 CFR 54.21(c)(1)(iii)</u> The changes to these sections provide additional alternatives for applications to manage these fatigue

Table 3-14 SRP-SLR Chapter 4.6, Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
	54.21(c)(1)(iii) by using an aging management program or activities to ensure the effects of fatigue-induced cracking or cumulative fatigue damage will be adequately managed during the subsequent period of extended operation. The updated guidelines include provisions for using GALL-SLR AMP X.M1 or a plant-specific AMP to manage these analyses. These sections have been revised to include criteria for use of an inspection-based AMP as the basis for managing these analyses.	analyses in ways that are technically acceptable and in accordance with 10 CFR 54.21(c)(1)(iii). The added provisions for plant-specific AMPs with 10 program elements in accordance with the guidance of Appendix A.1 of SRP-SLR ensure that such programs will be properly defined with all necessary information. For applicants who choose to use an inspection-based AMP, the provisions to perform inspections of the specific components to be managed, and the use of justified inspection methods ensure that the components included will be adequately age managed by the proposed inspection methods.

Table 3-15 SRP-SLR Chapter 4.7, Plant-Specific TLAA, Penetrations Fatigue, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section 4.7, Plant-Specific Time-Limited Aging Analysis (TLAAs), including all applicable subsections	The staff only did not amend the technical bases that apply acceptance criteria or review procedures for plant analyses that may qualify as plant-specific TLAAs. The staff did administratively amend the sections to better describe how these types of TLAAs would be accepted under one of the three criteria for accepting TLAAs, as given in 10 CFR 54.21(c)(1)(i), (ii), or (iii).	The staff made the administrative edits to improve the grammar, clarity, and formatting of the sections.
Table 4.7-1, Examples of Potential Plant-Specific TLAA Topics	The staff moved the corresponding table (i.e., Table 4.1-3) in NUREG–1800, Revision 2, from the scope of Chapter 4.1 in the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR) report, and renumbered it to Table 4.7-1, and moved it to SRP-SLR Chapter 4.7, Other Plant-Specific Time-Limited Aging Analyses. For the relocated table, the staff administratively amended the TLAA examples in the table to better define which types of plant designs (pressurized water reactors versus boiling water reactors) applied to the TLAA categories listed in the table.	The staff determined that it would be more appropriate to include this table in SRP-SLR Chapter 4.7, Other Plant-Specific Time-Limited Aging Analyses, which provides the staff's guidance for identifying that plant analyses, assessments, calculations, evaluation that qualify as plant-specific TLAAs and dispositioning them in accordance with the requirements in 10 CFR 54.21(c)(1)(i), (ii), or (iii). The administrative changes to the table should include better clarity on the applicability of the types of plant-specific TLAAs that are listed in the relocated table.

Table 3-16 SRP-SLR Chapter 5.0, Technical Specification Changes, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Chapter 5, Technical Specification Changes,	The staff included a new Chapter 5 for the SRP-SLR Report that covers the staff acceptance criteria and review procedure for identifying those Technical Specification (TS) changes that are necessary to manage the effects of aging. The new chapter includes the following section for evaluating whether a subsequent license renewal application would need to include any new TSs or existing TS changes in order to manage the effects of aging during a subsequent period of extended operations: (a) Review Responsibilities, (b) Section 5.1.1, Areas of Review, (c) Section 5.1.2, Acceptance Criteria, (d) Section 5.1.3, Review Procedures, (e) Section 5.1.4, Evaluation Findings, (f) Section 5.1.5, Implementation, and (g) Section 5.1.6, References.	The regulations in 10 CFR 54.22 require license renewal applicants to identify any new TSs or amendments to existing TS requirements that are needed to manage the effects of aging during a proposed period of extended operation, including those to subsequent license renewal applications. However, the previous guidelines in NUREG–1800, Revision 2, did not include any acceptance criteria and review procedures to assist a license renewal reviewer in determining whether TS amendments would be necessary to manage the effects of aging during a proposed period of extended operation, including subsequent periods of extended operations. The new chapter provides the staff's criteria for determining whether amendments of the operating license, including the plant's TS would need to be included in an subsequent license renewal application under the requirements of 10 CFR 54.22.

Table 3-17 SRP-SLR Appendices A.1, A.2, A.3, and A.4, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section A.1.1, Background	In addition to minor administrative edits made to this section, the staff edited the background discussion to include the following changes: (i) Updated the scope of condition monitoring programs to include programs that monitor or test for changes in material properties. This, in addition, includes condition monitoring programs that are based on inspection-based activities. (ii) Updated the background section to clarify that some aging management programs (AMPs) may be based on a combination of condition monitoring, performance monitoring, preventive monitoring, or mitigative monitoring activities.	Past license renewal applicants have identified condition monitoring programs that are based on material property testing activities. Examples are reactor vessel surveillance programs and neutron absorption material testing programs, such as those for Boraflex or Boral materials. The open-cycle cooling water system program is an example of an AMP that is based on mixed monitoring activities. The program involves the implementation of visual inspections as a condition monitoring basis and flow testing as a performance monitoring basis. This has been explained in the background section for Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR), Section A.1.1
Section A.1.2, Branch Technical Position Subsection A.1.2.1, Applicable Aging Effects	In addition to minor administrative edits made to this section, the staff edited the background discussion to include the following changes: (i) Updated the applicable aging effects section to discuss the types of conditions that may result in condensation during plant operations, and the types of aging effects that may be applicable to components that are exposed to an environment with condensation.	The staff updates of this section are consistent with the guidance in LR-ISG 2012-02, “Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation,” for identifying loss of material as an applicable aging effect for environments with condensation.

Table 3-17 SRP-SLR Appendices A.1, A.2, A.3, and A.4, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section A.1.2, Branch Technical Position Subsection A.1.2.2, Aging Management Programs for Subsequent License Renewal (SLR)	In addition to minor administrative edits made to this section, the staff edited the aging management program subsection to include new criteria for plant-specific AMPs that are based on the methods and criteria in NRC-approved topical reports or technical reports. The criteria include reminders that safety evaluations for NRC-approved report methods may include applicable limitations, conditions, or actions on use of the report methodologies. The guidance also provides criteria reminding applicants that an applicant's basis for resolving a particular limitation, condition, or action items may result in an augmentation of particular reports methodology beyond that recommended by the industry vendor or organization issuing the report.	The changes are consistent with those developed for Section 1.2.3, Aging Management Programs that Rely on Implementation of Nuclear Regulatory Commission Approved Technical or Topical Reports," of the SRP-SLR. Specifically, the staff determined that the program element criteria for AMPs that rely on technical or topical reports (TRs) for implementing NRC-endorsed methodologies or NRC-endorsed industry initiatives differ from those AMPs that are based on compliance with specific NRC requirements or conformance with NRC positions in NRC-issued generic communications. Therefore, the staff created a new SRP-SLR Section 1.2.3 and updated SRP-SLR Appendix A.1 to describe how implementation of such industry methodologies or initiatives would need to be implemented under the AMPs. The staff references NRC Office Instruction LIC-500 (most current version) to clarify that implementation of NRC-endorsed methodologies in these TRs may be subject to specific conditions, limitations or NRC requests in applicant/licensee action items, and therefore that adjustment of the TR methodology activities may need to be adjusted based on an applicant's bases for addressing and resolving limitations, conditions or action items that may have been issued in NRC-approved technical or topical reports.

Table 3-17 SRP-SLR Appendices A.1, A.2, A.3, and A.4, Differences from SRP-LR, Revision 2 and Their Technical Bases

Location of Change	Summary of the Change	Technical Basis for Change
Section A.1.2, Branch Technical Position Subsection A.1.2.2, Aging Management Program Elements for SLR	In addition to minor administrative edits made to this section, the staff edited the subsection to update the criteria for program elements 7, 8, and 9 in this subsection. Specifically, the staff updated the elements to state that corrective actions, administrative controls, and confirmatory actions defined in NRC-approved technical or TRs may provide additional corrective actions, administrative controls and confirmatory process activities for AMPs that rely on NRC-approved TRs. The staff states that his may be in addition to those activities that are implemented through an applicant's 10 CFR Part 50, Appendix B, Quality Assurance Program.	Changes are consistent with NRC-approved TRs, such as those issued by the boiling water reactor or pressurized water reactor Owners Groups, the Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) or the EPRI Boiling Water Reactor Vessel and Internals Project (BWRVIP), or by industry vendors.
Appendix A.3, Generic Safety Issues Related to Aging (Branch Technical Position RLSB-2)	Deleted all of Sections A.3.2.1 and A.3.2.2 except for the first paragraph of A.3.2.1	This Appendix discusses the treatment of Generic Safety Issues (GSIs) related to aging. The GSIs are generic issues for the current period of operation (i.e., first 40 years) and should not be addressed by license renewal.
Appendix A.4, Operating Experience for Aging Management Programs	New appendix on "Operating Experience for Aging Management Programs" was added.	This appendix was added under LR-ISG-2011-05, "Ongoing Review Of Operating Experience." Thus, it was a part of SRP-LR and now actually added to SRP-SLR.

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11. ABSTRACT (200 words or less)

This document is a knowledge management and knowledge transfer document associated with NUREG–2191, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” and NUREG–2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants” (SRP-SLR).

This publication documents the technical changes that were made from the guidance contained in Revision 2 of NUREG–1801, “Generic Aging Lessons Learned (GALL) Report,” for utilities applying for first license renewal to provide guidance to utilities wishing to apply for subsequent license renewal (i.e., for operation from 60 to 80 years) along with the technical bases for these changes. Changes for the review of subsequent license renewal applications (SLRAs) from Revision 2 of NUREG–1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” are also discussed in this document. Consequently, this document provides the underlying rationale that the U.S. Nuclear Regulatory Commission (NRC) staff used to develop the subsequent license renewal guidance documents.

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