NUREG-1833

Technical Bases for Revision to the License Renewal Guidance Documents

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Office of Nuclear Reactor Regulation
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ABSTRACT

This document establishes the basis for the changes that constitute Revision 1 to NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” and Revision 1 to NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (SRP-LR).

The technical changes that were made when revising the guidance contained in NUREG-1801 are captured in this document, along with the basis for the change. Changes to NUREG-1800, many of which derive from the changes to NUREG-1801, are also discussed in this document. Consequently, this document provides an understanding of the underlying rationale that NRC used in developing the current revisions of these guidance documents.

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TABLE OF CONTENTS

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LIST OF CONTRIBUTORS – 2004-2005

<u>License Renewal and Environmental Programs Section of Division of Regulatory Improvement Programs, Office of Nuclear Reactor Regulation</u>

P.T. Kuo	Program Director
S. Lee	Section Chief
S. West	Section Chief
J. Zimmerman	Section Chief
A. Hull	Team Leader

J. Dozier	Mechanical Engineering
K. Chang	Mechanical Engineering
K. Cozens	Materials Engineering
G. Cranston	Reactor Systems Engineering
D. Guha	Systems Engineering
M. Heath	Mechanical Engineering
S. Hoffman	Mechanical Engineering
K. Hsu	Materials Engineering
M. Lintz	Mechanical Engineering
D. Merzke	Mechanical Engineering
K. Naidu	Reactor Engineering
R. Subbaratnam	Mechanical Engineering
T. Terry	Civil Engineering
L. Tran	Electrical Engineering

<u>Office of Nuclear Reactor Regulation</u>

T. Chan	Section Chief
S. Coffin	Section Chief
R. Jenkins	Section Chief
S. Jones	Section Chief
L. Lund	Section Chief
R. Karas	Section Chief
K. Manoly	Section Chief
M. Mitchell	Section Chief
J. Nakoski	Section Chief
D. Terao	Section Chief
S. Weerakkody	Section Chief

H. Ashar	Structural Engineering
S. Bailey	Mechanical Engineering
T. Cheng	Structural Engineering
R. Davis	Materials Engineering
B. Elliot	Materials Engineering
J. Fair	Mechanical Engineering
G. Georgiev	Materials Engineering
N. Iqbal	Fire Protection Engineering
D. Jeng	Structural Engineering
K. Karwoski	Materials Engineering

LIST OF CONTRIBUTORS (continued)

A. Keim	Materials Engineering
C. Lauron	Chemical Engineering
L. Lois	Reactor Systems Engineering
Y. Li	Mechanical Engineering
R. McNally	Mechanical Engineering
J. Medoff	Materials Engineering
D. Nguyen	Electrical Engineering
A. Pal	Electrical Engineering
K. Parczewski	Chemical Engineering
J. Rajan	Mechanical Engineering
P. Shemanski	Electrical Engineering
J. Strnisha	Mechanical Engineering

<u>Office of Nuclear Regulatory Research</u>

A. Hiser	Section Chief
J. Vora	Team Leader
J. Davis	Materials Engineering
P. Kang	Electrical Engineering

<u>Parallax, Inc</u>

A. Baione	Team Leader
M. Bowman	Mechanical Engineering
K. Larsen	Technical Editing
E. Patel	Mechanical Engineering
R. Wells	License Engineering

<u>Argonne National Laboratory</u>

O. Chopra	Team Leader
D. Diercks	Materials Engineering
V. Sha	Materials/Mechanical Engineering
S. Tam	Materials Engineering

I. Introduction

This document establishes the basis for the changes that constitute Revision 1 to NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” (which includes Volumes 1 and 2) and Revision 1 to NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (SRP-LR). These documents were published in September 2005. NUREG-1832, “Analysis of Public Comments on the Revised License Renewal Guidance Documents,” provides the evaluation and disposition of public comments received by the NRC on the revision of the license renewal guidance documents (LRGDs). Figure 1 shows the historical development of the LRGDs. Figure 2 shows the LRGD update and development process.

The technical changes that were made when revising the guidance contained in the GALL Report are captured in this document, along with the basis for the change. Changes to the SRP-LR, many of which derive from the changes to the GALL Report, are also discussed in this document. Consequently, this document provides an understanding of the underlying rationale that NRC used in developing the current revisions of these guidance documents.

I.A Overview of Changes

Changes to the GALL Report and SRP-LR (the guidance documents) fall into the following categories:

- Roll-up changes
- NRC positions previously approved in other documents, such as safety evaluation reports and approved interim staff guidance
- Lessons learned
- Operating experience
- Technical clarifications or corrections
- Clarifications to the audit and review process (SRP-LR only)

Each of these categories is discussed further in the following sub-paragraphs.
Chapter II, “Justification for Inclusion of new AMR Line-Items,” documents the creation and justification for new aging management review (AMR) entries in the GALL Report. Chapter III, “Justification for Technical Changes,” documents the changes in the existing AMR line-items and basis to the guidance document.

Additionally, to facilitate and ensure consistency in understanding, Chapter IX was added to the GALL Report to provide standard terminology nomenclature and definitions. Appendix A, “Standard Terminology,” to this NUREG provides the basis for the new GALL Report Chapter IX. It also provides the ‘picklist’ used in the selection of terms used within the columns of the AMR tables in the GALL Report.

Lastly, GALL Volume 1 and the SRP-LR present summary information reflecting the AMR table data in GALL Volume 2. However, the SRP-LR and GALL Volume 1 do not identify the material or environment information contained in the AMR line-items in GALL Volume 2. Appendix B to this NUREG was created to bridge that gap.

I.B Roll-Up Methodology

The 2001 version of the GALL Report and the SRP-LR (each of which is referred to as Revision 0) contained aging management reviews (AMRs) that used very explicit component identification, material nomenclature, and environment definitions. In some situations, these explicit characterizations were more restrictive than technically necessary. Hence, an applicant might be less consistent with the GALL Report than it would have been if the AMR definitions were based on more practical component groupings, material nomenclature, and environment definitions.

In a letter from NEI dated May 11, 2004, "Transmittal of proposed method for updating the GALL Report, NUREG-1801" from Alex Marion to P.T. Kuo, modifications to the component groups, material nomenclature, and environmental definitions were proposed. The NRC Staff reviewed these proposals and, based on the technical merits of each proposed change either agreed with the recommendation, agreed with a modified version of the recommendation, or rejected the recommendation. The guidance documents were then modified to reflect the NRC Staff assessments of the NEI proposed changes.

As part of these changes, the roll-up process also included standardizing the terminology used throughout the GALL Report, the inclusion of certain technical criteria (such as temperature thresholds for aging effects in common use by the industry) to further clarify the applicability of the results, reformatting and the correction of editorial errors. Chapter IX was added to the revised GALL Report to standardize and define terminology used in the document.

I.C Incorporation of NRC Positions Previously Approved

In addition to the roll-up changes discussed above, the update of the GALL Report incorporates specific technical changes. These technical changes were based on the incorporation of NRC approved positions established in past precedents from approved license renewal safety evaluation reports, approved interim staff guidance (ISGs), and more recent operating experience. Table 1A, at the end of this chapter, summarizes the status and staff resolution for these ISGs. Unlike the roll-up process, these specific technical changes introduce new technical content to the updated documents. Section III, "Changes to Existing Aging Management Review Line-items," provides a listing of each new or existing AMR result in GALL that incorporates a technical change, and provides a specific basis for this change.

The NRC drew on two sources of information, previous Staff comments for improving the license renewal process (collected since the previous revision of GALL and the SRP-LR were issued), and the collection of approved SERs. Previous license renewal SERs were reviewed to identify instances where changes to the GALL AMR line-items should be made to improve the technical accuracy and consistency of the license renewal process. Over four hundred individual items were collected from these two information sources and each was reviewed for its applicability, value, and technical adequacy as part of the NRC review process.

In addition, the NUREG-1801 tables were updated to include new material, environment, aging effect and aging management program (MEAP) combinations that are common to most license renewal applications (LRAs), including those that have already been reviewed. In a letter dated July 30, 2004, NEI proposed adding about 40 new AMR line-items. The NRC Staff reviewed these items to identify if SERs had been accepted with the proposed MEAP combinations in previous LRAs. If a previous NRC Staff position was identified, the Staff determined whether the MEAP combination was sufficiently generic to warrant including this item in the revised LRGD. If so, it was added either in its proposed or in a modified form. Chapter II of this Bases Document further discusses these new AMR line-items. Appendix A.6 provides a listing of all the MEAP combinations in GALL Vol. 2 with cross-reference to SRP-LR listings.

I.D Operating Experience

Extended operation of nuclear reactors necessitates critical analysis of existing experience. An operating experience review was performed to identify AMR line-items necessary for addition or modification in the GALL Report. Both domestic and foreign operating experience was reviewed.

<u>Domestic Operating Experience</u>: The NRC Office of Research provided a listing of Licensee Event Reports (LERs) related to failures, cracking, degradation, etc. of passive components. This listing consisted of 128 items. These results were reviewed by the NRC Staff. The Staff subsequently modified AMR line-item R-68 and added AMR line-item RP-22 (on the basis of LER 528-1992-001). R-68 was modified to emphasize stress corrosion cracking associated with nozzle safe end welds. AMR line-item RP-22 was added to identify primary water stress corrosion cracking (PWSCC) of the pressurizer steam space nozzles.

<u>Foreign Operating Experience</u>: The international Incident Reporting System (IRS), jointly operated by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (NEA), compiles and analyses information on nuclear power plant events and promotes a systematic approach to the feedback of lessons learned from operating experience. NPP events reported to the IRS are significant in terms of causes and safety lessons learned. The main objective of the IRS is to assure proper feedback on events to help prevent occurrence or recurrence of serious incidents or accidents. Reports from this database are proprietary.

The IRS database was queried for reports relating to passive components with corrosion and cracking. Thirty-three reports were identified since 1992 that met these criteria. These reports were analyzed to determine if there were any AMR line-items that needed to be included in the GALL report. Many of the reports identified MEAP combinations that were already in the GALL Report or were addressed by staff ISG documents. A few of the items appeared to be specific to foreign plants and not generically applicable to US PWRs and BWRs. Based on the NRC review, there were no items warranting addition to the GALL report and, in general, it was concluded that the GALL Report's AMR line-items were comprehensive.

I.E Technical Clarifications and Corrections

Based on use and review of the guidance documents, some editorial changes were made to improve the technical clarity or revise inadvertent errors. As shown in Table IV of this Bases Document, there were a number of such changes made related to the Aging Management Programs (AMPs) in GALL Vol. 2. This also included updating references in the license renewal guidance documents.

I.F Clarifications to the Audit and Review Process (SRP-LR only)

A large number of changes made to the GALL Report required parallel changes to the SRP-LR. These types of changes are discussed in the preceding paragraphs and are not repeated here.

In addition to the above mentioned changes, the SRP-LR was revised to better reflect the methodology of performing the safety audit and reviews associated with the NRC Staff review of a LRA.

These changes include a better description of the work divided among the NRC branches performing the safety review. This was achieved by the addition of a new section to the SRP-LR, Section 3.0, which adds a step in the safety review of the Safety Review Project Manager (PM) to assign and document work assignments dividing the AMR and AMP reviews among various NRC branches and sections.

Table IA Summary of the Effect of the Interim Staff Guidance Process on the Updated License Renewal Guidance Documents (LRGDs)				
ISG No.	**Title and Reference**	**Purpose**	**Status Resolution**	**Affected LRGDs**
01	"Proposed Staff Guidance on the Position of the GALL Report Presenting One Acceptable Way to Manage Aging Effects for License Renewal," dated November 23, 2001 (ADAMS Accession No. ML013300531)	How to credit plant programs and activities	Closed Incorporated into LRGDs	SRP-LR, Chapter 3.0
02	"Staff Guidance on Scoping of Equipment Relied on to Meet the Requirements of the Station Blackout (SBO) rule (10 CFR 50.63) for License Renewal," dated April 1, 2002 (ADAMS Accession No. ML020920464)	Station blackout scoping	Closed Incorporated into LRGDs	SRP-LR, Chapter 2.0
03	"Proposed Revision of Chapters II and III of Generic Aging Lessons Learned (GALL) Report on Aging Management of Concrete Elements," dated November 23, 2001 (ADAMS Accession Nos. ML013300440 and ML013300445)	To clarify the concrete aging management programs in GALL and SRP-LR documents. Management of both accessible and inaccessible areas is addressed.	Closed Incorporated into LRGDs	GALL Volume 2, AMPs XI.S2, and XI.S6
04	"Interim Staff Guidance (ISG)-04: Aging Management of Fire Protection Systems for License Renewal," dated December 3, 2002 (ADAMS Accession No. ML023440137)	Fire protection system piping. Change the visual inspection interval from specific interval to plant specific interval based on plant operating experience and engineering evaluation.	Closed Incorporated into LRGDs	GALL Volume 2, AMPs XI.M26 and AMP XI.M27
05	"Interim Staff Guidance (ISG)-5 on the Identification and Treatment of Electrical Fuse Holders for License Renewal," dated March 10, 2003 (ADAMS Accession No. ML030690512, ML030690518)	To include fuse clips and fuse block for fuse holders and to add a new AMP for fuse clips (i.e., metallic)	Closed Incorporated into LRGDs	SRP-LR, Table 2.1-5, GALL Volume 2, AMP XI.E5 (new)
06	"Proposed Interim Staff Guidance on Identification and Treatment of Housing for Active Components for License Renewal," dated April 8, 2003 (ADAMS Accession No. ML031010423)	Housing for active components. To clarify a need for aging management review (AMR) for housing for fans, dampers, and H/C coils	Withdrawn and Closed Incorporated in final LRGDs (included in NEI 95-10, Rev. 6)	SRP-LR, Table 2.1-5, Chapter 3.0, and GALL Volume 2, IX.B Table

Table IA Summary of the Effect of the Interim Staff Guidance Process on the Updated License Renewal Guidance Documents (LRGDs)				
ISG No.	**Title and Reference**	**Purpose**	**Status Resolution**	**Affected LRGDs**
07	"Proposed Staff Guidance on the Scoping of Fire Protection Equipment for License Renewal, dated November 13, 2002 (ADAMS Accession No. ML023190479)	Scoping guidance To clarify the fire protection systems, structures, and components scoping. To clarify whether the scope would expand to include (BTP) APSCB 9.5-1	Withdrawn and closed incorporated in LRGDs (ADAMS Accession No. ML051590234)	GALL Volume 2, IX.B Table
08	"Process for Interim Staff Guidance Development and Implementation," dated December 12, 2003 (ADAMS Accession No. ML023520620)	To update and establish the interim staff guidance process.	Closed	N/A
09	"Industry Guidance on Revised 54.4(a)(2) Scoping Criterion for license renewal," dated June 6, 2003 (ADAMS Accession No. ML031570613)	Scoping criteria 54.4(a)(2) Scoping of non-safety-related systems, structures, and components conducted for license renewal is in accordance with the requirement of 54.4(a)(2)	Closed – Reg. Guide 1.188 endorsed NEI 95-10, Rev. 6	N/A
10	"Standardized Format for License Renewal Application," April 7, 2003 (ADAMS Accession No. ML030990052, ML030990292)	License renewal application format To standardize license renewal application format for 2003 applicants	Closed – Reg. Guide 1.188 endorsed NEI 95-10, Rev. 6	N/A
11	"Recommendations for Fatigue Environmental Effects in a License Renewal Application," dated January 21, 2004 (ADAMS Accession No. ML040220124)	Environmental fatigue for carbon/low-alloy steel To review the aging management of environmental fatigue in the ISG process, as agreed at the September 18, 2002, meeting: eliminate evaluation of carbon and low alloy steel components for the effects of the reactor coolant environment for LRA	Closed Staff concluded there is insufficient technical basis provided to justify the elimination of the evaluation of carbon and low alloy steel components for the effects of the reactor coolant environment for LRA	N/A

Table IA Summary of the Effect of the Interim Staff Guidance Process on the Updated License Renewal Guidance Documents (LRGDs)				
ISG No.	**Title and Reference**	**Purpose**	**Status Resolution**	**Affected LRGDs**
12	"Addition of Generic Aging Lessons Learned (GALL) Aging Management Program (AMP) XI.M35, 'One-time Inspection of Small-Bore Piping,' for License Renewal," dated November 3, 2003 (ADAMS Accession No. ML033100516)	Cracking of Class 1 small-bore piping To capture the operational experience related to the cracking of Class 1 small-bore piping	Withdrawn and Closed Incorporated in LRGDs	GALL Volume 2, AMP XI.M35 (new) and corresponding AMR line-items
13	Management of Loss of Preload on Reactor Vessel Internals Bolting Using the Loose Parts Monitoring System	To review the use of the loose parts monitoring system for the management of the loss of preload on reactor vessel internal bolting	Withdrawn and Closed Incorporated in LRGDs	GALL Volume 2, AMP XI.M14
14	Operating Experience with Cracking in Bolting	Cracking in bolting To capture the operational experience related to the cracking of bolting	Withdrawn and Closed Incorporated in LRGDs - revised GALL AMP XI.M18 and selected AMRs portion	GALL Volume 2, AMP XI.M18 and the corresponding AMR line-items
15	"Proposed Interim Staff Guidance (ISG)-15: Revision of Generic Aging Lessons Learned (GALL) Aging Management Program (AMP) XI.E2, 'Electrical Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits,' for License Renewal," dated August 12, 2003 (ADAMS Accession No. ML032250579)	To incorporate NEI's proposed revision to GALL AMP XI.E2 (i.e., replaced TS surveillance with specific calibrations or surveillance)	Withdrawn and Closed Incorporated in LRGDs	GALL Volume 2, AMP XI.E2
16	"Proposed Interim Staff Guidance (ISG)-16: Time-Limited Aging Analyses (TLAAs) Supporting Information for License Renewal Applications," dated May 12, 2003 (ADAMS Accession No. ML031320798)	To maximize the efficiency of the LRA review process and minimize RAIs using time-limited aging analyses (TLAAs) supporting information	Withdrawn and Closed Incorporated in LRGDs	SRP-LR Chapter 4
17	"Interim Staff Guidance (ISG)-17: Proposed Aging Management Program (AMP) XI.E4, 'Periodic Inspection of Bus Ducts," for License Renewal" See *Federal Register* notice, Vol. 69, No. 246, page 76960, dated December 23, 2004	Bus ducts To review bus insulation due to water intrusion in bus ducts and bus bar connection due to thermal cycles. To develop GALL AMP XI.E4 for bus ducts	Withdrawn and Closed Incorporated in LRGDs	GALL Volume 2, AMP XI.E4 (new) and corresponding AMR line-items

Table IA Summary of the Effect of the Interim Staff Guidance Process on the Updated License Renewal Guidance Documents (LRGDs)				
ISG No.	**Title and Reference**	**Purpose**	**Status Resolution**	**Affected LRGDs**
18	Revision to NUREG-1801 Program XI.E3 for Inaccessible Medium Voltage Cable	Inaccessible cable To develop aging management procedure to prevent moisture collection in man holes and to revise GALL AMP XI.E3	Withdrawn and Closed Incorporated in LRGDs - revision to GALL AMP XI.E3	GALL Volume 2, AMP XI.E3
19	"Proposed Aging Management Program XI.M11-A, 'Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only),' for License Renewal"	Nickel-alloy Revise aging management program XI.M11 to include nickel-alloy upper vessel heads (primary water stress corrosion cracking in nickel-alloy upper reactor vessel head penetration nozzles)	Withdrawn and Closed Incorporated in final LRGDs	GALL Volume 2, AMP XI.M11-A (new) and corresponding AMR line-items
20	Include Steam Generator Tube Integrity in AMP XI.M19	Steam Generator Tube Integrity Revise aging management program XI.M19 to include steam generator tube integrity	Withdrawn and Closed Incorporated in LRGD - revision to XI.M19	GALL Volume 2, AMP XI.M19
21	Improve GALL Guidance on Reactor Vessel Internals	Reactor vessel internals Revise Chapter IV tables, AMP XI.M9 and AMP XI.M16, to provide improved guidance on reactor vessel internals	Withdrawn and Closed Incorporated in LRGDs - revision to XI.M9 and replacement of XI.M16 with specific guidance in AMR line-items	GALL Volume 2, AMP XI.M9 and corresponding AMR line-items

Figure 1, below, shows that the developing NPP license renewal guidance was an evolutionary process. Such LRG documents provide a method for systematic review of plant aging related to continued operation and license renewal of operating reactors. Literature on mechanical, structural, and thermal-hydraulic components and systems reviewed consisted of Nuclear Plant Aging Research (NPAR) reports, NRC Generic Letters, Information Notices, Licensee Event Reports (LERs), Bulletins, NUMARC Industry Reports and literature on electrical components and systems. The results of these reviews were first systematized using a standardized tabular format and standardized definitions of aging-related degradation mechanisms and effects (GALL 1996). This knowledge base was then expanded upon to provide credit for existing plant programs and further systematized to increase the LR review process effectiveness and efficiency of the license renewal review process in the 2001 version of the GALL Report (GALL Rev. 0). GALL Rev.0 updated the knowledge base to include aging related events reported in the LERs and expanded the scope to include evaluation of existing plant programs. Concurrently in 2001, NRC published the standard review plan for review of license renewal applications for nuclear power plants (SRP-LR) and the Regulatory Guide (RG) 1.188, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," which endorses the Nuclear Energy Institute (NEI) guidance in NEI 95-10, Revision 3, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule." The SRP-LR sections are keyed to RG-1.188; the sections are numbered correspondingly. These documents were all revised in 2005 to incorporate lessons learned from operating experience and the past seven years of reviewing license renewal applications. Figure 2 shows the relationship between the five LRG NUREGs completed in 2005.

Figure 1
Historical LRG Development

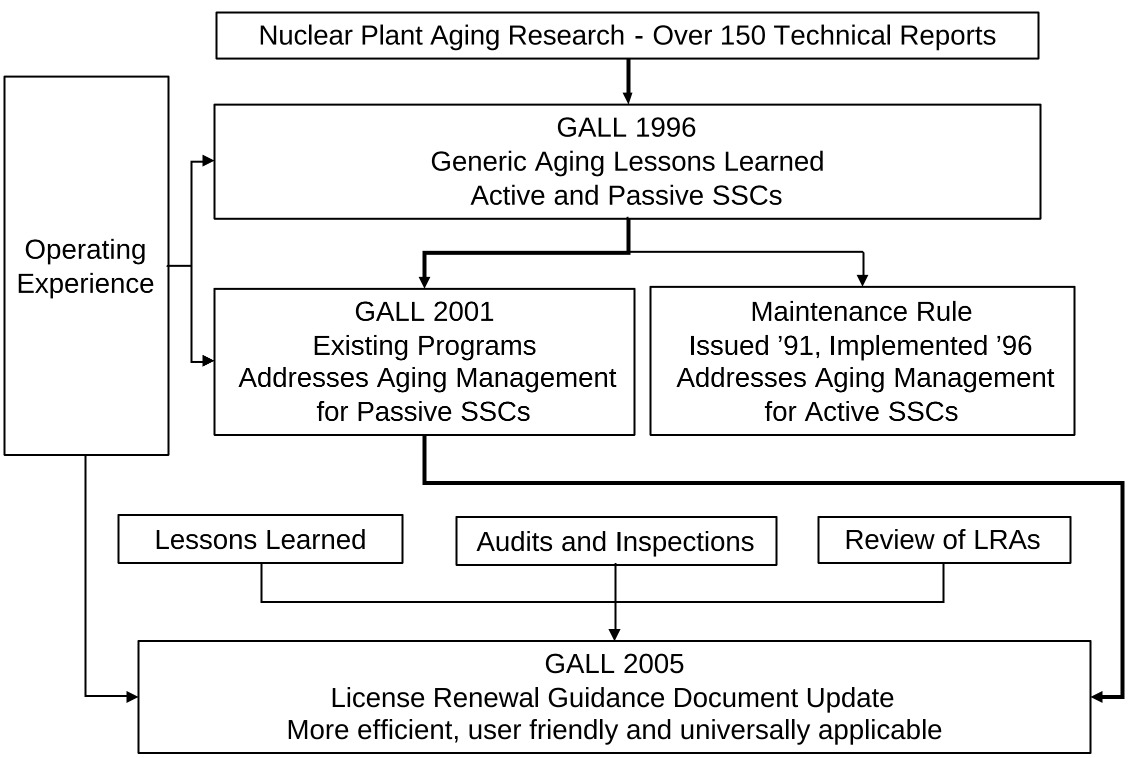
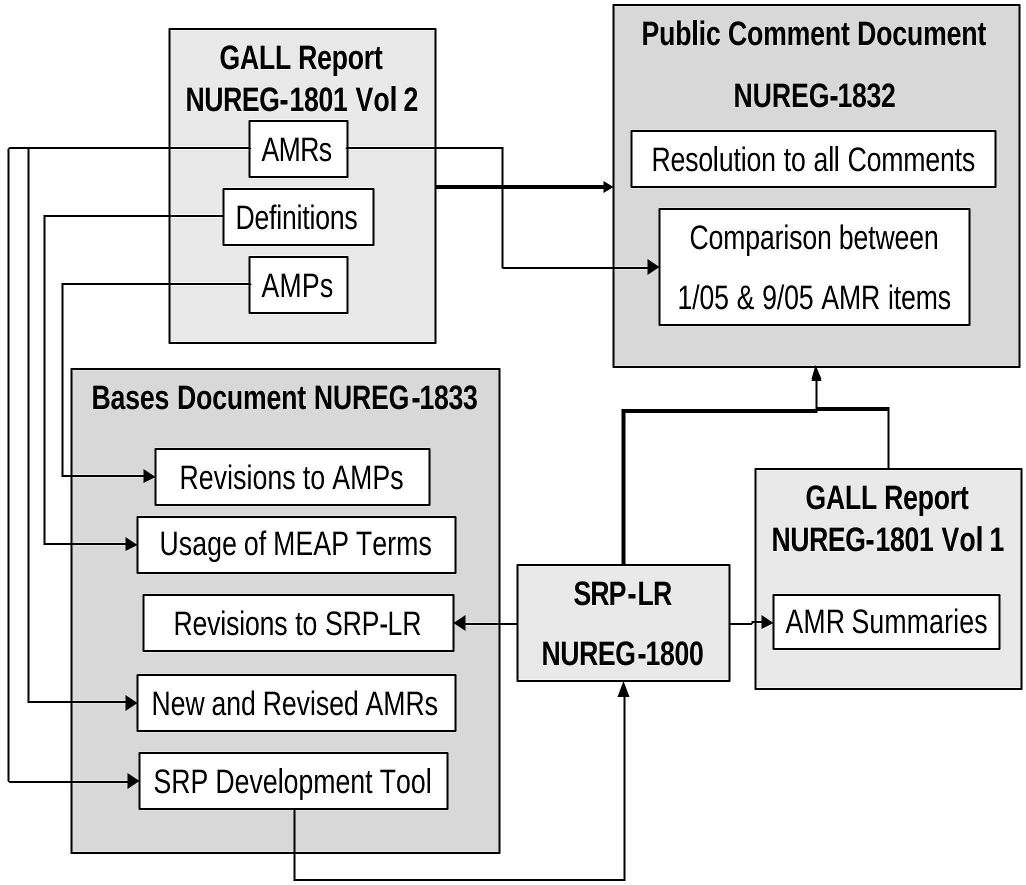


Figure 2

License Renewal Guidance Documents Update and Development Process



II. Justification for Inclusion of New Aging Management Review (AMR) Line-Items

Tables II.A, II.B and II.C identify the new MEAP combinations that were added to the GALL Report for the mechanical, structural, and electrical systems, respectively. In addition to the MEAPs, the structure and/or component as well as the item identifier are also identified. The following describes the information presented in each column of these tables.

GALL Rev. 1 has added new AMR line-items where the staff has accepted the position that a given material in the specified environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the current licensing basis (CLB) for the period of extended operation. Although there is a technical basis (e.g.; materials handbook references and industry operating experience) that no aging effects are expected for certain material/environment combinations, the position that a certain material is not subject to an aging effect may require further confirmation, since industry operating experience subsequent to the publication of GALL Rev. 1 should be considered in preparing license renewal applications.

Column Heading	**Description**
Item	Identifies the item number in Volume 2, Chapters II through VIII presenting the detailed information summarized by this row. The first letter identifies the discipline(s) that the precedent 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 this new MEAP combination.
Structure and/or Component	Identifies the structure or components to which the row applies
Material	Identifies the material of construction for the structure or components to which the row applies
Environment	Identifies the environmental conditions for the structure or components to which the row applies
Aging Effect/ Mechanism	Identifies the applicable aging effect and mechanism(s). See Chapter IX of the GALL Report Volume 2 for more information.
Aging Management Programs (AMP)	Identifies the time limited aging analysis or aging management program found acceptable for properly managing the affects of aging. See Chapter X and XI of the GALL Report Volume 2.
Precedent and Technical Basis for New AMR Line-Item	Provides background on the source of NRC positions previously approved (such as pertinent SERs in response to earlier LRAs) of the SRP-LR that provides further information on this evaluation.

Tables IIA through IIC provide the precedence and technical justification showing the relationship between the item number and the item identifier used in the tables found in Chapters II through VIII of the GALL Report Volume 2.

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II.A New AMR Line-items related to Mechanical Systems

Table II.A presents the new AMR line-items that are based on new Material, Environment, Aging Effect/Mechanism, and Aging Management Program (MEAP) combinations applicable to mechanical systems.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-1 EP-2	Piping, piping components, and piping elements	Aluminum	Air with borated water leakage	Loss of material/ boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	Aluminum piping, piping components, and piping elements when subject to air with borated water leakage are subject to loss of material due to boric acid corrosion. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.0.3.1.1, the Staff has accepted the position that loss of material due to boric acid corrosion exhibited by aluminum in an air with borated water leakage environment is properly managed by the Boric Acid Corrosion AMP which provides engineering evaluations and corrective actions to ensure that boric acid corrosion does not lead to degradation of the affected structures or components (including adjacent structures or components). The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-2 EP-4 SP-1	Piping, piping components, and piping elements	Steel	Air – indoor controlled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.1.2.1, the Staff has accepted the position that steel in an indoor controlled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that both oxygen and moisture must be present to corrode steel (Metals Handbook, 1987). Experience has shown that general corrosion of carbon steel or low alloy steel components would only occur if the components were exposed to outdoor environments or to indoor environments that could promote the condensation of water on the external surfaces of the components.
AP-3 EP-5 RP-01 SP-2	Piping, piping components, and piping elements	Steel	Concrete	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.3.2.4.21, the Staff has accepted the position that steel in a concrete environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that corrosion of embedded steel (surrounded by concrete) is not significant if the attributes of the concrete design are consistent with ACI 318-63, in particular a low water-to-cement ratio, low permeability, and adequate air entrainment as cited in NUREG-1557. This AMR item is not intended to apply to steel tanks simply in contact with concrete.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-4	Piping, piping components, and piping elements	Steel	Dried air	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.9.2, the Staff has accepted the position that steel in a dry air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that both oxygen and moisture must be present to corrode steel (Steelwork Corrosion Control, Bayliss and Deacon, 2002, pg. 5). Components are not subject to moisture in a dry air environment.
AP-6 EP-7 SP-4	Piping, piping components, and piping elements	Steel	Gas	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.1.2.4.1.2, the Staff has accepted the position that steel in an inert or non-reactive gas environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that gaseous corrosion (dry corrosion) usually involves reaction with high-temperature gases. This unique MEAP combination refers only to internal gas environments from non-reactive and/or inert gases that are truly dry and free from possible contaminants. The AMP XI.M26 "Fire Protection" is used for the periodic inspection and testing of the halon/CO_2 fire suppression system.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-8	Piping, piping components, and piping elements	Copper-alloy	Dried air	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in St. Lucie SER Section 3.3.8.2.1, the Staff has accepted the position that copper alloy in a dry air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that comprehensive tests, conducted over a 20-year period under the supervision of ASTM, have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in Metals Handbook, Volume 13, Corrosion, American Society for Metals, 1987.
AP-9 EP-9 SP-5	Piping, piping components, and piping elements	Copper-alloy	Gas	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.3.2.4.4 on page 3-220, the Staff has accepted the position that copper alloy in a gas environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. Operating experience shows that copper piping exposed to an internal gaseous operating condition will be resistant to age-related degradation. This unique MEAP combination refers only to internal gas environments from non-reactive and/or inert gases that are truly dry and free from possible contaminants. The AMP XI.M26 "Fire Protection" is used for the periodic inspection and testing of the halon/CO_2 fire suppression system.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-11 EP-12	Piping, piping components, and piping elements	Copper-alloy <15 % Zn	Air with borated water leakage	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.2.2.4.1.1, the Staff has accepted the position that copper alloy with less than 15% Zn in an air with borated water leakage environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. Ref: Metals Handbook, Volume 13, Corrosion, American Society for Metals, 1987, page 617.
AP-12 EP-36 RP-11 SP-8	Piping, piping components, and piping elements	Copper alloy	Closed cycle cooling water	Loss of material/ pitting, crevice and galvanic corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.0.3.7.3, the Staff has accepted the position that loss of material from pitting, crevice, and/or galvanic corrosion, exhibited by copper alloy in a closed-cycle cooling water environment, is properly managed by the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-13 EP-14	Piping, piping components, and piping elements Ducting	Galvanized Steel	Air – indoor uncontrolled Air – indoor controlled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.5.4, the Staff has accepted the position that galvanized steel in an indoor air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. The zinc coating in galvanized steel protects the underlying steel and the corrosion rate of zinc (coating the steel) in dry clean air is very low (0.13 µm/yr) as cited in references such as J.R. Davis, Corrosion, 2000. Since ducting is thinner than piping and thus potentially more prone to aging degradation, the environmental constraints are more severe for ducting (air indoor control) compared to piping (air indoor-uncontrolled) to allow the applicability of this 'null set' AMR line-item.
AP-14 EP-15 SP-9	Piping elements	Glass	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.3.2.4.4, the Staff has accepted the position that glass in an indoor, uncontrolled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that there have been no aging effects observed for glass components in this air environment. Ref: Handbook of Glass Properties, N. P. Bansal and R. H. Doremua, Academic Press 1986, pg. 646.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-15 EP-16 SP-10	Piping elements	Glass	Lubricating oil	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.2.2.4.1, the Staff has accepted the position that glass in a lubricating oil environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that no failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at the temperatures or during the time periods of concern for extended operation.
AP-16 EP-17 RP-03 SP-11	Piping, piping components, and piping elements	Nickel-alloy	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in the St. Lucie SER Section 3.2.2.2-1, the Staff has accepted the position that nickel alloy in an indoor, uncontrolled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that nickel alloys have superior corrosion resistance in normal atmosphere, surpassing stainless steel as cited in J. R. Davis, Corrosion, 2000.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-17 EP-18 RP-04 SP-12	Piping, piping components, and piping elements	Stainless Steel	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.3.2.4.6.1, the Staff has accepted the position that stainless steel in an indoor, uncontrolled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that stainless steels are highly resistant to corrosion in dry atmospheres in the absence of corrosive species, (which would be reflective of indoor uncontrolled air) as cited in Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555), Ninth Edition, American Society for Metals International, 1980 and 1987. Components are not subject to moisture in a dry air environment (and indoor uncontrolled air would have limited humidity and condensation).
AP-18 EP-19 RP-05	Piping, piping components, and piping elements	Stainless Steel	Air with borated water leakage	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.2.2.4.1.2, the Staff has accepted the position that stainless steel in an air with borated water leakage environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that stainless steel is not susceptible to general corrosion when subjected to borated water environments as cited in "Boric Acid Corrosion Guidebook," November 2001, EPRI 1000975.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-19 EP-20 RP-06 SP-13	Piping, piping components, and piping elements	Stainless Steel	Concrete	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.2.2.2.3, the Staff has accepted the position that stainless steel in a concrete environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that industrial experience shows no evidence of stainless steel being degraded when embedded in concrete. Ref: Steelwork Corrosion Control, D. A. Bayliss and D.H. Deacon, 2002. This AMR item is not intended to apply to steel tanks simply in contact with concrete.

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
AP-20	Piping, piping components, and piping elements	Stainless steel	Dried air	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in St. Lucie SER Section 3.3.8.2.1, the Staff has accepted the position that stainless steel in a dried air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that, on the basis of current industry research and operating experience, dry air on metal will not result in aging that will be of concern during the period of extended operation. Wrought austenitic stainless steels are not susceptible to significant general corrosion that would affect the intended function of components. This conclusion is based on the fact that stainless steels are highly resistant to corrosion in dry atmospheres in the absence of corrosive species. (Ref: Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555), Ninth Edition, American Society for Metals International, 1980 and 1987). Components are not subject to moisture in a dry air environment.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-22 EP-22 RP-07 SP-15	Piping, piping components and piping elements	Stainless Steel	Gas	None	None	An approved precedent exists for adding this material, environment, aging effect, and program (MEAP) combination to the GALL Report. As shown in Ginna SER Section 3.2.2.4.1.1, the Staff has accepted the position that stainless steel in a gas environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that stainless steels are highly resistant to corrosion in dry atmospheres in the absence of corrosive species (Ref: Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555), Ninth Edition, American Society for Metals International, 1980 and 1987). This unique MEAP combination refers only to internal gas environments from non-reactive and/or inert gases that are truly dry and free from possible contaminants. The AMP XI.M26 "Fire Protection" is used for the periodic inspection and testing of the halon/CO_2 fire suppression system.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-26 EP-24	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	A previously approved staff position exists for adding this material, environment, aging effect, and program combination for the auxiliary system in GALL Rev. 1. GALL Rev. 0 had this material, environment, aging effect, and program combination for RCS steam generators (IVD2.1-k as an example). As noted in EPRI NP-5769, steel gaskets can be subject to loss of preload even under conditions of indoor uncontrolled air. By requiring periodic inspection of closure bolting according to the recommendations of EPRI NP-5769 "Degradation and Failure of Bolting in Nuclear Power Plants" for loss of preload. AMP XI.M18 provides for proper management of the aging effects for this MEAP combination for this component. Thus, implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-27 EP-25	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	A previously approved staff position exists for adding this material, environment, aging effect, and program combination for the auxiliary system in GALL Rev. 1. GALL Rev. 0 had a similar material, environment, aging effect, and program combination for the general corrosion of steel closure bolting (see VII.I.2-a and VIII.H.2-a) exposed to "air, moisture, humidity, and leaking fluid." In GALL Rev. 1, the recategorization of environments led to this new AMR line-item. By requiring periodic inspection of closure bolting for loss of material due to corrosion. AMP XI.M18 provides for proper management of the aging effects for this MEAP combination for this component. Thus, implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-28 EP-1	Bolting	Steel	Air – outdoor (External)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	A previously approved staff position exists for adding this material, environment, aging effect, and program combination for the auxiliary system in GALL Rev. 1. GALL Rev. 0 had a similar material, environment, aging effect, and program combination for the general corrosion of steel closure bolting (VII.I.2-a and VIII.H.2-a) exposed to "air, moisture, humidity, and leaking fluid." In GALL Rev. 1, the recategorization of environments led to this new AMR line-item. This material, environment, aging effect, and program combination is consistent with that of AMR line-item V E.2-a in GALL Rev. 0. By requiring periodic inspection of closure bolting for loss of material due to corrosion. AMP XI.M18 provides for proper management of the aging effects for this MEAP combination for this component. Thus, implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-30 SP-25 EP-46	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ft. Calhoun Unit 1 SER Section 3.3.2.4.4, the Staff has accepted the position that steel in a lubricating oil environment exhibits a loss of material aging effect and therefore recommends management by a program. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-31 SP-27	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 considered this MEAP combination for Auxiliary system Chapter VII, item C2.3-a for component cooling water environment (which is similar to treated water environment). This MEAP combination was not included in other Auxiliary systems in Chapter VII. In Chapter VII, sections A4, C2, E3, and E4, this MEAP combination was added to address the potential for selective leaching in gray cast iron components in the Spent Fuel Pool Cooling and Cleanup (BWR), Closed-Cycle Cooling Water, Reactor Water Cleanup, and Shutdown Cooling (for Older BWRs) systems. As shown in Ginna SER Section 3.3.2.4.2, the Staff has accepted the position that gray cast iron in a treated water environment exhibits a loss of material due to selective leaching and therefore recommends management by a program. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes a hardness test or a destructive test to confirm that the iron matrix is not selectively leached away and a porous matrix of graphite is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-32 SP-55	Piping, piping components, and piping elements	Copper alloy >15% Zn	Treated water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	As shown in FCS Unit 1 SER Section 3.3.2.4.6, the Staff has accepted the position that selective leaching of copper-alloy in a treated water environment is properly managed by the Selective Leaching of Materials Program, which includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of material due to selective leaching is occurring. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the zinc is not selectively leached away and a porous matrix of copper is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-33	Diesel engine exhaust Piping, piping components, and piping elements	Stainless steel	Diesel exhaust	Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated	The Staff has accepted the position that the possible stress corrosion cracking of stainless steel diesel engine exhaust piping, piping components, and piping elements is managed by a plant-specific aging management program. The FCS SER section 3.3.2.4.3 identifies stainless steel as a material in diesel exhaust gas environment with loss of material and cracking as viable aging effects. GALL Rev. 0 Chapter VIIH.2.4-a only identifies carbon steel and loss of material due to general, pitting, and crevice corrosion of steel diesel engine combustion air exhaust subsystem components that are exposed to hot diesel engine exhaust gases containing moisture and particulates. Similar components constructed of stainless steel were observed to be susceptible to cracking in hot diesel exhaust gas. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-34 EP-13	Heat exchanger components	Copper alloy	Closed cycle cooling water	Loss of material/ pitting, crevice, and galvanic corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.0.3.7.3, the Staff has accepted the position that loss of material from pitting, crevice, and/or galvanic corrosion, exhibited by copper alloy in a closed-cycle cooling water (treated water) environment, is properly managed by AMP XI.M21, which ensures that system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396. Implementation of AMP XI.M21 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-35	Piping, piping components, and piping elements	Aluminum	Fuel oil	Loss of material/pitting, crevice, and microbiologically influenced corrosion	XI.M30 Fuel Oil Chemistry The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. Pitting, crevice and microbiologically influenced corrosion is a concern in stagnant conditions and when water is present. As shown in Ginna SER Section 3.3.2.4.8, the Staff has accepted the position that loss of material exhibited by aluminum in a fuel oil environment is properly managed by the Fuel Oil Chemistry AMP which monitors fuel oil quality and the levels of water and microbiological organisms in the fuel oil. Implementation of this program, augmented by XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-36	Piping, piping components, and piping elements	Aluminum	Air – indoor controlled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.14, the Staff has accepted the position that aluminum in an indoor controlled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. Aluminum has an excellent resistance to corrosion when exposed to humid air (uncontrolled indoor environment) the aluminum oxide film is bonded strongly to its surface and that, if damaged, reforms immediately in most environments. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometer thick but is highly effective in protecting the aluminum from corrosion (Hollingsworth and Hunsicker 1979). Therefore, aluminum exposed to indoor uncontrolled environment does not have any applicable aging effect. Reference: Hollingsworth, E. H., and Hunsicker, H. Y. 1979. "Corrosion Resistance of Aluminum and Aluminum Alloys," Metals Handbook Ninth Edition, Volume 2, Properties and Selection: Nonferrous Alloys and Pure Metals, pp. 204-236.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-37 SP-23	Piping, piping components, and piping elements	Aluminum	Gas	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Peach Bottom SER Section 3.2.6.2.1, the Staff has accepted the position that aluminum in a gas environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that aluminum is indicated to have excellent corrosion resistance in a gas environment (such as nitrogen) as cited in Corrosion Resistant Tables, Fifth Edition, Part C (Philip A. Schweitzer, ed.) Marcel Dekker, Inc. (2004), p. 2201. This unique MEAP combination refers only to internal gas environments from non-reactive and/or inert gases that are truly dry and free from possible contaminants. The AMP XI.M26 "Fire Protection" is used for the periodic inspection and testing of the halon/CO_2 fire suppression system.

Table II.A New AMR Line-items based on new ‘MEAP’ combinations relevant to Mechanical Systems (“A” for Auxiliary, “E” for Engineered Safety Features, “R” for Reactor Coolant, and “S” for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-38 SP-24 EP-26	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material/ pitting and crevice corrosion	XI.M2 Water Chemistry The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program. Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI. M32, “One-Time Inspection,” for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER Section 3.2.2.4.1, the Staff has accepted the position that loss of material is exhibited by aluminum in a demineralized water environment. Aluminum subjected to a similar treated water environment will similarly be subject to loss of material due to corrosion. As shown in D/QC SER Section 3.2.2.4.1, the aging effect is properly managed by the Water Chemistry AMP which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. Implementation of this program, augmented by XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-39	Heat exchanger components	Steel	Lubricating oil	Loss of material/ general, pitting, crevice and microbiologically influenced corrosion, and fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.2.4, the Staff has accepted the position that a steel heat exchanger shell in a lubricating oil environment exhibits a loss of material and, therefore, necessitates an aging management program. Water contained in the lubricating oil will cause corrosion in steel materials. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-40	Heat exchanger components	Steel	Air – outdoor (Ext)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring"	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 addressed this MEAP combination in VII.I.1-b where the external surfaces of steel components exposed to air, moisture, and humidity are vulnerable to general corrosion (essentially captured in GALL Rev. 1 by A-77 and A-78 in VII.I addressing external surfaces of components and miscellaneous bolting). This additional AMR line-item is created to consider the corrosion of steel heat exchanger components in outdoor air. AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-41	Heat exchanger components	Steel	Air – indoor uncontrolled (Ext)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring"	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 addressed this MEAP combination in VII.I.1-b where the external surfaces of steel components exposed to air, moisture, and humidity are vulnerable to general corrosion (essentially captured in GALL Rev. 1 by A-77 and A-78 in VII.I addressing external surfaces of components and miscellaneous bolting). This additional AMR line-item is created to consider the corrosion of steel heat exchanger components in indoor uncontrolled air. AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-43 EP-27 RP-12 SP-29	Piping, piping components, and piping elements	Copper alloy >15% Zn	Closed cycle cooling water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials "	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS Unit 1 SER Section 3.3.2.4.6, the Staff has accepted the position that selective leaching of copper-alloy in a closed-cycle cooling water environment is properly managed by the Selective Leaching of Materials Program, which includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of material due to selective leaching is occurring. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the zinc is not selectively leached away and a porous matrix of copper is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-44	Piping, piping components, and piping elements	Copper-alloy	Fuel oil	Loss of material/ pitting, crevice and microbiologically influenced corrosion	XI.M30 Fuel Oil Chemistry The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. Pitting and crevice corrosion occurs in this environment where water contamination could be present. MIC could also occur when the affected system operates at less than 212°F. As shown in NA/S SER Section 3.6.2, the Staff has accepted the position that loss of material exhibited by copper-alloy in a fuel oil environment is properly managed by the Fuel Oil Chemistry AMP, which monitors fuel oil quality and the levels of water and microbiological organisms in the fuel oil. This program is to be augmented by verifying the effectiveness of fuel oil chemistry control. Implementation of this program, augmented by XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-45 SP-31	Piping, piping components, and piping elements	Copper alloy	Raw water	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.14, the Staff has accepted the position that copper-alloy in a raw water environment exhibits a loss of material and therefore recommends management by a program. GALL Rev. 0 had a similar material, environment, aging effect, and program combination for auxiliary systems (VII.C1.1-a and C1.2-b) for loss of material in various metals exposed to raw water (captured in GALL Rev. 1 by AMR line-items A-43 in VII.C31 and A-44 in VII.C1 for copper alloy in raw water). This related AMR line-item was created to expand the environmental scope and thus encompass other auxiliary systems such as the emergency diesel generator system (H2) and in steam and power conversion systems such as auxiliary feedwater. The implementation of AMP XIM.20 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation based on the inspection and surveillance performed on these components.

Table II.A New AMR Line-items based on new ‘MEAP’ combinations relevant to Mechanical Systems (“A” for Auxiliary, “E” for Engineered Safety Features, “R” for Reactor Coolant, and “S” for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-47 SP-32 EP-45	Piping, piping components, and piping elements	Copper-alloy	Lubricating oil	Loss of material/pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER Section 3.3.2.4.14, the Staff has accepted the position that copper-alloy in a lubricating oil environment exhibits a loss of material and therefore recommends management by a program. GALL Rev. 0 had a similar material, environment, aging effect, and program combination for loss of material in steel and copper alloy in fire protection auxiliary systems (G.7-b, which is captured in GALL Rev. 1 by AMR line-item A-83 in VII.G). This related AMR line-item was created to address different structures and components. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-48 SP-33	Piping elements	Glass	Air	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER Section 3.2.2.4.1 and FCS SER Section 3.3.2.4.6, the Staff has accepted the position that glass in an air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that operating experience cited in St. Lucie SER Section 3.3.2.4.1 states that no attack of sight glasses in the component water cooling system was observed in an air environment. The book, <u>Corrosion Guide</u>, Second Edition, by Erich Rabald, (Elsevier Publishing Company, 1968), p. 781 states that borosilicate glasses exhibit good corrosion resistance to steam at temperatures up to 300°C (572°F) under no pressure, but these same glasses exhibit corrosion rates of between 1.2 and 1.8 g/m^2 per hour in steam at 176°C (349°F) at a pressure of 9 atm. In high-pressure steam, these glasses are stated to be unsatisfactory.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-49	Piping elements	Glass	Fuel oil	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.5, the Staff has accepted the position that glass in a fuel oil environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. Borosilicate glass is identified as compatible with fuel oil at temperatures up to 116°C (240°F) as cited in <u>Corrosion Resistant Tables</u>, Fifth Edition, Part B (Philip A. Schweitzer, ed.) Marcel Dekker, Inc. (2004), p. 1458. To summarize, glass as a material is impervious to normal plant environments.
AP-50 EP-28 SP-34	Piping elements	Glass	Raw water	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Handbook of Glass Properties, N. P. Bansal and R. H. Doremua, silicate glasses are highly inert. Operating experience also shows that there are no aging related failures of glass in this environment. Therefore, glass in a raw water environment exhibits no aging effect and the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-51 EP-29 SP-35	Piping elements	Glass	Treated water	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.16, the Staff has accepted the position that glass in a treated water environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that glass as a material is impervious to normal plant environments.
AP-52 EP-30	Piping elements	Glass	Treated borated water	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in St. Lucie SER Section 3.2.2.1.1, the Staff has accepted the position that glass in a treated borated water environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-53	Piping, piping components, and piping elements	Nickel-alloy	Raw water	Loss of material/pitting and crevice corrosion	XI.M20 Open-Cycle Cooling Water System	Nickel based alloys are particularly susceptible to pitting and crevice attack because of the passive nature of these alloys. Any localized attack tends to progress rapidly at the point of attack as cited in Smithells Metals Reference Book, p. 31-5. The Staff has accepted the position that loss of material exhibited by nickel-alloy in a raw water environment is properly managed by the Open-Cycle Cooling Water System AMP which includes surveillance and control techniques to manage aging effects caused by biofouling, corrosion, erosion, protective coating failure, and silting. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-54	Piping, piping components, and piping elements	Stainless Steel	Fuel oil	Loss of material/pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M30, "Fuel Oil Chemistry" The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in the NA/S SER Section 3.6.4.2 and the FCS SER Section 3.3.2.4.5, the Staff has accepted the position that loss of material exhibited by stainless steel in a fuel oil environment is properly managed by the Fuel Oil Chemistry AMP which monitors fuel oil quality and the level of contamination from water and micro-organisms in the fuel oil. The implementation of this program, as augmented by AMP XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-55 EP-55 SP-36	Piping, piping components, and piping elements	Stainless Steel	Raw water	Loss of material/pitting, and crevice, and microbiologically influenced corrosion	Chapter XI.M20 Open-Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in ANO-1, Unit 1 SER Section 3.3.4.2, the Staff has accepted the position that stainless steel in a raw water environment exhibits a loss of material and therefore recommends management by a program. The aging effect is adequately managed by AMP XI.M20. Implementation of AMP XI.M20 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-56 EP-31 SP-37	Piping, piping components, and piping elements	Stainless Steel	Soil	Loss of material/pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER Section 3.4.2.4.3, the Staff has accepted the position that stainless steel in a soil environment exhibits a loss of material and therefore recommends management by a program. Soil can present an aggressive environment in the context of aging degradation. Such an aggressive environment consisting of a wetted surface or pooled liquid, oxygen, and contaminants must be present for pitting and crevice corrosion to occur. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-59 SP-38	Piping, piping components, and piping elements	Stainless Steel	Lubricating oil	Loss of material/pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in NA/S SER Section 3.6.2 and FCS SER Section 3.3.2.4.14, the Staff has accepted the position that stainless steel in a lubricating oil environment exhibits a loss of material and therefore recommends management by a program. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-60 EP-44 SP-54	Piping, piping components, and piping elements	Stainless Steel	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 had this material, environment, aging effect and program combination for the heat exchanger channel head and access cover, tubesheet, tubes, and shell and access cover in the BWR reactor water cleanup system (VII.E3.4-a) which is essentially captured in GALL Rev. 1 by A-68. A-68 addressed heat exchanger shell side components including tubes. This AMR line-item was created to also consider the SCC of stainless steel piping, piping components, and piping elements. AMP XI.M21, "Closed-Cycle Cooling Water System" has been revised to include stress corrosion cracking. Thus, this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-61	Heat exchanger components	Stainless Steel	Raw water	Reduction of heat transfer/ fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.15, the Staff has accepted the position that reduction of heat transfer exhibited by stainless steel heat exchanger components in a raw water environment is properly managed by the Open-Cycle Cooling Water System AMP which includes surveillance and control techniques to manage aging effects caused by fouling, corrosion, erosion, protective coating failure, and silting. GALL Rev. 0 had this material, environment, aging effect and program combination only for the steam and power conversion system (VIII: E.4-c, F.4-c and G.5-b) which is essentially captured in GALL Rev. 1 by S-28 addressing reduction of heat transfer in the PWR steam generator blowdown system heat exchanger components. This additional AMR line-item AP-61 is created to also consider the reduction of heat transfer of stainless steel heat exchanger components in auxiliary systems such as the open-cycle cooling water, the ultimate heat sink, and the fire protection systems. AMP XI.M20 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-62 EP-34 SP-40	Heat exchanger tubes	Stainless Steel	Treated water	Reduction of heat transfer/ fouling	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.3.2, the Staff has accepted the position that stainless steel in a treated water environment exhibits a reduction of heat transfer and that control of water chemistry provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. Implementation of AMP XI.M2, as augmented by AMP XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-63 EP-35 SP-41	Heat exchanger tubes	Stainless Steel	Closed cycle cooling water	Reduction of heat transfer/ fouling	Chapter XI.M21 Closed-Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.2, the Staff has accepted the position that reduction of heat transfer exhibited by stainless steel heat exchanger components in a closed-cycle cooling water (treated water – other) environment is properly managed by the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396 and surveillance testing and inspections are conducted to ensure component functionality. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-64	Piping, piping components, and piping elements	Copper alloy	Treated water	Loss of material/ pitting, crevice, and galvanic corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.0.3.7.3, the Staff has accepted the position that loss of material from pitting, crevice, and/or galvanic corrosion, exhibited by copper alloy in a closed-cycle cooling water (treated water) environment recommends an aging management program. The aging effect is adequately managed by AMP XI.M2. Implementation of AMP XI.M2, as augmented by AMP XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-65	Heat exchanger components	Copper alloy >15% Zn	Treated water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	As shown in FCS Unit 1 SER Section 3.3.2.4.6, the Staff has accepted the position that selective leaching of copper-alloy in a treated water environment is properly managed by the Selective Leaching of Materials Program, which includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of material due to selective leaching is occurring. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the zinc is not selectively leached away and a porous matrix of copper is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-66 EP-38	Piping, piping components and piping elements	Copper alloy >15% Zn	Air with borated water leakage	Loss of material/boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	Copper alloy >15% Zn piping, piping components, and piping elements when subject to air with borated water leakage are subject to loss of material due to boric acid corrosion. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER Section 3.0.3.1.1, the Staff has accepted the position that loss of material due to aggressive chemical attack (boric acid corrosion) exhibited by copper alloy > 15% Zn (brass) in an air with borated water leakage environment is properly managed by the Boric Acid Corrosion AMP which provides engineering evaluations and corrective actions to ensure that boric acid corrosion does not lead to degradation of the leakage source or adjacent structures or components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
AP-73	Piping, piping components, and piping elements	Stainless steel	Sodium pentaborate solution	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. The sodium pentaborate solution will effectively be a treated water environment. Sodium pentaborate solution is relatively benign for stainless steel. As for other cases of stainless steel in treated water (e.g., A-58) loss of material is a possible aging effect. XI.M2 and XI.M32 are acceptable AMPS for this MEAP combination based on similar rows in the GALL (e.g., A-59). AMP XI.M2 can be credited for managing the aging mechanism of corrosion.
AP-74	Piping, piping components, and piping elements	Aluminum	Condensation	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. ANO-2 SER Section 3.3.2.3.11 acknowledged that aluminum components in a condensation environment are subject to loss of material. Aluminum may be used in HVAC systems where condensation is a possible environment. This line is similar to lines AP-38, EP-26, and SP-24 which address loss of material for aluminum in a treated water environment, in that the condensation environment is frequently wetted. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-75	Elastomer seals and components	Elastomers	Raw water	Hardening and loss of strength/ elastomer degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. CNP SER Section 3.3.2.3.2 acknowledged the potential for a change of material properties for elastomeric components exposed to a raw water environment in the open-cycle cooling water system. In CNP SER Section 3.3.2.1.2 the Staff accepted that hardening and loss of strength is adequately managed by AMP XI.M20. AMP XI.M20 has been revised to specifically address elastomers. Cleanliness and material integrity of elastomers that are part of the Open-Cycle Cooling Water (OCCW) system or that are cooled by the OCCW system are periodically inspected, monitored, or tested.
AP-76	Elastomer seals and components	Elastomers	Raw water	Loss of material/ erosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. CNP SER Section 3.3.2.3.2 acknowledged the potential for a change of material properties for elastomeric components exposed to a raw water environment in the open-cycle cooling water system. In CNP SER Section 3.3.2.1.2 the Staff accepted that loss of material is adequately managed by AMP XI.M20. AMP XI.M20 has been revised to specifically address elastomers. Cleanliness and material integrity of elastomers that are part of the Open-Cycle Cooling Water (OCCW) system or that are cooled by the OCCW system are periodically inspected, monitored, or tested.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-77	Heat exchanger tubes	Steel	Closed cycle cooling water	Reduction of heat transfer/ fouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this environment, aging effect and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.2, the Staff has accepted the position that reduction of heat transfer exhibited by stainless steel heat exchanger components in a closed-cycle cooling water environment is properly managed by the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396 and surveillance testing and inspections are conducted to ensure component functionality. The basis for this new line is the same as AP-63 except that the material is steel versus stainless steel. Implementation of AMP XI.M21 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-78	Piping, piping components, and piping elements	Copper alloy	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	Line-item A-46 addresses copper alloy components in a condensation (external) environment. This item has an identical aging effect as A-46; the only difference is that the condensation is on the internal surface of the component in the fire protection system. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-79	Piping, piping components, and piping elements	Stainless Steel; Steel with stainless steel cladding	Treated borated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 stated that "the effects of pitting and crevice corrosion (loss of material) on stainless steel are not significant in reactor coolant (i.e., treated borated water), and therefore are not included" as an aging effect that required management (i.e., an AMR line-item was not included in the GALL Report). This statement is true for PWRs in part because water chemistry program requirements minimize contaminants that could lead to a loss of material. The Staff has removed this statement from the GALL Report and has added this new AMR line-item in the GALL Rev. 1 Report for PWRs, which although no significant loss of material is expected, recognizes that applicants can manage loss of material in stainless steel in a treated borated water environment by virtue of their use of a water chemistry program which meets XI.M2.

Table II.A New AMR Line-items based on new ‘MEAP’ combinations relevant to Mechanical Systems (“A” for Auxiliary, “E” for Engineered Safety Features, “R” for Reactor Coolant, and “S” for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-80 EP-39 SP-57	Heat exchanger tubes	Copper Alloy	Closed cycle cooling water	Reduction of heat transfer/ fouling	Chapter XI.M21, “Closed-Cycle Cooling Water System”	An approved precedent exists for adding this environment, and aging effect combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.2, the Staff has accepted the position that reduction of heat transfer exhibited by heat exchanger components in a closed-cycle cooling water environment is properly managed by the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396 and surveillance testing and inspections are conducted to ensure component functionality. Implementation of this AMP provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the extended period of operation. This row is similar to AP-63 except that the material is copper alloy instead of stainless steel.
AP-81	Piping, piping components, and piping elements	Stainless steel	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	Chapter XI.M24, “Compressed Air Monitoring”	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. As shown in FNP SER Section 3.3.2.3.19, the Staff has accepted the position that loss of material from pitting and crevice corrosion is exhibited by stainless steel in a condensation internal (wetted air/gas) environment and therefore recommends management by a program. AMP XI.M24 provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
AP-82	Piping, piping components, piping elements, and tanks	Stainless steel	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water	An approved precedent exists for adding this material, environment, and aging effect combination item to Chapter VII of the GALL Report. This row is identical to E-12 in Chapter V of the GALL. This new line has been added to the PWR Chemical and Volume Control System.
AP-83	Piping, piping components, and piping elements	Aluminum	Raw water	Loss of material/ pitting and crevice corrosion	Chapter XI.M26, "Fire Protection"	An approved precedent exists for adding this material, environment, and aging effect combination item to the GALL Report. FNP SER Section 3.3.2.3.13 for the fire protection system acknowledged (by reference to Table 3.3.2-13 of the FNP LRA) that aluminum components in a raw water environment are subject to loss of material which can be managed by the fire protection program. This line is similar to lines AP-38, EP-26, and SP-24 which address loss of material for aluminum in a treated water environment.
AP-85 EP-49	Pump Casings	Steel with stainless steel cladding	Treated borated water	Loss of material/ cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. The management of aging effects of pump casings was addressed by the Staff in FNP SER Section 3.0.3.3.4. Unique problems with stainless cladding have been identified for high head safety injection pump as discussed in NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks." This line-item is similar to V.D1.2-a from GALL Rev. 0. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-3	Piping, piping components, and piping elements	Aluminum	Air – indoor uncontrolled (Int/Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.3.2.4.5.1, the Staff has accepted the position that aluminum in an indoor, uncontrolled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. Aluminum has an excellent resistance to corrosion. When exposed to humid air (uncontrolled indoor environment), the aluminum oxide film bonds strongly to the aluminum surface. If damaged, this film reforms immediately in most environments. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometer thick but is highly effective in protecting the aluminum from corrosion. Therefore, aluminum exposed to indoor uncontrolled environment does not have any applicable aging effect (Hollingsworth and Hunsicker 1979).

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-10 SP-6	Piping, piping components, and piping elements	Copper-alloy	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.2.2.4.4.2, the Staff has accepted the position that copper alloy in an indoor, uncontrolled air environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that comprehensive tests conducted over a 20-year period under the supervision of ASTM have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in Metals Handbook, Volume 13, Corrosion, American Society for Metals, 1987.
EP-32	Piping, piping components, and piping elements	Stainless Steel	Treated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in NA/S SER Section 3.6.2, the Staff has accepted the position that stainless steel in a treated water environment exhibits a loss of material and therefore recommends management by a program. Pitting of stainless steel components is primarily related to the presence of detrimental ionic species such as chlorides, fluorides, and sulfates. Crevice corrosion of stainless steel components is primarily related to the presence of significant levels of dissolved oxygen. Implementation of AMPs XI.M2 and M32 provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. Use of these programs for this material, environment, aging effect, and program combination is consistent with other AMR line-items in the GALL Report.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
EP-33 SP-39	Piping, piping components, and piping elements	Stainless Steel	Closed cycle cooling water	Loss of material/pitting and crevice corrosion	Chapter XI.M21 Closed-Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 had this material, environment, aging effect, and program combination for the closed-cycle cooling water system (VII.C2.2-a) which is captured in GALL Rev. 1 as the corresponding A-52. Since GALL Rev. 0 did not include this material, environment, aging effect, and program combination for the ESF or SPCS systems, new AMR line-items have been created to address this oversight. The aging effect is adequately managed by the Closed-Cycle Cooling Water System AMP, which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-37	Heat Exchanger components	Copper alloy >15% Zn	Closed cycle cooling water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials "	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS Unit 1 SER Section 3.3.2.4.6, the Staff has accepted the position that selective leaching of copper-alloy >15% Zn in a closed-cycle cooling water environment is properly managed by the Selective Leaching of Materials Program, which includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of material due to selective leaching is occurring. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the zinc is not selectively leached away and a porous matrix of copper is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-40 SP-63	Heat exchanger tubes	Steel	Lubricating oil	Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. The D.C. Cook SER Section 3.2.2.3.3 acknowledged the potential for fouling of copper alloy components in a lubricating oil environment. The SER addressed components in a PWR ECCS system, but these conditions would be equally applicable to components of other lube oil systems. Steel heat exchanger tubes would also be subject to fouling in a lubricating oil environment. The reduction of heat transfer due to fouling of heat exchanger tubes will be managed by AMP XI.M39, as augmented by XI.M32. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
EP-41	Piping, piping components, piping elements, and tanks	Stainless steel	Treated borated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 stated that "the effects of pitting and crevice corrosion (loss of material) on stainless steel are not significant in reactor coolant (i.e., treated borated water), and therefore are not included" as an aging effect that required management (i.e., an AMR line-item was not included in the GALL Report). This statement is true for PWRs in part because water chemistry program requirements minimize contaminates that could lead to a loss of material. The Staff has removed this statement from the GALL Report and has added this new AMR line-item in the GALL Rev. 1 Report for PWRs, which although no significant loss of material is expected, recognizes that applicants can manage loss of material in stainless steel in a treated borated water environment by virtue of their use of a water chemistry program which meets XI.M2.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
EP-42	Encapsulation Components	Steel	Air – indoor uncontrolled (Internal)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. Encapsulation components were previously not in the GALL Report, but a precedent exists for including these items based on the Millstone and FNP LRAs and corresponding NRC Staff reviews. The Staff accepted aging management programs identified by these applicants for these material and environment combinations for loss of material in the SERs, Millstone SER Section 2.3A.2.3 and FNP SER Section 3.2.2.2.2. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-43	Encapsulation Components	Steel	Air with borated water leakage (Internal)	Loss of material/ general, pitting, crevice and boric acid corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. Encapsulation components were previously not in the GALL Report, but a precedent exists for including these items based on the Millstone and FNP LRAs and corresponding NRC Staff reviews. The Staff accepted aging management programs identified by these applicants for these material and environment combinations for loss of material in the SERs, Millstone SER Section 2.3A.2.3 and FNP SER Section 3.2.2.2.2. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. (Note: this leakage is on the inside of the encapsulation components). See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-47 SP-53	Heat exchanger tubes	Copper alloy	Lubricating oil	Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. D.C. Cook SER Section 3.2.2.3.3 acknowledged the potential for fouling of copper alloy components in a lubricating oil environment. The SER addressed components in a PWR ECCS system, but these conditions would be equally applicable to components of other lube oil systems. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
EP-48 RP-10	Piping, piping components, and piping elements	Steel	Closed cycle cooling water	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 had a similar material, environment, aging effect, and program combination for the corrosion of steel heat exchanger shell side components including tubes in the PWR emergency core cooling system (V.D1.6-a). GALL Rev. 1 captured this line-item in E-17 but this corresponding AMR line-item has been extended to the ESF Containment Isolation Components section and the RCS Chapter IV. AMP XI.M21 provides for proper management of the aging effects for this MEAP combination. Thus, implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-50 SP-62	Heat exchanger tubes	Stainless steel	Lubricating oil	Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	CNP SER Section 3.2.2.3.3 acknowledged the potential for fouling of copper alloy components in a lubricating oil environment. The SER addressed components in a PWR ECCS system, but these conditions would be equally applicable to components of other lube oil systems. Stainless steel heat exchanger tubes would also be subject to fouling in a lubricating oil environment. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
EP-51	Piping, piping components, and piping elements	Stainless steel	Lubricating oil	Loss of material/ pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	The GALL Report assumes contaminants or moisture for the lubricating oil environment; therefore, this item was added to address the potential for loss of material as a plausible aging effect that should be managed with stainless steel. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
EP-52	Piping, piping components, piping elements	Gray cast iron	Closed cycle cooling water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	This line is similar to AP-31 and SP-27 except they apply to treated water environments. In the closed-cycle cooling water environment, gray cast iron exhibits a loss of material due to selective leaching and therefore recommends management by a program. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the iron matrix is not selectively leached away and a porous matrix of graphite is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
EP-53	Piping, piping components, piping elements internal surfaces, and tanks	Stainless steel	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	The basis for this new line-item is similar to AP-72. The addition of this item extends the MEAP combination for BWRs contained in E-14 to PWRs. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
RP-13	Bottom-mounted guide tube	Stainless steel	Reactor coolant leakage	Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In the RNP SER section 3.1.2.4.6.6, the Staff has accepted the position that cracking due to SCC is exhibited by stainless steel with reactor coolant leakage. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-14	Steam generator structural Anti-vibration bars	Chrome plated steel; stainless steel; Nickel alloy	Secondary feedwater/ steam	Cracking/ stress corrosion cracking	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In the NA/S SER section 3.4.5, the Staff has accepted the position that cracking due to SCC is exhibited by stainless steel and nickel alloy in a secondary feedwater/steam environment. This aging effect/mechanism is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. AMPs XI.M19 and XI.M2 provides for proper management of the aging effects for this MEAP combination. The implementation of these AMPs provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
RP-15	Steam generator structural Anti-vibration bars	Chrome plated steel; stainless steel; Nickel alloy	Secondary feedwater/ steam	Loss of material/ crevice corrosion and fretting	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In several PWR plant license renewal SERs, the Staff has accepted the position that loss of material due to crevice corrosion and fretting is exhibited by stainless steel and nickel alloy in a secondary feedwater/steam environment. This aging effect/mechanism is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. AMPs XI.M19 and XI.M2 provides for proper management of the aging effects for this MEAP combination. The implementation of these AMPs provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new ‘MEAP’ combinations relevant to Mechanical Systems (“A” for Auxiliary, “E” for Engineered Safety Features, “R” for Reactor Coolant, and “S” for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-16	Steam generator Tube bundle wrapper	Steel	Secondary feedwater/ steam	Loss of material/ erosion, general, pitting, and crevice corrosion	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In NA/S SER section 3.4.5, the Staff has accepted the position that loss of material due to general, pitting, and crevice corrosion is exhibited by steel in a secondary feedwater/steam environment. This aging effect/mechanism is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. AMPs XI.M19 and XI.M2 provides for proper management of the aging effects for this MEAP combination. The implementation of these AMPs provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-17	Primary Side Divider Plate	Stainless steel	Reactor coolant	Cracking/ Stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In RNP SER section 3.1.2.4.6.7, the Staff has accepted the position that cracking due to SCC is exhibited by nickel alloy in a reactor coolant environment. This aging effect/mechanism is properly managed by the Inservice Inspection and Water Chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. Stainless steel would behave similarly to nickel alloy. While the ISI Program was cited in the above SER, this program is not generically used to manage the aging effect for this component. Thus, the Staff determined that only program XI.M2 is necessary to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
RP-18	Steam Dryers	Stainless steel	Reactor coolant	Cracking/ flow-induced vibration	A plant-specific aging management program is to be evaluated.	In the D/QC SER, Appendix A, commitment 9, for plants performing extended power uprate, steam dryers are in scope for category (a)(2), and may exhibit cracking due to flow-induced vibration and therefore require management by a program. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-21	Primary Side Divider Plate	Nickel alloy; steel with nickel-alloy cladding	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In RNP SER section 3.1.2.4.6.7, the Staff has accepted the position that cracking due to SCC is exhibited by nickel alloy in a reactor coolant environment. This aging effect/mechanism is properly managed by the Inservice Inspection and Water Chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. While the ISI Program was cited in the above SER, this program is not generically used to manage the aging effect for this component. Thus, the Staff determined that only program XI.M2 is necessary to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-22	Pressurizer surge and steam space nozzles and welds	Nickel alloy	Reactor coolant/ steam	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In the VCS SER section 3.1.2.4.6, the Staff has accepted the position that cracking due to PWSCC is exhibited by nickel alloy in a reactor coolant environment. This aging effect/mechanism is properly managed by the Inservice Inspection and Water Chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on pressurizer components. Programs XI.M1 and XI.M2, supplemented by NRC Orders, Bulletins or Generic Letters and staff accepted industry guidelines, provide the additional guidance to ensure that the component's intended functions will be maintained within the CLB for the extended period of operation. However, if alloy 600 or its associated weld materials (alloy 82/182) is used, the Staff has requested a commitment in the FSAR supplement as stated. AMR line-item RP-22 was added to identify primary water stress corrosion cracking (PWSCC) of the pressurizer steam space nozzles and was added on the basis of a study of domestic operating experience. The NRC Office of Research provided a 128-item listing of LERs related to failures, cracking, degradation, etc of passive components.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-23	Piping, piping components, and piping elements; flanges; heater sheaths and sleeves; penetrations; thermal sleeves; vessel shell heads and welds	Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	GALL Rev. 0 stated that "the effects of pitting and crevice corrosion on stainless steel are not significant in reactor coolant (i.e., treated borated water), and therefore are not included" as an aging effect that required management (i.e., an AMR line-item was not included in the GALL Report). This statement is true for PWRs in part because water chemistry program requirements minimize contaminates that could lead to a loss of material. The Staff has removed this statement from the GALL Report and has added this new AMR line-item in the GALL Rev. 1 Report for PWRs, which although no significant loss of material is expected, recognizes that applicants can manage loss of material in stainless steel in a treated borated water environment by virtue of their use of a water chemistry program which meets XI.M2. The above approach for managing loss of material in treated borated water also applies to nickel alloy.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-24	Reactor vessel internals components	Stainless steel; nickel alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	GALL Rev. 0 stated that "the effects of pitting and crevice corrosion (loss of material) on stainless steel are not significant in reactor coolant (i.e., treated borated water), and therefore are not included" as an aging effect that required management (i.e., an AMR line-item was not included in the GALL Report). This statement is true for PWRs in part because water chemistry program requirements minimize contaminates that could lead to a loss of material. The Staff has removed this statement from the GALL Report and has added this new AMR line-item in the GALL Rev. 1 Report for PWRs which, although no loss of material is expected, recognizes that applicants can manage loss of material in stainless steel in a treated borated water environment by virtue of their use of a water chemistry program which meets XI.M2. The above approach for managing loss of material in treated borated water also applies to nickel alloy.
RP-25	Reactor Vessel: Flanges, nozzles; penetrations; safe ends; vessel shells, heads and welds	Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor Coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Unlike the PWR reactor coolant environment (see RP-24 above), the BWR treated water environment does not contain boron (which is a recognized corrosion inhibitor). Thus for this AMR line-item related to BWRs, it is necessary to have the AMP XI.M2, "Water Chemistry," augmented by verifying the effectiveness of water chemistry control.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-26	Reactor vessel internals components	Stainless steel; nickel alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry" for BWR water	The Staff added this line-item for consistency with RP-28. However, unlike the PWR reactor coolant environment, the BWR reactor coolant environment (i.e., treated water) does not contain boron, a recognized corrosion inhibitor. Therefore, for this AMR line-item, it is necessary to have the Chapter XI.M2, "Water Chemistry" AMP augmented by verifying the effectiveness of water chemistry control. NRC Staff determined that the appropriate AMP description is Chapter XI.M2, "Water Chemistry," for BWR water and Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for these Class 1 components with no further evaluation. The above approach for managing any significant loss of material in reactor coolant (treated water) also applies to nickel alloy.
RP-27	Reactor coolant pressure boundary components	Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	The Staff added this line-item for consistency with RP-28 and RP-25. However, unlike the PWR reactor coolant environment, the BWR reactor coolant environment (i.e., treated water) does not contain boron, a recognized corrosion inhibitor. Therefore, for this AMR line-item, it is necessary to have the Chapter XI.M2, "Water Chemistry" AMP augmented by verifying the effectiveness of water chemistry control.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-28	Flanges, nozzles; penetrations; pressure housings; safe ends; vessel shells, heads and welds	Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor Coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water chemistry," for PWR primary water	GALL Rev. 0 stated that "the effects of pitting and crevice corrosion (loss of material) on stainless steel are not significant in reactor coolant (i.e., treated borated water), and therefore are not included" as an aging effect that required management (i.e., an AMR line-item was not included in the GALL Report). This statement is true for PWRs in part because water chemistry program requirements minimize contaminants that could lead to a loss of material. As part of the public comment process, the Staff has removed this statement from the GALL Report and has added this new AMR line-item in the GALL Rev. 1 Report for PWRs which, although no significant loss of material is expected, recognizes that applicants can manage loss of material in stainless steel in a treated borated water environment by virtue of their use of a water chemistry program that meets XI.M2. The above approach for managing loss of material in treated borated water also applies to nickel alloy.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
RP-31	Piping, piping components, and piping elements	Nickel alloy	Reactor coolant/ steam	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. In the VCS SER section 3.1.2.2.7, the Staff has accepted the position that cracking due to PWSCC is exhibited by nickel alloy in a reactor coolant environment. This aging effect/mechanism is properly managed by the Inservice Inspection and Water Chemistry programs which ensure that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on pressurizer components. Implementation of AMPs XI.M1 and XI.M2, supplemented by NRC Orders, Bulletins or Generic Letters and staff accepted industry guidelines, provides the additional guidance to assure that the component's intended functions will be maintained within the CLB for the extended period of operation. However, if alloy 600 or its associated weld materials (alloy 82/182) is used, the Staff has requested a commitment in the FSAR supplement as stated. This AMR line-item is an expansion of RP-22. AMR line-item RP-22 was added to identify primary water stress corrosion cracking (PWSCC) of the pressurizer steam space nozzles and was added on the basis of a study of domestic operating experience.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-16	Piping, piping components and piping elements	Stainless steel	Treated water	Loss of material/ pitting and crevice corrosion	XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Piping, piping components, and piping elements in the PWR feedwater system (VIII.D1) and the steam generator blowdown system (VIII.F), if made of stainless steel and exposed to treated water, can be subject to loss of material due to pitting and crevice corrosion. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in NA/S SER Section 3.6.2, the Staff has accepted the position that stainless steel in a treated water environment exhibits a loss of material and therefore recommends management by a program. Pitting of stainless steel components is primarily related to the presence of detrimental ionic species such as chlorides, fluorides, and sulfates. Crevice corrosion of stainless steel components is primarily related to the presence of significant levels of dissolved oxygen. The aging effect is adequately managed by the Water Chemistry AMP, which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. Consistent with GALL Rev. 0, the AMP is augmented by one-time inspection to confirm that unacceptable degradation is not occurring and that the concentration of chemical contaminants falls within acceptable limits. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-17	Piping, piping components and piping elements	Stainless steel	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	XI.M2, "Water Chemistry," for PWR secondary. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination in GALL Rev. 1. GALL Rev. 0 had a similar MEAP combination for auxiliary systems (VII.E3.1-a) for crack initiation and growth due to SCC and IGSCC in stainless steel piping (captured in GALL Rev. 1 by AMR line-item A-60 in VII.E3 for the reactor water cleanup system). This related AMR line-item was created to extend the MEAP combination to the applicable PWR steam and power conversion systems. The aging effect is adequately managed by the Water Chemistry AMP, which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. The AMP is augmented by one-time inspection to confirm that unacceptable degradation is not occurring. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-18	Piping, piping components and piping elements	Nickel-based alloys	Steam	Loss of material/ pitting and crevice corrosion	XI.M2, "Water Chemistry," for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As discussed in RNP SER section 3.1.2.4.1, pg. 3-136, the Staff has accepted the position that nickel alloy in a treated water/steam environment exhibits a loss of material and therefore recommends management by a program. In GALL Rev. 0, nickel alloy recirculating steam generator tubes and sleeves (IV D1.2-f) in steam environment were considered to be subject to loss of material due to wastage and pitting corrosion. In VCS SER Section 3.1.2.4.7, the Staff concluded that the chemistry program is acceptable for managing loss of material due to pitting and crevice corrosion in nickel-based components. Pitting of nickel alloy components is primarily related to the presence of detrimental ionic species such as chlorides, fluorides, and sulfates. Crevice corrosion of nickel alloy components is primarily related to the presence of significant levels of dissolved oxygen. The aging effect is adequately managed by the Water Chemistry AMP, which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. Because the steam is specified as dry in line-item SP-18 and thus not as corrosive, only the Water Chemistry program is required and further augmentation is not needed. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-19	Piping, piping components and piping elements	Stainless steel	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for BWR Water. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report for piping, piping components, and piping elements in the BWR steam and power conversion condensate system (VIII.E). GALL Rev. 0 had a similar MEAP combination for auxiliary systems (VII.E3.1-a) for crack initiation and growth due to SCC and IGSCC in stainless steel piping (captured in GALL Rev. 1 by AMR line-item A-60 in VII.E3 for the reactor water cleanup system). The aging effect is adequately managed by the Water Chemistry AMP, which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. The AMP is augmented by one-time inspection to confirm that unacceptable degradation is not occurring. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-26 EP-54	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS Unit 1 SER Section 3.3.2.4.16, the Staff has accepted the position that gray cast iron in a soil environment exhibits a loss of material due to selective leaching and therefore recommends management by a program. GALL Rev. 0 had a similar MEAP combination for auxiliary systems (VII.C1.1-c) for loss of material due to selective leaching and general corrosion in cast iron piping in soil (captured in GALL Rev. 1 by A-02 in VII.C1). This related AMR line-item was created to focus only on selective leaching as an aging mechanism for specified auxiliary systems. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the iron matrix is not selectively leached away and a porous matrix of graphite is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-28	Piping, piping components, and piping elements	Gray cast iron	Raw water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.3.2.4.5 and FCS Unit 1 SER Section 3.3.2.4.1, the Staff has accepted the position that gray cast iron in a raw water environment exhibits a loss of material due to selective leaching and therefore recommends management by a program. The aging effect is adequately managed by AMP XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that the iron matrix is not selectively leached away and a porous matrix of graphite is left. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
SP-30	Piping, piping components, and piping elements	Copper alloy >15% Zn	Raw water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in FCS SER Section 3.3.2.4.14, the Staff has accepted the position that copper alloy >15%Zn in a raw water environment exhibits a loss of material due to selective leaching and therefore recommends management by a program. Per EPRI TR-1003056, copper alloy >15%Zn is considered susceptible to selective leaching. The aging effect due to selective leaching is adequately managed by AMP XI.M33 which includes a hardness test or a destructive test to confirm that zinc is not leaching out, and that the material is not becoming soft. Implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-42	Tanks	Stainless Steel	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. Condensate system storage tanks (VIII.E) containing treated water are subject to cracking due to SCC, a potential aging mechanism for stainless steels with operating temperatures >140°F. Chlorides, fluorides, sulfates, and dissolved oxygen are contributors to SCC. As shown in NA/S SER Section 3.5.2, the Staff has accepted the position that cracking exhibited by stainless steel in treated water > 140°F environment is properly managed by the Chemistry Control AMP which includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. AMP XI.M2 is augmented by one-time inspection to confirm that unacceptable degradation is not occurring. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
SP-43	Piping, piping components, and piping elements	Stainless steel	Steam	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER, section 3.4.2.4.5, the Staff has accepted the position that loss of material due to pitting and crevice corrosion exhibited by stainless steel in steam is properly managed by the Water Chemistry AMP which includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
SP-44	Piping, piping components, and piping elements	Stainless steel	Steam	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR secondary water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER, section 3.4.2.4.5, the Staff has accepted the position that cracking due to SCC exhibited by stainless steel in steam is properly managed by the Water Chemistry AMP which includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
SP-45	Piping, piping components, and piping elements	Stainless steel	Steam	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER, section 3.4.2.4.1, the Staff has accepted the position that cracking exhibited by stainless steel in steam is properly managed by the Water Chemistry AMP which includes specifications for chemical species, sampling, analysis frequencies, and corrective actions for control of reactor water chemistry. The AMP is augmented by one-time inspection, based on operating experience for BWRs that SCC occurs in this environment, to confirm that unacceptable degradation is not occurring. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-46	Piping, piping components, and piping elements	Stainless steel	Steam	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER, section 3.4.2.4.1, the Staff has accepted the position that loss of material due to pitting and crevice corrosion exhibited by stainless steel in steam is properly managed by the Water Chemistry AMP which includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
SP-56	Heat exchanger tubes	Copper alloy	Raw water	Reduction of heat transfer/ fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect, and program combination to Chapter VIII of the GALL Report. This line-item has the same MEAP combination as A-72.
SP-58	Heat exchanger tubes	Copper alloy	Treated water	Reduction of heat transfer/ fouling	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	This row applies to heat exchangers in any system with treated water on either side of the tubes. The basis for this new line-item is similar to SP-40 except that the material is copper alloy instead of stainless steel. Copper alloy in a treated water environment exhibits the same aging effect as stainless steel. AMP XI.M2 program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-59	Piping, piping components, and piping elements	Steel	Air – outdoor (Internal)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	An approved precedent exists for adding this material, environment, aging effect, and program combination to Chapter VIII of the GALL Report. This row was added to cover the interior surfaces of the main steam safety vents to the atmosphere downstream of the safety valves. This line-item is similar to other lines with the combination of steel, outdoor air, and loss of material, such as line-item A-24. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
SP-60	Piping, piping components, and piping elements	Steel	Condensation (Internal)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	An approved precedent exists for adding this material, environment, aging effect, and program combination to Chapter VIII of the GALL Report. This row covers steam piping that is empty in standby condition during normal operations, such as AFW turbine steam lines during normal operation. This line-item is the same as A-23. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.A New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" for Auxiliary, "E" for Engineered Safety Features, "R" for Reactor Coolant, and "S" for Steam and Power Conversion)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
SP-61	Piping, piping components, and piping elements	Copper alloy	Treated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	An approved precedent exists for adding this material, environment, aging effect, and program combination to Chapter VIII of the GALL Report. This new row is similar to new row AP-64. Implementation of AMP XI.M2, as augmented by AMP XI.M32, provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

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II.B New AMR Line-items related to Structural Systems

Table II.B presents the new AMR line-items that are based on new MEAP combinations applicable to structural systems.

Table II.B New AMR Line-items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures and Component Supports")

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-1	Sliding support bearings and sliding support surfaces	Lubrite®, graphitic tool steel	Air – indoor uncontrolled	Loss of mechanical function/ Corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S6, "Structures Monitoring Program"	Similar to T-28. GALL Rev. 0 considered this MEA combination for ASME piping and component supports for Chapter III; items B1.1.3-a, B1.2.2-a, and B1.3.2-a. This line-item is needed to address these supports for non-ASME piping and components. Implementation of the Structures Monitoring Program adequately manages this aging effect by visual inspection.
TP-2	Sliding support bearings and sliding support surfaces	Lubrite®, graphitic tool steel	Air – outdoor	Loss of mechanical function/ Corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S6, "Structures Monitoring Program"	Similar to T-28 and TP-1. The environment is more aggressive, outdoor vs. indoor uncontrolled. However the aging effect is the same. GALL Rev. 0 considered this MEA combination for ASME piping and component supports for Chapter III; items B1.1.3-a, B1.2.2-a, and B1.3.2-a. This line-item is needed to address these supports for non-ASME piping and components. Implementation of the Structures Monitoring Program adequately manages this aging effect by visual inspection.

Table II.B New AMR Line-items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures and Component Supports")						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
TP-3	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel, aluminum	Air with borated water leakage	Loss of material/ boric acid corrosion	Chapter XI.M10, "Boric Acid Corrosion"	An approved precedent exists for adding this material, environment, aging effect and program combination to the GALL Report. As shown in RNP SER Section 3.5.2.4.3.2, galvanized steel in a borated water environment could result in loss of material due to boric acid corrosion. Also, in Millstone SER section 3.5B.2.3.36, galvanized steel and aluminum in a borated water environment could result in loss of material due to boric acid corrosion. Aggressive chemical attack causes localized corrosion as a result of leaks from borated water systems that can concentrate boric acid and lead to loss of material in galvanized steel and aluminum. Implementation of the boric acid corrosion program will adequately manage this aging effect. In the GALL Report Rev. 1 this item number was inadvertently applied to Table III.B1.3 (BWR Containment Supports). Boric acid corrosion is not a concern for BWRs.
TP-4	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air with borated water leakage	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER Section 3.2.2.4.1.2, stainless steel components and structures in an air with borated water leakage environment exhibit no aging effect and will therefore remain capable of performing their intended functions consistent with the CLB for the period of extended operation. This conclusion is based on the fact that stainless steel is not susceptible to general corrosion when subjected to borated water environments as cited in "PWR Primary Water Chemistry Guideline," EPRI NP-7077, Revision 2, Project 2493, November 1990.

Table II.B New AMR Line-items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures and Component Supports")

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-5	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel	Air – indoor uncontrolled	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.3.2.4.6.1, stainless steel components and structures in an indoor, uncontrolled air environment exhibit no aging effect and will therefore remain capable of performing their intended functions consistent with the CLB for the period of extended operation. Current industry research and operating experience also confirms that stainless steel in indoor air is not subject to aging effects that could be of concern during the period of extended operation.
TP-6	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel, aluminum, stainless steel	Air – outdoor	Loss of material/ pitting and crevice corrosion	Chapter XI.S6, "Structures Monitoring Program"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.5.2.4.3.2, galvanized steel and stainless steel in an outdoor air environment could result in loss of material due to constant wetting and drying conditions. Aluminum would also be susceptible to a similar kind of aging effect in the outdoor environment. Implementation of the Structures Monitoring Program adequately manages the aging effect by performing routine visual inspections of the surface of the structural components.
TP-7	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Elastomers such as EPDM rubber	Various	Loss of sealing/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Chapter XI.S6, "Structures Monitoring Program"	Similar to C-18. GALL Rev. 0 considered this MEA combination for Chapter II, item A3.3-a, and B4.3-a. This MEA combination was not included in Chapter III. Implementation of the Structures Monitoring Program adequately manages this aging effect, based on visual examination for deterioration of seals and gaskets.

Table II.B New AMR Line-items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures and Component Supports")

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-8	Support members; welds; bolted connections; support anchorage to building structure	Aluminum	Air – indoor uncontrolled	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.3.2.4.5.1, aluminum components and structures in an indoor, uncontrolled air environment exhibit no aging effect and will therefore remain capable of performing their intended functions consistent with the CLB for the period of extended operation. Aluminum has an excellent resistance to corrosion. When exposed to humid air (uncontrolled indoor environment), the aluminum oxide film bonds strongly to the aluminum surface. If damaged, this film reforms immediately in most environments. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometers thick, but is highly effective in protecting the aluminum from corrosion. Therefore, aluminum exposed to indoor uncontrolled environment does not have any aging effect (Hollingsworth and Hunsicker 1979).
TP-9	High strength bolting for NSSS component supports	Low alloy steel, yield strength >150 ksi	Air – indoor uncontrolled	Loss of material/ general corrosion	Chapter XI.M18, "Bolting Integrity"	Loss of material is an applicable aging effect for this material/environment combination, similar to other bolting line-items, such as T-30, and the appropriate program is similar to T-27. This item was added to address the presence of high strength bolts, which are subject to this aging effect. AMP XI.M18 provides for proper management of the aging effects for this MEAP combination. Thus, implementation of this AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.B New AMR Line-items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures and Component Supports")

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-10	Support members; welds; bolted connections; support anchorage to building structure	Stainless steel, steel	Treated Water < 60^{0}C (<140^{0}F)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water, and Chapter XI.S3, "ASME Section XI, Subsection IWF"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER Section 3.5.2.4.5, loss of material could occur for stainless steel and steel component supports in a treated water environment due to wetting conditions. The Water Chemistry Program and the ASME Section XI, Subsection IWF program will provide the necessary preventive and detection capability to adequately manage this aging effect.
TP-11	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel	Air-indoor uncontrolled	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER Section 3.5.2.4.3.2, galvanized steel components and structures in an air-indoor uncontrolled environment exhibit no aging effect will therefore remain capable of performing their intended functions consistent with the CLB for the period of extended operation. The zinc coating in galvanized steel protects the underlying steel as cited in references such as J.R. Davis, Corrosion, 2000.

II.C New AMR Line-items related to Electrical Systems

Table II.C presents the new AMR line-items that are based on new MEAP combinations applicable to electrical systems.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-01	Fuse Holders (Not Part of a Larger Assembly) Metallic Clamp	Copper alloy	Air – indoor	Fatigue /ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E5, "Fuse Holder"	This line-item was added consistent with ISG-5. Additionally, an approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in VCS SER 3.6.2.3.1, the Staff has accepted the position that copper alloys in an air environment for fuse holders exhibit fatigue and therefore require management by a program. Operating experience, as discussed in NUREG-1760, "Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants," indicates that aging stressors such as vibration, thermal cycling, electrical transients, mechanical stress, fatigue, corrosion, chemical contamination, or oxidation of the connection surfaces can result in fuse holder failure. AMP XI.E5 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
						provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
LP-02	Fuse Holders (Not Part of a Larger Assembly); Insulation	Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Air – indoor uncontrolled (Internal/ External)	None	None	This line-item was added consistent with ISG-5. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in St. Lucie SER 3.6.2.1.4, the Staff has accepted the position that insulation material as used in fuse holders in a mild environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. A mild environment is below the threshold temperature and radiation dose level that are accepted as causing any degradation in these materials.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
LP-03	Fuse Holders (Not Part of a Larger Assembly); Insulation	Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation (Thermal/ thermoxidative) of organics/thermoplastics, radiation-induced oxidation, moisture intrusion and ohmic heating	Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	This line-item was added consistent with ISG-5. The Staff has determined that embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance, and electrical failure are applicable aging effects for insulation material of fuse holders. GALL Rev. 0 considered this MEAP combination for Electrical Components Chapter VI, AMR line-item A.1-a. The "Electric Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements" AMP will adequately manage the aging effects based on the fact that the fuse block is similar to terminal blocks and visual inspection will be performed for fuse blocks located in adverse environment. Implementation of AMP XI.E1 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-04	Metal enclosed bus Bus/connections	Aluminum / Silver Plated Aluminum Copper / Silver Plated Copper; Stainless steel, steel	Air – indoor and outdoor	Loosening of bolted connections/ thermal cycling and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Ginna SER 3.6.2.4.4.2, the Staff has accepted the position that loosening of fastener components (bolted bus connections) is a valid aging effect and therefore recommends management by a program. NRC IN 2000-14 identifies the phenomenon of "torque relaxation" of bus splice plate connecting bolts. AMP XI.E4 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. This item is based, in part, on the information contained in ISG-17.

Table II.C New AMR Line-items based on new ‘MEAP’ combinations relevant to Electrical Systems (“L” Electrical)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
LP-05	Metal enclosed bus Insulation/ insulators	Porcelain, xenoy, thermo-plastic organic polymers	Air – indoor and outdoor	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ thermal/thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation; moisture/debris intrusion, and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in D/QC SER, section 3.6.2.4.1, the Staff has accepted the position that porcelain, xenoy, or thermo-plastic organic polymers exposed to an air environment may be vulnerable to embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure and therefore require management by a program. NRC IN 89-64 also identified bus duct insulation problems. AMP XI.E4 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation. This item is based, in part, on the information contained in ISG-17.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
LP-06	Metal enclosed bus Enclosure assemblies	Steel; galvanized steel	Air – indoor and outdoor	Loss of material/ general corrosion	Chapter XI.S6, "Structures Monitoring Program"	The Staff has determined that loss of material due to general corrosion is an applicable aging effect. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in RNP SER 3.5.2.4.3.2, the Staff has accepted the position that galvanized steel in an outdoor air environment results in loss of material due to constant wetting and drying conditions. GALL Rev. 0 addressed this material, environment, aging effect, and program combination in the Structures section III (item A1.2-a et.al. and B2.1-a et.al.) The Structures Monitoring Program will adequately manage this aging effect by visual inspection for corrosion. This item is based, in part, on the information contained in ISG-17.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-07	High voltage insulators	Porcelain, Malleable iron, aluminum, galvanized steel, cement	Air – outdoor	Degradation of insulator quality/presence of any salt deposits or surface contamination	A plant-specific aging management program is to be evaluated for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution).	The Staff has determined that the degradation of insulator quality is an applicable aging effect. Information Notice IN 93-95 applicable to insulator contamination relates to loss of power due to salt build-up. Per St. Lucie SER, section 3.6.4.2.2, high-voltage insulators at St. Lucie are washed and coated with silicon to prevent salt buildup. Other LER precedents related to salt deposits and surface contamination as aging mechanisms causing degradation of insulator quality include: St Lucie – LER 94-007-0; Pilgrim – LER 91-024-00; Pilgrim – 85-025-00. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
LP-08	Transmission conductors and connections	Aluminum, steel	Air – outdoor	Loss of material/wind induced abrasion, fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	The Staff has determined that the loss of material, loss of conductor strength, and increased resistance of connections are applicable aging effects. The most prevalent mechanism contributing to loss of conductor strength of aluminum-core steel-reinforced (ACSR) conductors is corrosion. For ACSR conductors, degradation begins as a loss of zinc from galvanized steel wire cores and depends largely on air quality. Loss of material due to wear could be caused by vibration and sway caused by wind loading. Loss of pre-load could be caused because aluminum conductor material expands faster than most bolting material. If plastic deformation occurs during thermal loading (i.e., heatup) when the connection cools, the joint will be loose. In the FCS SER, section 3.6.2.4.3, a plant-specific program is provided to manage these aging effects. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-09	Switchyard bus and connections	Aluminum, copper, bronze, stainless steel, galvanized steel	Air – outdoor	Loss of material/wind induced abrasion, fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated	The Staff has determined that the loss of material, loss of conductor strength, and increased resistance of connections are applicable aging effects. In both the Ginna SER section 3.6.2.4.5.2 and the FCS SER section 3.6.2.4.3, the Staff accepted the position that loss of pre-load is a valid aging mechanism that could cause torque relaxation and thereby increased resistance of connection. In the FCS SER, 3.6.2.4.3, a plant-specific program is provided to manage these aging effects. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-10	Metal enclosed bus Enclosure assemblies	Elastomers	Air – indoor and outdoor	Hardening and loss of strength/ elastomers degradation	Chapter XI.S6, "Structures Monitoring Program"	The Staff has determined that the hardening and loss of strength are applicable aging effects. Hardening and loss of strength exhibited by elastomers in an air environment is properly managed by the Structures Monitoring AMP based on inspection for degradation of elastomers surface. GALL Rev. 0 included this MEA combination in section V, item B.1-b; and also in section VII, items F1.1-b, et al. Implementation of AMP XI.S6 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. This item is based, in part, on the information contained in ISG-17.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**AMP**	**Precedent and Technical Basis for New Line-Item**
LP-11	High voltage insulators	Porcelain, Malleable iron, aluminum, galvanized steel, cement	Air – outdoor	Loss of material/ mechanical wear due to wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated	The Staff has determined that loss of material is the applicable aging effect. Mechanical wear due to wind blowing on transmission conductors is an aging mechanism for strain and suspension insulators in that they are subject to movement. Movement can be caused by wind blowing the supported transmission conductor, causing it to swing from side to side. If this swinging is frequent enough, it could cause wear in the metal contact points of the insulator string and between the insulator and the supporting hardware. A plant-specific aging management program will be evaluated to provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

Table II.C New AMR Line-items based on new 'MEAP' combinations relevant to Electrical Systems ("L" Electrical)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
LP-12	Cable Connections (Metallic Parts)	Various metals used for electrical contacts	Air – indoor and outdoor	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	This item is included in the GALL Report to address the metallic portion of connections (similar to fuse holder). SAND 96-0344, "Aging Management Guidelines For Electrical Cable and Terminations," identified loosened terminations at several plants. Additionally, EPRI TR-104213 recommends inspection of bolted joints for evidence of overheating, signs of burning or discoloration, and indication of loose bolts. It recommends checking the joint resistance of bolted joints using a low range ohmmeter. AMP XI.E6 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

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III. Changes to Existing Aging Management Review Line-Items

The following tables identify “significant changes” that were made to the MEAP line-items in the tables in Chapters II through VIII of Volume 2 to NUREG-1801. A change was deemed “significant” if it involved a technical change to an aging effect, an Aging Management Program (AMP), or a change to the “Further Evaluation” column. Editorial changes were not deemed significant. Examples of editorial changes include, but are not limited to, the following:

- “Crack initiation and growth/ stress corrosion cracking” was replaced with “Cracking/ stress corrosion cracking”
- Deleted the reference to the EPRI document in the AMP column for AMP XI.M2, “”Water Chemistry.” The reference to the specific EPRI document does not need to be included in the Aging Management Program column. This information is identified in the AMP description in Chapter XI of the GALL Report.

The following tables identify the Item Number in the revised GALL (GALL Rev. 1), the GALL Rev. 0 MEAP Item Number, the material, environment, aging effect/ mechanism, the AMP, the further evaluation recommended, and the basis for the change. Changes in each table row are identified by bold, italics. Also, in some cases, aging effects/mechanisms originally presented in GALL Rev. 0 were encompassed by other aging effects/mechanisms and; therefore, these changes were not deemed significant. For example, loss of material/flow accelerated corrosion was replaced with wall thinning/flow accelerated corrosion. As noted in Appendix A to this Bases Document, wall thinning is defined as a loss of material due to flow-accelerated corrosion.

Additionally, in cases where a change affected multiple AMR lines items, these line-items are shown in one row in their respective table. For example, line-items E-35, E-44, and E-46, the only change was to revise their AMPs to Chapter XI.M36, "External Surfaces Monitoring.” For simplicity, these line-items are shown in one row in Table III.D even though these line-items have different environments.

It should be noted that the process used to develop these tables leaves the cells in a column blank if the entry would duplicate the entry in the row above. Therefore, to determine the value that applies where a cell is blank, the reader must scan back up the column to the previous non-blank cell. Similarly, if one or more cells do not have a lower border when the table spans a page, the absence of this border indicates the continuation of the cell’s value onto the following page.

Finally, a new section B1.2 was added in Chapter II, Containment Structures, to address Mark I concrete containment structures, which was not previously included in NUREG-1801, Volume 2, July 2001. No new rows beyond those that already existed in Chapter II were required to be added. The existing rows included in new section B1.2 are C-06, C-07, C-23, C-31, C-35, C-39, and C-41.

III.A Containment Structures

Table III.A presents the changes made to existing AMR line-items for containment structures.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
C-01	Concrete Dome; wall; basemat; ring girder; buttresses	II.A1.1-a	Concrete	***Air-outdoor***	Loss of material (spalling, scaling) and cracking/ freeze-thaw	***Chapter XI.S2, "ASME Section XI, Subsection IWL"*** ***Accessible areas: Inspections performed in accordance with IWL will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.*** ***Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the***	***Yes, for inaccessible areas of plants located in moderate to severe weathering conditions***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557 that based on initial and subsequent inspections of concrete that had air content of 3% to 6%, these inspections did not show any degradation related to freeze thaw. The environment was revised to air-outdoor instead of outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						evaluation. ***The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.***		further evaluation is required for plants located in moderate to severe weathering conditions. If the applicant meets the conditions specified in the AMP column for inaccessible areas, then no specific AMP is necessary to manage this aging effect. However, opportunistic inspections are recommended.
C-02	Concrete Dome; wall; basemat; ring girder; buttresses	II.A1.1-b	Concrete	Water - flowing	Increase in porosity, permeability/ leaching of calcium hydroxide	***Chapter XI.S2, "ASME Section XI, Subsection IWL"*** ***Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide.*** ***Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557, that leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						***flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R*.**		controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77 or later revisions. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-03	Concrete Dome; wall; basemat; ring girder; buttresses	II.A1.1-c	Concrete	***Ground water/soil or air –indoor uncontrolled or air - outdoor***	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.*** ***Inaccessible Areas: For plants with non-***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to reflect the actual environment. The FE column was revised to make it consistent with other lines where a plant-specific program is

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		called out.
C-04	Concrete: Dome; wall; basemat; ring girders; buttresses	II.A1.1-d	Concrete	***Any***	***Cracking due to expansion/ reaction with aggregates***	*Chapter XI.S2, "ASME Section XI, Subsection IWL."* ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						cracking due to reaction with aggregates. ***Inaccessible Areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. ***Therefore, if these conditions are satisfied, aging management is not necessary.***		approved ISG-3. The environment was revised to "any" since the aging effect could occur in any environment – more dependent on aggregates than environment. The FE column was revised to clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revisions is acceptable.
C-05	Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel	II.A1.1-e	Concrete, steel	*Air-indoor uncontrolled or air-outdoor*	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of***	***Yes, if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						cracking, loss of bond, and loss of material (spalling, scaling) due to aggressive chemical attack. ***Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended***		environment was revised to air-indoor uncontrolled or air-outdoor instead of inside or outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						operation.		
C-06	Concrete elements: All	II.B2.2.1-e II.B3.2.1-f	Concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring Program.” 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 period of extended operation.	***Yes, if not within the scope of the applicant’s structures monitoring program or a de-watering system is relied upon***	The AMP column was revised to delete reference to initial licensing basis for settlement and the NRC approval to delete the program. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-07	Concrete: foundation; sub-foundation	II.A1.1-g II.A2.2-g II.B2.2.1-f II.B3.1.2-f II.B3.2.1-g	Concrete: porous concrete	Water-flowing	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring Program” Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. If a de-watering	***Yes, if not within the scope of the applicant’s structures monitoring program or a de-watering system is relied upon***	The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						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 period of extended operation.		
C-08	Concrete: Dome, wall, basemat, ring girder, buttress	II.A1-1h	Concrete	Air-indoor uncontrolled or air-outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program. 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	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP column are not exceeded, then a plant specific program is not necessary.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						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 this reduction is applied to the design allowables.		
C-12	Penetration sleeves	II.A3.1-a II.B4.1-a	Steel; Dissimilar metal welds	Air-indoor uncontrolled or air-outdoor	Loss of material/general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," ***(Note: IWE examination category E-F, surface examination of dissimilar metal welds, is recommended)*** and Chapter XI.S4, "10 CFR Part 50, Appendix J."	No	A note was added to the AMP column because NUREG-1667 specifically recommended this examination. Also, removed mentioning of the relief request for coatings program. Relief requests associated with ISI are usually plant-specific and only valid during the 10-year ISI program. They are not considered for license renewal, in general, and therefore the mentioning of the relief request was removed.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
C-16	Personnel airlock, equipment hatch, CRD hatch	II.A3.2-a II.B4.2-a	Steel	Air-indoor uncontrolled or air-outdoor	Loss of material/general, pitting, and crevice corrosion	***Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J."***	No	In the AMP column, removed mentioning of the relief request for coatings program. Relief requests associated with ISI are usually plant-specific and only valid during the 10-year ISI program. They are not considered for license renewal, in general, and therefore the mentioning of the relief request was removed.
C-19	Steel elements: Drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; ECCS suction header NOTE: Inspection of containment	II.B1.1.1-a II.B3.1.1-a	Steel	Air – indoor uncontrolled or treated water (as applicable)	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.S1, "ASME Section XI, Subsection IWE." For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of***	Yes, if corrosion is significant for inaccessible areas	In the AMP column, removed mentioning of the relief request for coatings program. Relief requests associated with ISI are usually plant-specific and only valid during the 10-year ISI program. They are not considered for license renewal, in general, and therefore the mentioning of the relief request was removed.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)					***penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner.*** ***If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.*** ***Chapter XI.S4, "10 CFR Part 50, Appendix J"***	No	
C-22	Steel elements: Vent line bellows	II.B1.1.1-d	Stainless steel	Air-indoor uncontrolled	Cracking/stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Yes, detection of aging effects is to be evaluated	Identified the specific edition of the ASME Code in the AMP column, which includes the referenced IWE

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						Evaluation of 10 CFR 50.55a/IWE is augmented as follows: (4) Detection of Aging Effects: Stress corrosion cracking (SCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ***ASME Code 1995 edition, with addenda through 1996,*** Subsection IWE covers inspection of these items under Examination Categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B and E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue.		Examination Categories that are no longer identified in the current versions of the code.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						(10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.		
C-25	Concrete: Basemat	II.A2.2-c II.B.3.1.2-b	Concrete	***Ground water/soil***	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas:*** ***Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.*** **Inaccessible Areas:** ***For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to reflect the actual environment. The FE column was revised to make it consistent with other lines where a plant-specific program is called out.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
C-26	Concrete: Containment, wall, basemat	II.B2.2.1-b II.B1.2.	Concrete	***Ground water/soil***	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.*** **Inaccessible Areas:** ***For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to reflect the actual environment. The FE column was revised to make it consistent with other lines where plant-specific program is called out.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
C-27	Concrete: Dome, wall, basemat	II.B3.2.1-c	Concrete	***Ground water/soil***	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.*** **Inaccessible Areas:** ***For plants with non-***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to reflect the actual environment. The FE column was revised to make it consistent with other

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		lines where a plant-specific program is called out.
C-28	Concrete: Basemat	II.A2.2-a	Concrete	***Air-outdoor***	Loss of material (spalling, scaling) and cracking/ freeze-thaw	***Chapter XI.S2, “ASME Section XI, Subsection IWL”*** ***Accessible areas: Inspections performed in accordance with IWL will***	***Yes, for inaccessible areas of plants located in moderate to severe weathering***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. ***Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation.*** ***The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.***	***conditions***	approved ISG-3. Documented evidence exists in NUREG-1557 that based on initial and subsequent inspections of concrete that had air content of 3% to 6%, these inspections did not show any degradation related to freeze thaw. The environment was revised to air-outdoor instead of outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is required for plants located in moderate to severe weathering conditions. If the applicant meets the conditions specified in the AMP column for inaccessible areas, then no specific AMP is necessary to manage this aging effect. However,

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								opportunistic inspections are recommended.
C-29	Concrete: Dome, wall, basemat	II.B3.2.1-a	Concrete	***Air-outdoor***	Loss of material (spalling, scaling) and cracking/ freeze-thaw	***Chapter XI.S2, "ASME Section XI, Subsection IWL"*** ***Accessible areas: Inspections performed in accordance with IWL will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.*** ***Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation.***	***Yes, for inaccessible areas of plants located in moderate to severe weathering conditions***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557 that based on initial and subsequent inspections of concrete that had air content of 3% to 6%, these inspections did not show any degradation related to freeze thaw. The environment was revised to air-outdoor instead of outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is required for plants located in

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.		moderate to severe weathering conditions. If the applicant meets the conditions specified in the AMP column for inaccessible areas, then no specific AMP is necessary to manage this aging effect. However, opportunistic inspections are recommended.
C-30	Concrete: Basemat	II.A2.2-b II.B3.1.2-a	Concrete	Water - flowing	Increase in porosity, permeability/ leaching of calcium hydroxide	***Chapter XI.S2, "ASME Section XI, Subsection IWL" Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide.*** ***Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557, that leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						concrete was constructed in accordance with the recommendations in ACI 201.2R.		proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77 or later revisions. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-31	Concrete: Containment, wall, basemat	II.B2.2.1-a	Concrete	Water - flowing	Increase in porosity, permeability/ leaching of calcium hydroxide	***Chapter XI.S2, "ASME Section XI, Subsection IWL"*** ***Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide.*** ***Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557, that leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						***confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R*.**		controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77 or later revisions. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-32	Concrete: Dome, wall, basemat	II.B3.2.1-b	Concrete	Water - flowing	Increase in porosity, permeability/ leaching of calcium hydroxide	***Chapter XI.S2, "ASME Section XI, Subsection IWL"*** ***Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide.*** ***Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557, that leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.		controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77 or later revisions. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-33	Concrete: Dome, wall, basemat	II.B3.2.1-h	Concrete	Air-indoor uncontrolled or air-outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program. 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	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP column are not exceeded, then a plant specific program is not necessary.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						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 this reduction is applied to the design allowables.		
C-34	Concrete: Basemat	II.A2.2-h	Concrete	Air-indoor uncontrolled or air-outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program. 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,	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP column are not exceeded, then a plant specific program is not necessary.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						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 this reduction is applied to the design allowables.		
C-35	Concrete: Containment, wall, basemat	II.B2.2.1-g	Concrete	Air-indoor uncontrolled or air-outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F	Plant-specific aging management program. The implementation of 10 CFR 50.55a and ASME Section XI, Subsection IWL would not be able to identify the reduction of strength and	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
					local)	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 this reduction is applied to the design allowables.		column are not exceeded, then a plant specific program is not necessary.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
C-36	Concrete: Basemat	II.A2.2-f II.B3.1.2-e	Concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program." ***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 period of extended operation.***	***Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon***	The AMP column was revised to delete reference to initial licensing basis for settlement and the NRC approval to delete the program. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-37	Concrete: Dome; wall; basemat; ring girders; buttresses	II.A1.1-f	Concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program." ***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 period of extended operation.***	***Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon***	The AMP column was revised to delete reference to initial licensing basis for settlement and the NRC approval to delete the program. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-38	Concrete: Basemat	III.A2.2-d	Concrete	***Any***	***Cracking due to expansion/ reaction with aggregates***	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						indicate the presence of cracking due to reaction with aggregates. ***Inaccessible Areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. ***Therefore, if these conditions are satisfied, aging management is not necessary.***		approved ISG-3. The environment was revised to "any" since the aging effect could occur in any environment – more dependent on aggregates than environment. The FE column was revised to clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revision is acceptable.
C-39	Concrete: Containment, wall, basemat	II.B2.2.1-c	Concrete	***Any***	***Cracking due to expansion/ reaction with aggregates***	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						cracking due to reaction with aggregates. ***Inaccessible Areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. ***Therefore, if these conditions are satisfied, aging management is not necessary.***		environment was revised to "any" since the aging effect could occur in any environment – more dependent on aggregates than environment. The FE column was revised to clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revision is acceptable.
C-40	Concrete: Dome, wall, basemat	II.B3.2.1-d	Concrete	***Any***	***Cracking due to expansion/ reaction with aggregates***	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of cracking due to reaction with aggregates.***	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to "any" since

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. ***Therefore, if these conditions are satisfied, aging management is not necessary.***		the aging effect could occur in any environment – more dependent on aggregates than environment. The FE column was revised to clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revision is acceptable.
C-41	Concrete: Basemat, reinforcing steel	II.B2.2.1-d II.B1.2	Concrete, steel	***Air-indoor uncontrolled or air-outdoor***	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to aggressive chemical attack.***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to air-indoor uncontrolled or air-outdoor instead of inside or outside

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						Inaccessible Areas: ***For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.***		containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is recommended.
C-42	Concrete: Dome; wall; basemat;	II.B3.2.1-e	Concrete, steel	***Air-indoor uncontrolled or air-***	Cracking, loss of bond, and loss of material	***Chapter XI.S2, "ASME Section XI, Subsection IWL."***	***Yes, plant specific if environment is***	The AMP column was revised to clearly address concrete in

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
	reinforcing steel			***outdoor***	(spalling, scaling)/ corrosion of embedded steel	***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to aggressive chemical attack.*** ***Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP***	***aggressive***	accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to air-indoor uncontrolled or air-outdoor instead of inside or outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
C-43	Concrete: Basemat, reinforcing steel	II.A2.2-e II.B3.1.2-d	Concrete, steel	***Air-indoor uncontrolled or air-outdoor***	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to aggressive chemical attack.*** ***Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider*** ***(1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and*** ***(2) Periodic monitoring of***	***Yes, plant specific if environment is aggressive***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to air-indoor uncontrolled or air-outdoor instead of inside or outside containment to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
C-46	Steel elements: Suppression chamber; drywell liner; drywell head; embedded shell; sand pocket region; support skirt; downcomer pipes; region shielded by diaphragm floor NOTE:	II.B2.1.1-a II.B2.2.2-a	Steel	Air – indoor uncontrolled or treated water (as applicable)	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.S1, "ASME Section XI, Subsection IWE." For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete***	Yes, if corrosion is significant for inaccessible areas	In the AMP column, removed mentioning of the relief request for coatings program. Relief requests associated with ISI are usually plant-specific and only valid during the 10-year ISI program. They are not considered for license renewal, in general, and therefore the mentioning of the relief request was removed.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	Inspection of containment supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)					***is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner.*** ***If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.*** ***Chapter XI.S4, "10 CFR Part 50, Appendix J"***	No	
C-49	Steel elements: Suppression chamber liner	II.B2.2.2-b II.B1.2	Stainless steel, steel	***Air – indoor uncontrolled or treated water (as***	***Loss of material/ general, pitting, and crevice***	***Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix***	No	Treated water is a potential environment for the BWR Mark II suppression chamber.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	(interior surface)			***applicable)***	***corrosion***	***J"***		Cracking as an aging effect was removed because as defined in GALL Report, Volume 2, Chapter IX.D, cracking (an issue in treated water >140°F) is not present, so the AE/AM column was revised to identify only loss of material.
C-50	Concrete: Basemat, concrete fill-in-annulus	II.B3.1.2-g	Concrete	Air-indoor uncontrolled or air-outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program. 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	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP column are not exceeded, then a plant specific program is not necessary.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						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 this reduction is applied to the design allowables.		
C-51	Concrete: Basemat, concrete fill-in annulus	II.B3.1.2-c	Concrete	***Any***	***Cracking due to expansion/ reaction with aggregates***	***Chapter XI.S2, "ASME Section XI, Subsection IWL."*** ***Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of cracking due to reaction with aggregates.*** ***Inaccessible Areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The environment was revised to "any" since the aging effect could occur in any environment – more dependent on aggregates than environment. The FE column was revised to

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. ***Therefore, if these conditions are satisfied, aging management is not necessary.***		clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revision is acceptable.

III.B Structures and Components Supports

Table III.B presents the changes made to existing AMR line-items for structures and component supports.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
T-01	Concrete: Exterior above and below grade; foundation	III.A1.1-a III.A2.1-a III.A3.1-a III.A5.1-a III.A7.1-a III.A8.1-a III.A9.1-a	Reinforced concrete	***Air– outdoor***	Loss of material (spalling, scaling) and cracking/ freeze-thaw	***Chapter XI.S6, "Structures Monitoring Program"*** ***Accessible Areas: Inspections performed in accordance with Structures Monitoring Program will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.*** ***Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that the in-place concrete had the air content between 3% to 6% and water-to-cement ratio of 0.35-0.45 and the subsequent***	***Yes, if not within the scope of the applicant's structures monitoring program or for inaccessible areas of plants located in moderate to severe weathering conditions***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. Documented evidence exists in NUREG-1557 that based on initial and subsequent inspections of concrete that had air content of 3% to 6%, these inspections did not show any degradation related to freeze thaw. The environment was revised to air-outdoor instead of weather exposed to be consistent with Chapter II changes. The FE column was revised to clarify the conditions where further evaluation is recommended and required for plants located in moderate to severe weathering conditions. If the applicant meets the conditions specified in the

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						inspections performed did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation. ***The weathering index for the continental US is shown in ASTM C33-90, Fig.1.***		AMP column for inaccessible areas, then no specific AMP is necessary to manage this aging effect. However, opportunistic inspections are recommended.
T-02	Concrete: Exterior above and below grade; foundation	III.A1.1-b III.A2.1-b III.A3.1-b III.A5.1-b III.A7.1-b III.A8.1-b III.A9.1-b	Reinforced concrete	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	***Chapter XI.S6, "Structures Monitoring Program"*** ***Accessible Areas: Inspections performed in accordance with Structures Monitoring Program will indicate the presence of increase in porosity and permeability due to leaching of calcium hydroxide*** ***Inaccessible Areas:*** An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms	***Yes, if concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was with the approved ISG-3. Documented evidence exists in NUREG-1557, that leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed in accordance with ACI 201.2R-77 or later

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.		revisions. The FE column was revised to clarify the conditions where further evaluation is recommended.
T-03	Concrete: All	III.A1.1-c III.A2.1-c III.A3.1-c III.A4.1-b III.A5.1-c III.A7.1-c III.A8.1-c III.A9.1-c	Reinforced concrete	Any	Cracking due to expansion/ reaction with aggregates	***Chapter XI.S6, "Structures Monitoring Program."*** ***Accessible Areas: Inspections/evaluations performed in accordance with Structures Monitoring Program will indicate the presence of expansion and cracking due to reaction with aggregates.*** ***Inaccessible Areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially	***Yes, if not within the scope of the applicant's structures monitoring program or concrete was not constructed as stated for inaccessible areas***	The AMP column was revised to clearly address concrete in accessible and inaccessible areas. The basis for this revision was the approved ISG-3. The FE column was revised to clarify the conditions where further evaluation is recommended. Use of ACI 201.2R-77 or later revision is acceptable.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.		
T-04	Concrete: Interior and above-grade exterior	III.A1.1-d III.A2.1-d III.A3.1-d III.A4.1-d III.A5.1-d III.A7.1-d III.A9.1-d	Reinforced concrete	***Air – indoor uncontrolled or air – outdoor***	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S6, "Structures Monitoring Program"*** ***Accessible areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.***	***Yes, if not within the scope of the applicant's structures monitoring program***	The AMP column was revised to clearly address concrete in accessible areas. The basis for this revision was to make the AMP column consistent with the approved ISG-3. The environment was revised to air-indoor uncontrolled or air-outdoor to better reflect the actual environment. The FE column was revised to clarify the conditions where further evaluation is recommended.
T-05	Concrete: Below-grade exterior; foundation	III.A1.1-e III.A2.1-e III.A3.1-e III.A5.1-e III.A7.1-e III.A8.1-d III.A9.1-e	Reinforced concrete	Groundwater/soil	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S6, "Structures Monitoring Program"*** ***Accessible Areas: Inspections performed in accordance with the***	***Yes, plant-specific if environment is aggressive***	The AMP column was revised to clearly address concrete in inaccessible areas. The basis for this revision was to make the AMP column consistent with the approved ISG-3.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						Structures Monitoring Program will indicate the cracking, loss of bond, or loss of material (spalling, scaling) due to corrosion of embedded steel. ***Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant***		The FE column was revised for consistency.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
T-06	Concrete: Interior and above-grade exterior	III.A1.1-f III.A2.1-f III.A3.1-f III.A4.1-a III.A5.1-f III.A7.1-f III.A9.1-f	Reinforced concrete	Air-indoor uncontrolled or air-outdoor	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S6, "Structures Monitoring Program"*** ***Accessible Areas: Inspections performed in accordance with "Structures Monitoring Program" will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.***	***Yes, if not within the scope of the applicant's structures monitoring program***	The AMP column was revised to address concrete in accessible areas. The basis for this revision was to incorporate approved ISG-3. The FE column was revised to clarify the conditions where further evaluation is recommended.
T-07	Concrete: Below-grade exterior; foundation	III.A1.1-g III.A2.1-g III.A3.1-g III.A5.1-g III.A7.1-g III.A8.1-e III.A9.1-g	Reinforced concrete	Aggressive environment	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the***	***Yes, plant-specific if environment is aggressive***	The AMP column was revised to address concrete in inaccessible areas. Additionally, further evaluation was required only if an aggressive below-grade environment existed. The basis for this

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		revision was the approved ISG-3.
T-08	Concrete: All	III.A1.1-h III.A2.1-h III.A3.1-h III.A5.1-h III.A7.1-h III.A8.1-f III.A9.1-h	Reinforced concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring Program.” ***If a de-watering system is relied upon for control of settlement,***	***Yes, if not within the scope of the applicant’s structures monitoring program or a***	The AMP column was revised to delete reference to initial licensing basis for settlement and the NRC approval to delete the program.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
		III.A6.1-f				***then the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.***	***de-watering system is relied upon***	The FE column was revised to clarify the conditions where further evaluation is recommended.
T-09	Concrete; Foundation, subfoundation	III.A1.1-i III.A2.1-i III.A3.1-i III.A5.1-i III.A6.1-g III.A7.1-i III.A8.1-g III.A9.1-i	Reinforced concrete; porous concrete	Water – flowing under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, “Structures Monitoring Program” Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. NRC IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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 period of extended operation.	***Yes, if not within the scope of the applicant’s structures monitoring program or a de-watering system is relied upon***	The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
T-10	Concrete: All	III.A1.1-j III.A2.1-j III.A3.1-j III.A4.1-c III.A5.1-j	Reinforced concrete	Air-indoor uncontrolled	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 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 which are allowed to have increased temperatures not to exceed 200°F.	***Yes, if temperature limits are exceeded***	The FE column was revised to clarify the conditions where further evaluation is recommended. If the temperatures as shown in the AMP column are not exceeded, then a plant specific program is not necessary.
T-11	Steel components: All structural steel	III.A1.2-a III.A2.2-a III.A3.2-a III.A4.2-a III.A5.2-a III.A7.2-a III.A8.2-a	Steel	Air – indoor uncontrolled or air – outdoor	Loss of material/corrosion	Chapter XI.S6, “Structures Monitoring Program.” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	***Yes, if not within the scope of the applicant’s structures monitoring program***	The FE column was revised to clarify the conditions where further evaluation is recommended.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
T-13	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; ***Steam generator supports***	III.A4.2-b	Lubrite®	Air – indoor uncontrolled	Lock-up/ wear	***Chapter XI.S3, "ASME Chapter XI, Subchapter IWF" or Chapter XI.S6, "Structures Monitoring Program"***	***Yes, if not within the scope of Chapter XI, IWF or structures monitoring program***	Added "steam generator supports" in the structure/component list to include instances where Lubrite® supports are used. Also, provided the option of using AMP XI.S3 for those plants that have a Section XI, subsection NF program in place. The FE column was revised to clarify the conditions where further evaluation is recommended.
T-14	Steel components: Fuel pool liner	III.A5.2-b	Stainless steel	***Treated water or treated borated water***	Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" and, ***Monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.***	No	Treated water or Treated borated water environment is a more accurate description of spent fuel pool environment. The AMP column was revised to provide more information on verification of water chemistry by monitoring leakage from the leak chase channel.
T-15	Concrete: Exterior above and below grade; foundation	III.A6.1-a	Reinforced concrete	Air-outdoor	Loss of material (spalling, scaling) and cracking/ freeze-thaw	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and	***Yes, for inaccessible areas of plants located in moderate to severe weathering conditions***	Text in the AMP column was made consistent with other chapters of the GALL Report and the approved ISG-3. Documented evidence exists in NUREG-1557 that based on initial and subsequent inspections of concrete

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						maintenance ***Accessible Areas: Inspections performed in accordance with Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw.*** ***Inaccessible Areas:*** As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, or in above- and below-grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering		that had air content of 3% to 6%, these inspections did not show any degradation related to freeze thaw. The FE column was revised to clarify the conditions where further evaluation is recommended and to make it consistent with other Chapter II and Chapter III line-items with the same material/environment/aging effect combination. If the applicant meets the conditions specified in the AMP column for inaccessible areas, then no specific AMP is necessary to manage this aging effect. However, opportunistic inspections are recommended.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day-inch/yr) or moderate (100-500 day-inch/yr), provided that the concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. The weathering index is defined in ASTM C33-90, Table 3, Footnote E. Fig. 1 of ASTM C33-90 illustrates the various weathering index regions throughout the U.S.		
T-16	Concrete: Exterior above and below grade; foundation; interior slab	III.A6.1-b	Reinforced concrete	Water-flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of	***Yes, if concrete was not constructed as stated for inaccessible areas***	Text in the AMP column was made consistent with other chapters of the GALL Report and approved ISG-3. The FE column was revised to clarify the conditions where further

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						Engineers dam inspections and maintenance programs ***Accessible Areas: Inspections performed in accordance with Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide*** ***Inaccessible Areas:*** As described in NUREG-1557, leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Even if reinforced concrete is		evaluation is recommended and to make it consistent with other Chapter II and Chapter III line-items with the same MEA combination.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						exposed to flowing water, such leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed with the guidance of ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.		
T-17	Concrete: All	III.A6.1-c	Reinforced concrete	Any	***Cracking due to expansion/ reaction with aggregates***	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. ***Accessible Areas: Inspections/evaluations***	***Yes, if concrete was not constructed as stated for inaccessible areas***	Text in the AMP column was made consistent with other chapters of the GALL Report and approved ISG-3. The FE column was revised to clarify the conditions where further evaluation is recommended and to make it consistent with other Chapter II and Chapter III line-items with the same MEA

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						performed in accordance with "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of expansion and cracking due to reaction with aggregates. ***Inaccessible areas:*** As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete		combination. Use of ACI 201.2R-77 or later revision is acceptable.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.		
T-18	Concrete: All	III.A6.1-d	Reinforced concrete	Air-indoor uncontrolled or air-outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs*** ***Accessible areas: As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the***	***Yes, plant-specific if environment is aggressive***	Text in the AMP column was made consistent with other chapters of the GALL Report and approved ISG-3. The FE column was revised to clarify the conditions where further evaluation is recommended and to make it consistent with other Chapter II and Chapter III line-items with the same MEA combination.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. ***Inaccessible areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil,***		

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
T-19	Concrete: All	III.6A.1-e	Reinforced concrete	Groundwater/soil	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	***Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs*** ***Accessible Areas: Inspections performed in accordance with "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power***	***Yes, plant-specific if environment is aggressive***	Text in the AMP column was made consistent with other chapters of the GALL Report and approved ISG-3. The FE column was revised to clarify the conditions where further evaluation is recommended and to make it consistent with other Chapter II and Chapter III line-items with the same MEA combination.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						Plants" or the FERC / US Army Corp of Engineers . the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. ***Inaccessible areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider: (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have***		

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.		
T-21	Metal components: all structural members	III.A6.2-a	Steel, Copper alloys	Air – indoor uncontrolled or air - outdoor; ***Water – flowing or water – standing***	Loss of material/ general (steel only), pitting and crevice corrosion	***Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. If protective coatings are relied upon to manage the effects of aging, this AMP is to include provisions to address protective coating monitoring and maintenance.***	No	Added the environment of flowing or standing water for items such as sheet piles and gates.
T-29	Building concrete at locations of expansion and	III.B1.1.4-a III.B1.2.3-a	Reinforced concrete; Grout	Air-indoor uncontrolled or air-outdoor	Reduction in concrete anchor capacity due to local concrete	***Chapter XI.S6, "Structures Monitoring Program"***	***Yes, if not within the scope of the applicant's***	The FE column was revised to clarify the conditions where further evaluation is

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	grouted anchors; grout pads for support base plates	III.B1.3.3-a III.B2.2-a III.B3.2-a III.B4.3-a III.B5.2-a			degradation/ service-induced cracking or other concrete aging mechanisms		***structures monitoring program***	recommended.
T-30	Support members; welds; bolted connections; support anchorage to building structure	III.B2.1-a III.B3.1-a III.B4.1-a III.B5.1-a	Steel	Air – indoor uncontrolled or air – outdoor	Loss of material/ general and pitting corrosion	***Chapter XI.S6, "Structures Monitoring Program"***	***Yes, if not within the scope of the applicant's structures monitoring program***	The FE column was revised to clarify the conditions where further evaluation is recommended.
T-31	Vibration isolation elements	III.B4.2-a	Non-metallic (e.g., Rubber)	Air – indoor uncontrolled or air – outdoor	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	***Chapter XI.S6, "Structures Monitoring Program"***	***Yes, if not within the scope of the applicant's structures monitoring program***	The FE column was revised to clarify the conditions where further evaluation is recommended.
T-32	***Sliding surfaces***	***III.B1.1.3-a III.B1.2.2-a III.B1.3.2-a***	***Lubrite®***	***Air–indoor uncontrolled or air–outdoor***	***Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads***	***Chapter XI.S3, "ASME Section XI, Subsection IWF"***	***No***	Split up component type from T-28 into three separate line-items. This makes it consistent with GALL Report Chapter III.B4. Deleted "elastomer hardening" as an aging mechanism. These component types do not include elastomeric materials.

IIIB. Changes in Existing AMR Line-Items related to Structures and Component Supports (Chapter III in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
T-33	***Vibration isolation elements***	***III.B1.1.3-a III.B1.2.2-a III.B1.3.2-a***	***Non-metallic (e.g., Rubber)***	***Air–indoor uncontrolled or air–outdoor***	***Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading***	***Chapter XI.S3, "ASME Section XI, Subsection IWF"***	***No***	Split up component type from T-28 into three separate line-items. This makes it consistent with GALL Report Chapter III.B4.

III.C Reactor Vessels, Internals, and Reactor Coolant Systems

Table III.C presents the changes made to existing AMR line-items for reactor vessels, internals, and reactor coolant systems.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-01 R-06 R-88 R-89	IV.D1.1-I IV.D1.1-j IV.D2.1-h IV.C2.5-k IV.C2.5-s IV.C2.5-m IV. A2.6-a IV.A2.7-a	Nickel alloy; steel with nickel-alloy cladding	Reactor coolant	Cracking/ primary water stress corrosion cracking	***Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines***	***No, but licensee commitments to be confirmed***	The AMP was changed from requiring a plant-specific program to calling out XI.M1 and XI.M2 explicitly, as supplemented by the actions (identified in Orders, Bulletins, and Generic Letters) that are associated with recent experience with primary water stress corrosion cracking in nickel alloy components. These sources provide more precise guidance on what would constitute an acceptable plant specific AMP. The Staff position would encompass ISGs and branch technical positions published in other regulatory guidance documents. If alloy 600 or its associated weld materials (alloy 82/182) is used, the Staff has requested a commitment in the FSAR supplement as stated. Also, added to the further evaluation column the recommendation for the licensee commitment to be

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)

Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
							confirmed.
R-02	IV.C2.1-g IV.C2.2-h	***Stainless steel; steel with stainless steel cladding***	Reactor coolant	***Cracking/ stress corrosion cracking, thermal and mechanical loading***	***Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR water and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"***	***No***	In GALL Rev. 0, both IV C2.1-g and IV C2.2-h addressed Class 1 piping, fittings and branch connections < NPS 4 for the PWR reactor coolant systems and connected lines. Small-bore RCS piping in PWR reactor coolant systems and connected lines are generally stainless steel. Cracking of these components is managed by the same AMPs regardless of whether the mechanisms are SCC or thermal and mechanical loading. The addition of AMP XI.M35 for small bore piping in GALL Rev. 1 provides specific guidance and replaces the prior need for a plant specific AMP. As a result of this change, the Further Evaluation column was changed to "No."
R-03	IV.C1.1-i	Stainless steel; steel	Reactor coolant	***Cracking/ stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical***	***Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for BWR water and XI.M35, "One-Time Inspection of ASME Code Class 1***	***No***	In GALL Rev. 0, the AMR line-item IV C1.1-i addressed Class 1 piping, fittings and branch connections < NPS 4 for the BWR reactor coolant pressure boundary. Cracking of these components is managed by the same AMPs regardless of whether the mechanisms are SCC or thermal and

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
				loading	***Small-bore Piping"***		mechanical loading. The addition of AMP XI.M35 for small bore piping in GALL Rev. 1 provides specific guidance and replaces the prior need for a plant specific AMP. As a result of this change, the Further Evaluation column was changed to "No."
R-04	IV.A1.1-b IV.A1.2-a IV.A1.2-b IV.A1.3-a IV.A1.3-d IV.A1.4-b IV.A1.5-b IV.A1.6-a	***Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy***	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6 separate items. • R-04 which includes (for BWRs) the IV.A1 links and the components defined as BWR vessel components: flanges; nozzles; penetrations; safe ends; thermal sleeves, vessel shells, heads, and welds. • R-219 which includes (for PWRs) the IV.A2 links and the PWR Reactor vessel components defined as: flanges, nozzles; penetrations; pressure housings; safe ends, thermal sleeves, vessel shells, heads and welds. • R-220 which includes (for BWRs) the IV.C1 links and the components defined as piping, piping components, and piping elements.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)

Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
							• R-223 which includes (for PWRs) the IV.C2 links and the components defined as: piping, piping components, and piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; and thermal sleeves • R-221 which includes IV.D1 link and the components defined as recirculating steam generator components: flanges; penetrations; nozzles; safe ends, lower heads and welds. • R-222 which includes IV.D2 link and the components defined as: once-through steam generator components: primary side nozzles; safe ends and welds
R-05	IV.C2.1-e IV.C2.2-g IV.C2.5-i	Cast austenitic stainless steel	***Reactor coolant***	Cracking/ stress corrosion cracking	Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later) minimize the potential of SCC, and material selection according to	Yes, plant-specific	The environment was changed from chemically treated borated water to reactor coolant. The corresponding sections in the SRP-LR (3.1.2.2.7 and 3.1.3.2.7) both discuss the potential for cracking due to stress corrosion cracking (SCC)

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
					NUREG-0313, Rev. 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 guidelines, a plant-specific aging management program is to be 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.		to occur in ASME Class 1 PWR piping, piping components, and piping elements fabricated from cast austenitic stainless steel (CASS). Although NUREG-0313 was written in evaluation of BWR piping (and not PWR piping) its application is being extended to cover materials selection, alloying chemistry and component fabrication criteria to CASS piping in PWR-designed light-water reactors.
R-09	IV.C2.3-b IV.C2.4-b	Stainless steel; steel with stainless steel cladding	Reactor coolant	Cracking/ stress corrosion cracking	***Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water***	No	The AMP column was simplified to require both the water chemistry and the ISI AMPs. In GALL Rev. 0, these AMR line-items stipulated stainless steel and/or cast austenitic stainless steel (CASS) with the recommended AMP described as "Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later revisions or update)

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
							minimize the potential of stress corrosion cracking and material selection according to the NUREG-0313, Rev. 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 guidelines, an aging management program should conform to Chapter XI.M1, "ASME Section XI, Subsections IWB, IWC, and IWD." (In other words, this is fundamentally a combination of GALL AMPs XI.M2 and XI.M1) In GALL Rev. 1, it was acknowledged that, with the exception of the loss of fracture toughness due to thermal and neutron irradiation embrittlement, CASS and stainless steel share the same aging effects/mechanisms and AMPs in GALL. The change to the AMP column effectively recommends both the first provision (water chemistry, XI.M2) of the GALL Rev. 0 entry, and conservatively applies the ISI AMP (XI.M1).

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-12 R-80 R-27 R-32	IV.C2.3-g IV.C2.4-g IV.C2.5-p IV.A2.2-g IV.C1.2-e IV.C1.3-f IV.D1.1-f IV.D2.1-k	Low-alloy steel, stainless steel Low-alloy steel SA 193 Gr. B7 Steel	Air with reactor coolant leakage System temperature up to 288°C (550°F) System temperature up to 340°C (644°F)	Loss of preload/ ***thermal effects, gasket creep, and self-loosening***	Chapter XI.M18, "Bolting Integrity"	No	The aging effect/mechanism was revised to describe a more precise description of the loss of preload aging effect and to be consistent with changes to the definitions in Chapter IX. The AMP continues to provide an acceptable means of managing aging of these components for this revised MEAP.
R-16	IV.C1.4-b	Stainless steel; steel	Reactor coolant	Loss of material/ general (steel only), pitting and crevice corrosion	***Chapter XI.M2, "Water Chemistry," for BWR water*** ***The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.***	Yes, detection of aging effects is to be evaluated	The AMP was revised from XI.M1 (ISI) and XI.M32 to XI.M2 and M32. This revision and the basis for change is similar to other rows, such as RP-25 and RP-27. The One-Time Inspection is to verify the water chemistry program is achieving its mitigative purpose, to satisfy part 54. Although not credited, any applicable ASME Section XI ISI requirements for these components will need to be met to satisfy 10 CFR 50.55(a).
R-24	IV.C2.5-j	Nickel alloy; stainless steel	Reactor coolant	Cracking/ stress corrosion cracking, primary	***Chapter XI.M2, "Water Chemistry," and Chapter XI.M32 "One-Time***	***No, unless licensee commitment needs to be confirmed***	The AMP was revised from plant-specific to AMPS XI.M2 and M32. The AMP was

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
				water stress corrosion cracking	***Inspection" and, for nickel alloy welded spray heads, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.***		changed to explicitly call out the actions identified by Orders, Bulletins, and Generic Letters associated with recent experience with nickel alloys to provide more precise guidance on what would constitute an acceptable AMP. The Staff position would encompass ISGs and branch technical positions published in other regulatory guidance documents. If alloy 600 or its associated weld materials (alloy 82/182) is used, the Staff has requested a commitment in the FSAR supplement as stated. Also, added to the further evaluation column the recommendation for the licensee commitment to be confirmed. In Staff's SE on WCAP-14574, License Renewal Evaluation: Aging Management Evaluation for Pressurizers (July 1996), the Staff did not identify pressurizer spray heads as passive, long-lived components that are within the scope of license renewal. Furthermore, the scoping and screening processes for pressurizer spray

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
							heads in previous PWR applications have not always identified that pressurizer spray heads are within the scope of license renewal as passive long-lived components nor has the Reactor System Branch (SXRB) of the Division of Safeguards and Safety Analysis always required pressurizer spray heads to be within the scope of license renewal. A PWR license renewal applicant can take an exception to these items if their position is that the pressurizer spray heads within their facilities are not within the scope of license renewal. Such an exception will need to be justified to the satisfaction of the RLEP or SXRB Staff performing the scoping and screening review for the application. This scoping discussion also applies to R-52 for pressurizer spray heads.
R-35	IV.D2.1-a	Steel with stainless steel or nickel alloy cladding	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	***Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and,***	***No, but licensee commitments to be confirmed***	The AMP was changed to explicitly call out the actions identified by Orders, Bulletins, and Generic Letters associated with recent experience with nickel alloys to provide more precise guidance on what would constitute an acceptable

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
					for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.		AMP. The Staff position would encompass ISGs and branch technical positions published in other regulatory guidance documents. If alloy 600 or its associated weld materials (alloy 82/182) is used, the Staff has requested a commitment in the FSAR supplement as stated. Also, added to the further evaluation column the recommendation for the licensee commitment to be confirmed.
R-41	IV.D1.2-h	Steel	Secondary feedwater/ steam	Wall thinning/flow-accelerated corrosion	***Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water***	***No***	The AMP was changed from plant-specific to AMP XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP, and consequently, the further evaluation column was changed to "No."
R-42	IV.D1.2-k	Steel	Secondary feedwater/ steam	Ligament cracking/ corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
							evaluation column was changed to "No."
R-43	IV.D1.2-g	Nickel alloy	Secondary feedwater/ steam	Denting/ corrosion of carbon steel tube support plate	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water. For plants that could experience denting at the upper support plates, the applicant should evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02, "Rapidly Propagating Cracks in SG Tubes."	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to "No."
R-44	IV.D1.2-a IV.D2.2-a	Nickel alloy	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR primary water	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to "No."
R-47	IV.D1.2-b IV.D2.2-b	Nickel alloy	Secondary feedwater/ steam	Cracking/ outer diameter stress corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
				cracking	XI.M2, “Water Chemistry,” for PWR secondary water		effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to “No.”
R-48	IV.D1.2-c IV.D2.2-c	Nickel alloy	Secondary feedwater/ steam	Cracking/ intergranular attack	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to “No.”
R-49	IV.D1.2-e	Nickel alloy	Secondary feedwater /steam	Loss of material/ fretting and wear	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	***No***	The AMP and further evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to “No.”
R-50	IV.D1.2-f	Nickel alloy	Secondary	Loss of material/	Chapter XI.M19, “Steam	***No***	The AMP and further

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
			feedwater /steam	wastage and pitting corrosion	Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water		evaluation columns in GALL Rev. 0 required a review of the effectiveness of XI.M19. As part of the GALL Rev. 1 revision, XI.M19 was revised to identify recent experience that eliminates the need to verify the effectiveness of the AMP and consequently, the further evaluation column was changed to "No."
R-75 R-90	IV.A2.2-a IV.A2.7-b	Nickel alloy	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water and ***Chapter XI.M11-A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)"***	No	The AMP column was revised to replace AMP XI.M11, which was deleted, with the new AMP XI.M11-A
R-98	B1.2-a	Stainless steel	Reactor coolant	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-	***Chapter XI.M9, "BWR Vessel Internals," for top guide and Chapter XI.M2, "Water Chemistry," for BWR water. Additionally, for top guides with neutron***	No	Additional information was added to the AMP column regarding the top guides. The Staff wanted to ensure that this guidance was followed by licensees during the license renewal process. IGSCC is a

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
				assisted stress corrosion cracking	***fluence exceeding the IASCC threshold (5E20, E>IMeV) prior to the period of extended operation, inspect five percent (5%) of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation. An additional 5% of the top guide locations will be inspected within twelve years after entering the period of extended operation.*** ***Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5% of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5% of the top guide locations will be inspected within twelve***		concern for neutron fluence exceeding a threshold for 5E 20 MeV. The extent of the examination and its frequency will be based on a ten percent sample of the total population, which includes all grid beam and beam-to-beam crevice slots.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
					years after the date projected for exceeding the threshold. ***The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold.*** ***The extent and frequency of examination of the top guide is similar to the examination of the control rod drive housing guide tube in BWRVIP-47.***		
R-106 R-109 R-116 R-120 R-123 R-130 R-138 R-143 R-146 R-149 R-155 R-159 R-166 R-172 R-173 R-175	IV.B2.1-a IV.B2.1-e IV.B2.2-a IV.B2.3-a IV.B2.4-a IV.B2.5-a IV.B2.5-k IV.B2.6-a IV.B3.1-a IV.B3.2-a IV.B3.3-a IV.B3.4-a IV.B3.5-a IV.B4.1-a IV.B4.1-b IV.B4.2-a	Stainless steel, nickel alloy	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	***Chapter XI.M2, "Water chemistry" for PWR primary water. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the***	***No, but licensee commitment to be confirmed.***	The AMP column was changed to delete reference to XI.M16 (AMP M16 was also deleted from the GALL Report) and add a commitment to apply industry programs to be developed in the future for proper management of reactor internals. The commitment has to be provided in the FSAR supplement. Also, added to the further evaluation column the requirement for the licensee commitment to be confirmed.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-176 R-180 R-181 R-185 R-193 R-202 R-209 R-214	IV.B4.2-b IV.B4.3-a IV.B4.3-b IV.B4.4-a IV.B4.5-a IV.B4.6-a IV.B4.7-a IV.B4.8-a				***industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.***		
R-107 R-110 R-113 R-117 R-119 R-121 R-124 R-126 R-131 R-134 R-139 R-144 R-147 R-151 R-158 R-160 R-163 R-168 R-174 R-177 R-182 R-187 R-195	IV.B2.1-b IV.B2.1-f IV.B2.1-j IV.B2.2-b IV.B2.2-e IV.B2.3-b IV.B2.4-b IV.B2.4-d IV.B2.5-b IV.B2.5-f IV.B2.5-l IV.B2.6-b IV.B3.1-b IV.B3.2-c IV.B3.3-b IV.B3.4-b IV.B3.4-f IV.B3.5-c IV.B4.1-c IV.B4.2-c IV.B4.3-c IV.B4.4-c IV.B4.5-c	Stainless steel; nickel alloy	Reactor coolant	Changes in dimensions/ void swelling	***No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals***	***No, but licensee commitment to be confirmed.***	The AMP and further evaluation columns in GALL Rev. 0 required a plant-specific AMP, participation in industry programs to investigate aging effects and determine an appropriate an AMP. Otherwise, the applicant was to provide the basis for concluding that void swelling is not an issue for the component. This has been replaced with requiring a commitment, to be provided in the FSAR Supplement, to apply industry programs that will be developed in the future for proper management of reactor internals. Also, added to the further evaluation column the requirement for the licensee commitment to be confirmed.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-199 R-204 R-211 R-215	IV.B4.5-h IV.B4.6-c IV.B4.7-c IV.B4.8-b				***to the NRC for review and approval.***		
R-108 R-114 R-129 R-136 R-137 R-154 R-165 R-184 R-192 R-197 R-201 R-207 R-213	IV.B2.1-d IV.B2.1-k IV.B2-4-h IV.B2.5-h IV.B2.5-i IV.B3.2-g IV.B3.4-h IV.B4.3-e IV.B4.4-h IV.B4.5-e IV.B4.5-j IV.B4.6-g IV.B4.7-e	Stainless steel, nickel alloy	Reactor coolant	Loss of preload/ stress relaxation	***No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to:*** ***(1) participate in industry programs for investigating and managing aging effects applicable to Reactor Internals,*** ***(2) evaluate and implement the results of the industry programs as applicable to the Reactor Internals design and,*** ***(3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.***	***No, but licensee commitment to be confirmed.***	The AMP column was changed to delete XI.M1, M14, and M15 (the current versions of the latter two AMPs are no longer acceptable to NRC and have been deleted from GALL Rev. 1) and instead recommend a commitment, to be provided in the FSAR Supplement, to apply industry programs that will be developed in the future for proper management of reactor internals. Also, added to the further evaluation column the requirement for this licensee commitment to be confirmed.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)

Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
R-122 R-127 R-128 R-132 R-135 R-141 R-157 R-161 R-164 R-169 R-178 R-188 R-196 R-205 R-212 R-216	IV.B2.3-c IV.B2.4-e IV.B2.4-f IV.B4.5-i IV.B2.5-c IV.B2.5-g IV.B2.5-n IV.B3.3-a IV.B3.4-c IV.B3.4-g IV.B3.5-d IV.B4.2-e IV.B4.4-d IV.B4.5-d IV.B4.6-d IV.B4.7-d IV.B4.8-c	Stainless steel; nickel alloy	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	***No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in industry programs for investigating and managing aging effects applicable to Reactor Internals, (2) evaluate and implement the results of the industry programs as applicable to the Reactor Internals design and, (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.***	***No, but licensee commitment to be confirmed.***	The AMP column was changed to delete reference to XI.M16 (AMP M16 was also deleted from the GALL Report) and instead require a commitment in the FSAR Supplement to apply industry programs to be developed in the future for proper management of reactor internals. Also, added to the further evaluation column the requirement for the licensee commitment to be confirmed.
R-112 R-118 R-125 R-133 R-150 R-162 R-167 R-186	IV.B2.1-i IV.B2.2-d IV.B2.4-c, IV.B4.5-g IV.B2.5-e IV.B3.2-b IV.B3.4-e IV.B3.5-b IV.B4.4-b	Stainless steel, nickel alloy	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion	***Chapter XI.M2, "Water chemistry" for PWR primary water. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1)***	***No, but licensee commitment to be confirmed***	The AMP column was changed to delete reference to XI.M16 (AMP M16 was also deleted from the GALL Report) and instead require a commitment in the FSAR Supplement to apply industry programs to be developed in the future for proper management of reactor

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)

Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
R-194 R-203 R-210	IV.B4.5-b IV.B4.6-b IV.B4.7-b			cracking	***participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.***		internals. Also, added to the further evaluation column the requirement for the licensee commitment to be confirmed.
R-145	IV.B2.6-c	Stainless steel with or without chrome plating	Reactor coolant	Loss of material/ wear	***Chapter XI.M37, "Flux Thimble Tube Inspection"***	No	The AMP column was revised from AMP XI.M1 to AMP XI.M37. AMP XI.M37 is a program that is based on the recommendations of NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors." This program was created to monitor for thinning of the flux thimble tube walls, which provide a path for the incore neutron flux monitoring system detectors and form part of the RCS pressure boundary.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
							(See Table IV for additional information on AMP XI.M37.)
R-219	***IV.A2.1-b IV.A2.2-c IV.A2.3-c IV.A2.4-a IV.A2.5-d***	***Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy***	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6 generic items including R-219 which includes (for PWRs) the IV.A2 links and the PWR Reactor vessel components defined as Flanges, nozzles; penetrations; pressure housings; safe ends, Thermal sleeves, vessel shells, heads and welds.
R-220	***IV.C1.1-b IV.C1.1-d IV.C1.1-e IV.C1.1-h IV.C1.2-a IV.C1.3-d***	***Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy***	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6 generic items including R-220 which includes (for BWRs) the IV.C1 links and the components defined as piping, piping components, and piping elements.
R-221	***IV.D1.1-h***	***Steel; stainless***	Reactor coolant	Cumulative fatigue damage/	Fatigue is a time-limited aging analysis (TLAA) to	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)

Item	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
		steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy		fatigue	be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).		generic items including R-221 which includes IV.D1 link and the components defined as "Recirculating steam generator components: Flanges; Penetrations; Nozzles; Safe ends, lower heads and welds."
R-222	***IV.D2.1-c***	***Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy***	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6 generic items including R-222 which includes IV.D2 link and the components defined as "Once-through steam generator components: Primary side nozzles; Safe ends and welds."
R-223	***IV.C2.1-a IV.C2.1-b IV.C2.2-a IV.C2.2-b IV.C2.2-c IV.C2.3-a***	***Steel; stainless steel; steel with nickel-alloy or***	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components,	Yes, TLAA	The Staff decided it was appropriate to split R-04 into 6 generic items including R-223 which includes (for PWRs) the IV.C2 links and the components defined as piping,

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	IV.C2.4-a IV.C2.5-a IV.C2.5-d IV.C2.5-e IV.C2.5-f IV.C2.5-q	***stainless steel cladding; nickel-alloy***			environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).		piping components, and piping elements; flanges; Nozzles and safe ends; Pressurizer vessel shell heads and welds; Heater sheaths and sleeves; Penetrations; and Thermal sleeves.
R-224 R-59	IV.D2.1-e IV.A1.1-a	Steel	Secondary feedwater/ steam Reactor Coolant	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.***	Yes, detection of aging effects is to be evaluated	The AMP was revised from XI.M1 (ISI) and XI.M32 to XI.M2 and M32. These AMPs are more appropriate to use to detect loss of material from general, pitting, and crevice corrosion to ensure that significant degradation is not occurring.
R-225	IV.C1.4-a IV.C1.4-b	Stainless steel; steel	Reactor coolant	Cracking/ ***cyclic loading***	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components The AMP in Chapter XI.M1 is to be augmented to detect cracking due to cyclic loading and verification of the effectiveness of the program is necessary to ensure that significant degradation is not occurring and the	Yes, detection of aging effects is to be evaluated	This is identical to GALL Rev. 0 row IV.C.1-4a except that the Staff decided to create separate rows for the aging effect/mechanism of cracking/ stress corrosion cracking, intergranular stress corrosion cracking, and cracking/cyclic loading. GALL Row R-15 addresses the aging effect/mechanism of cracking/ stress corrosion cracking and intergranular stress corrosion cracking.

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (Chapter IV in GALL Vol. 2)							
Item	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
					component intended function will be maintained during the extended period of operation. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.		
R-226	***IV.D2***	Nickel alloy	Secondary feedwater/ steam	Denting/ corrosion of carbon steel tube support plate	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water.	No	Extended the applicability of R-43 (recirculating steam generator tubes) to once through steam generators, except that Bulletin 88-02 does not apply.

III.D Engineered Safety Features

Table III.D presents the changes made to existing AMR line-items for engineered safety features.

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
E-01	Partially encased tanks with breached moisture barrier	V.D1.8-c	Stainless steel	***Raw water***	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Yes, plant-specific	The terminology for this environment was changed to remove "Untreated water" and instead use "Raw water." The change conforms with the change made to the definitions in Chapter IX of the GALL Report.
E-07	Piping, piping components, and piping elements	V.D2.1-f	Steel	***Steam***	Wall thinning/ flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	No	The environment was changed from "Air and Steam" to "Steam" because it is the steam environment that gives rise to the potential for flow accelerated corrosion. Additionally, in GALL Rev. 0 this line applied to the steam lines to the HPCI and RCIC pump turbine. However, the steam lines to the HPCI and RCIC Turbine are used less than 2% of the time and, therefore, are

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								not susceptible to flow accelerated corrosion. The steam drain lines however, see constant steam flow and are therefore susceptible to flow accelerated corrosion. The AMP continues to provide an acceptable means of managing aging of these components for this revised MEAP.
E-22 E-34	Containment isolation piping and components internal surfaces	V.C.1-a V.C.1-b	Steel Stainless Steel	***Raw water***	Loss of material/ general, pitting, crevice and micro-biologically influenced corrosion ***and fouling***	***Chapter XI.M20, "Open-Cycle Cooling Water System"***	No	The terminology for this environment was changed to remove "Untreated water" and instead use "Raw water." The change conforms with the change made to the definitions in Chapter IX of the GALL report. Fouling was added to the aging effect/mechanism to acknowledge the fact that biofouling also operates as an aging mechanism in a raw water environment. Also, the AMP was changed from plant-

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								specific to XI.M20 and the further evaluation was changed to "No." The scope of this program notes that this program addresses the aging effects of material loss and fouling due to micro- or macro-organisms and various corrosion mechanisms.
E-25	Ducting and components internal surfaces	V.B.2-a	Steel	Air – indoor uncontrolled (Internal)	Loss of material/ general corrosion	***Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"***	***No***	The AMP and FE columns were revised to refer to AMP XI.M38. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								be maintained within the CLB for the period of extended operation.
E-27	Piping and components internal surfaces	V.D2.1-e	Steel	Condensation (Internal)	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"***	***No***	The AMP and FE columns were revised to refer to AMP XI.M38, which identifies an acceptable means of managing aging of these components. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
E-29	Piping and components	V.A.2-a V.A.5-a	Steel	Air – indoor uncontrolled	Loss of material/	***Chapter XI.M38, "Inspection of Internal***	***No***	The AMP and FE columns were revised

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
	internal surfaces	V.D2.5-a		(Internal)	general corrosion	***Surfaces in Miscellaneous Piping and Ducting Components"***		to refer to AMP XI.M38, which identifies an acceptable means of managing aging of these components. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
E-33	Containment isolation piping and components internal surfaces	V.C.1-b	Stainless steel	Treated water	Loss of material/ pitting and crevice corrosion	***Chapter XI.M2, "Water Chemistry"*** ***The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time***	***Yes, detection of aging effects is to be evaluated***	The AMP was revised from plant specific to AMP XI.M2 as augmented by XI.M32. As noted in the Preventive Actions portion of AMP XI.M2,

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						Inspection," for an acceptable verification program.		this program "includes specifications for chemical species, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. System water chemistry is controlled to minimize contaminant concentration and mitigate loss of material due to general, crevice, and pitting corrosion. . ."
E-35 E-44 E-46	Containment isolation piping and components external surfaces External surfaces External surfaces	V.C.1-a V.E. V.E.1-b	Steel	Air – indoor uncontrolled (External) Air – indoor uncontrolled (External) Condensation (External)	Loss of material/ general corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, "External Surfaces Monitoring." AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation.
E-40	Ducting closure bolting	V.B.1-a	Steel	Air – indoor uncontrolled (External)	Loss of material/ general corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column has been changed to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, “External Surfaces Monitoring.” AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. For ducting closure bolting, this AMP is used instead of M18, "Bolting Integrity" due to the lower operating pressures within this ducting. Therefore, these components would not be within the scope of AMP XI.M18.
E-42	***Piping, piping components, and piping elements***	***V.B.***	***Steel (with or without coating or wrapping)***	***Soil***	***Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion***	***Chapter XI.M28, "Buried Piping and Tanks Surveillance," or*** ***Chapter XI.M34, "Buried Piping and Tanks Inspection"***	***No*** ***Yes, detection of aging effects and operating experience are to be further evaluated***	This row is identical to A-01 and was added to cover buried piping in ESF systems. Underground steel (with or without coating or wrapping) piping, piping components, and piping elements exposed to a soil environment are subject to loss of material due to

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								general, pitting, crevice, and microbiologically influenced corrosion. This aging effect can be managed by either surveillance (XI.M28) or inspection (XI.M34). Although buried steel without coating or wrapping is not commonly found, the “with or without” was included to ensure that all steel pipe in a soil environment was addressed by this line-item.
E-43	***Motor Cooler***	***V.A V.D1.***	*Gray cast iron*	***Treated water***	***Loss of material/ selective leaching***	***Chapter XI.M33, “Selective Leaching of Materials”***	***No***	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As discussed in FNP SER section 3.2.2.4.1.2, the Staff has accepted the position that cast iron in a treated water environment exhibits a loss of material due to selective leaching and is properly managed by

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								the Selective Leaching of Materials Program, which includes a one-time visual inspection and hardness measurement of selected components to determine whether loss of material due to selective leaching is occurring. Implementation of AMP XI.M33 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

III.E Electrical Components

There were no significant changes to existing AMR line-items for electrical components

III.F Auxiliary Systems

Table III.F presents the changes made to existing AMR line-items for Auxiliary Systems.

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
A-02	Piping, piping components, and piping elements	VII.C1.1-c VII.C3. VII.G. VII.H1. VII.H2.	Gray cast iron	Soil	***Loss of material/ selective leaching***	Chapter XI.M33, “Selective Leaching of Materials”	No	General corrosion was removed from the aging effect/mechanism column because it is already addressed under A-01.
A-08	Ducting and components internal surfaces	VII.F1.1-a VII.F1.4-a VII.F2.1-a VII.F2.4-a VII.F3.1-a VII.F3.4-a VII.F4.1-a	Steel	***Condensation (Internal)***	***Loss of material/ general, pitting, crevice, and (for drip pans and drain lines) microbiologically influenced corrosion***	***Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"***	***No***	The AMP and FE columns were revised to refer to AMP XI.M38. This AMP was developed to provide for proper management of the aging effects for this MEAP combination. See Table IV for further discussion of the basis for this AMP. The environment was changed to better describe a moist air environment which could lead to condensation.

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
A-10	Ducting and components external surfaces	VII.F1.1-a VII.F1.4-a VII.F2.1-a VII.F2.4-a VII.F3.1-a VII.F3.4-a VII.F4.1-a	Steel	Air – indoor uncontrolled (External)	Loss of material/ general corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, “External Surfaces Monitoring.” AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation. For ducting closure
A-105	Ducting closure bolting	VII.F1.1-a VII.F2.1-a VII.F3.1-a VII.F4.1-a VII.I						
A-77	External surfaces	VII.I.1-b						
A-78	External surfaces	VII.I.1-b		Air – outdoor (External)				
A-81	External surfaces	VII.I.1-b		Condensation (External)				

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								bolting, this AMP is used instead of M18, “Bolting Integrity” due to the lower operating pressures within this ducting.
A-15 A-16	***Elastomer lining***	***VII.A3.2-a VII.A3.2-d VII.A3.3-a VII.A3.3-d VII.A3.5-a VII.A3.5-c*** ***VII.A4.2-a VII.A4.2-b VII.A4.3-a VII.A4.3-b VII.A4.5-a VII.A4.5-b***	***Elastomers***	***Treated borated water***	***Hardening and loss of strength/elastomers degradation***	***A plant-specific aging management program that determines and assesses the qualified life of the linings in the environment is to be evaluated.***	***Yes, plant specific***	The GALL Rev. 0 line-item was for steel with elastomer lining. However, only the metal component was covered. This line-item was created to address the elastomer lining. (Although 95°F is a recognized threshold, temperature is not the only factor for aging of elastomers. Discussion of aging elastomers should consider aging effects from other factors causing degradation such as exposure to ozone, oxidation, and radiation)
A-23	Piping, piping components, and piping elements	VII.H2.2-a VII.H2.3-a VII.G.	Steel	***Moist air or condensation (Internal)***	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and***	***No***	The environment was changed to add condensation (internal) to reflect moisture in the emergency diesel

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						Ducting Components"		starting air system. The aging effects are the same for both environments and the definition in Chapter IX says the two environments are similar. The AMP and FE columns were also revised to refer to AMP XI.M38. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								operation.
A-24	Piping, piping components, and piping elements	VII.H1.1-a VII.H1.2-a VII.H1.3-a	Steel	Air – outdoor (External)	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, “External Surfaces Monitoring.” AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								operation.
A-38	Piping, piping components, and piping elements	VII.C1.1-a VII.C1.2-a VII.C1.5-a VII.C1.6-a VII.C3.1-a VII.C3.2-a VII.C3.3-a VII.H2.1-b	***Steel (with or without lining/coating or with degraded lining/coating)***	Raw water	***Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation***	Chapter XI.M20, “Open-Cycle Cooling Water System”	No	The Materials column was expanded to indicate that this material may exist with or without lining/coating. The aging effect/mechanism column was also revised to add "and lining/coating degradation" similar to rows A-39 and A-40.
A-50	Piping, piping components, and piping elements	VII.C2.3-a VII.F3.	Gray cast iron	Closed cycle cooling water	***Loss of material/ selective leaching***	***Chapter XI.M33, “Selective Leaching of Materials”***	No	Deleted pitting and crevice corrosion from the aging effect/mechanism. Deleted AMP XI.M21 from the AMP column. Line-item A-25 includes general, pitting, and crevice corrosion for steel which includes gray cast iron for these mechanisms. Thus, only selective leaching needs to be addressed here. This row is similar to AP-31; therefore VII.F3 was added to the

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								related item column to reflect that this environment may also apply to the Primary Containment Heating and Ventilation System.
A-68	***Heat exchanger components***	VII.E3.4-a	Stainless steel; steel with stainless steel cladding	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	***Chapter XI.M21, "Closed-Cycle Cooling Water System"***	***No***	The Structures and/or Components column was simplified to state "Heat exchanger components." The reference to the shell side or tube side of the heat exchanger unnecessarily limits the applicability of the line-item because the configuration of the heat exchanger does not alter the aging effects or the appropriate aging management program. Consequently, this reference has been deleted. The program was revised from plant-specific to XI.M21, "Closed - Cycle Cooling Water System." In the FNP

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								LRA, the Water Chemistry Control Program satisfies the program elements of XI.M21 to manage cracking due to stress corrosion cracking in stainless steel in this environment. This was accepted by the Staff in Section 3.0.3.2.1 of the FNP SER. AMP XI.M21, "Closed –Cycle Cooling Water System" has also been revised to include stress corrosion cracking.
A-76	High-pressure pump Casing	VII.E1.5-a	***Stainless steel***	Treated borated water	***Cracking/ stress corrosion cracking, cyclic loading***	***Chapter XI.M2, "Water Chemistry," for PWR primary water*** ***The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading.***	Yes, plant-specific	Closure bolting was removed from the Structures and/or Components since this environment is not external and closure bolts are covered under (high strength steel). Steel was removed from the material column since there are no steel high pressure pump casings. The AMP was changed to

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
						A plant specific aging management program is to be evaluated.		add AMP XI.M2 augmented by XI.M32, and continue to call out plant specific, consistent with ANO-2 SER 3.3.2.2.4.
A-80	***Piping and components external surfaces***	***VII.D.2-a VII.D.3-a VII.D.1-a VII.D.4-a VII.D.6-a VII.D.5-a***	***Steel***	***Air – indoor uncontrolled (External)***	***Loss of material/ general corrosion***	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	This line-item was added to address the external surface of compressed air components. The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, “External Surfaces Monitoring.” AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								AMP. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
A-82 A-83	Reactor coolant pump oil collection system Tank Reactor coolant pump oil collection system Piping, tubing, valve bodies	VII.G.7-a VII.G.7-b	Steel	Lubricating oil	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M39, "Lubricating Oil Analysis"*** ***The AMP is to be augmented to evaluate the thickness of the lower portion of the tank. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.***	Yes, detection of aging effects is to be evaluated	The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M39, "Lubricating Oil Analysis." AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
A-90	Structural fire barriers: Walls, ceilings and floors	VII.G.1-b VII.G.2-b VII.G.3-b VII.G.4-b VII.G.5-a	Reinforced concrete	Air – indoor uncontrolled	***Concrete cracking and spalling/ aggressive chemical attack, and reaction with aggregates***	Chapter XI.M26, "Fire Protection" and Chapter XI.S6, "Structures Monitoring Program"	No	Freeze-thaw was deleted from the aging effect/mechanism column. Freeze-thaw is not an applicable aging mechanism in an air - indoor uncontrolled environment. The AMP continues to provide an acceptable means of managing aging of these components for this revised MEAP.
A-103	Closure bolting	VII.D.2-a	Steel	Condensation	Loss of material/ general, pitting, and crevice corrosion	***Chapter XI.M18, "Bolting Integrity"***	No	GALL Rev. 0 line-item VII.D.2-a was split into three AMR

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev.0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								line-items in the GALL Report Rev. 1 (i.e., A-26, A-80, and A-103). This line-item (A-103) specifically treats the closure bolts as a separate line-item and assigns the XI.M18, "Bolting Integrity" aging management program to these components. This program provides an acceptable means of managing aging of these components.
A-104	High-pressure pump Closure bolting	VII.E1.5-a	High-strength steel	Air with steam or water leakage	Cracking/ cyclic loading, stress corrosion cracking	***Chapter XI.M18, "Bolting Integrity." The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.***	***Yes, if the bolts are not replaced during maintenance***	The AMP column was revised from plant specific to XI.M18, "Bolting Integrity" program. The AMP is to be augmented by bolt inspection or replacement to reflect the applicability of the revised XI.M18 to adequately manage the aging effects of cracking due to cyclic loading and stress corrosion cracking on high-strength steel bolts and to reflect

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								operating experience. The FE entry was also changed to be consistent with the change to the AMP.
A-105	Ducting closure bolting	VII.F1.1-a VII.F2.1-a VII.F3.1-a VII.F4.1-a VII.I.	Steel	Air – indoor uncontrolled (External)	Loss of material/ general corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column has been changed to eliminate the need for a plant specific aging management program in light of the development AMP XI.M36, "External Surfaces Monitoring Program." AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component's

IIIF. Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	Structures and/or Components	GALL Rev.0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
								intended functions will be maintained within the CLB for the period of extended operation.

III.G Steam and Power Conversion System

Table III.G presents the changes made to existing AMR line-items for the steam and power conversion system.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
S-08	Piping, piping components, and piping elements	VIII.B1.1-b VIII.B2.1-c	Steel	Steam ***or treated water***	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Yes, TLAA	The environment column was revised to add treated water since fatigue may not be limited to piping with an internal steam environment. The AMP continues to adequately provide for proper management of the aging effects for this revised MEAP combination.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
S-12	Piping, piping components, and piping elements	VIII.G.1-d	Steel	***Raw water***	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	A plant-specific aging management program is to be evaluated.	Yes, plant-specific	The terminology for this environment was changed to remove "Untreated water" and instead use "Raw water." The change conforms with the change made to the definitions in Chapter IX of the GALL report. The AMP continues to adequately provide for proper management of the aging effects for this revised MEAP combination.
S-17 S-20	***Heat exchanger components***	VIII.G.5-d	Steel Stainless Steel	Lubricating oil	Loss of material/ general (steel only), pitting, crevice, and microbiologically influenced corrosion Loss of material/ pitting, crevice, and microbiologically influenced corrosion	***Chapter XI.M39, "Lubricating Oil Analysis"*** ***The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.***	***Yes, detection of aging effects is to be evaluated***	The Structures and/or Components column was simplified to state "Heat exchanger components." The reference to the shell side or tube side of the heat exchanger unnecessarily limits the applicability of the line-item because the configuration of the heat exchanger does not alter the aging effects or the appropriate aging management program.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
								Consequently, this reference has been deleted. The AMP and FE columns were also revised to refer to AMP XI.M39. AMP XI.M39 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components with one-time inspection (AMP XI.M32) to provide a mitigative and verification method. See Table IV for further discussion of the basis for these AMPs. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
S-29 S-41 S-42	External surfaces	VIII.H.1-b	Steel	Air – indoor uncontrolled (External) Air – outdoor (External) Condensation (External)	Loss of material/ general corrosion	***Chapter XI.M36, "External Surfaces Monitoring"***	***No***	The AMP column was revised to eliminate the need for a plant specific aging management program in light of the development of AMP XI.M36, “External Surfaces Monitoring.” AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. See Table IV for further discussion of the basis for this AMP. The implementation of this program provides reasonable assurance that the component’s intended functions will be maintained within the CLB for the period of extended operation.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL Rev. 0 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
S-33	Closure bolting	VIII.H.	Steel	Air – indoor uncontrolled (External)	***Loss of preload/ thermal effects, gasket creep, and self-loosening***	Chapter XI.M18, "Bolting Integrity"	No	The aging effect/mechanism was revised to describe a more precise description of the loss of preload aging effect and to be consistent with changes to the definitions in Chapter IX. The AMP continues to provide an acceptable means of managing aging of these components for this revised MEAP.

IIIG. Changes in Existing AMR Line-Items related to Steam and Power Conversion Systems (Chapter VIII in GALL Vol. 2)

Item	Structures and/or Components	GALL Rev. 0 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
S-39	Heat exchanger components	VIII.F.4-a	Stainless steel	Treated water >60°C (>140°F)	***Cracking/stress corrosion cracking***	Chapter XI.M2, "Water Chemistry," for PWR secondary water. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Yes, detection of aging effects is to be evaluated	The Staff added this row to address cracking of stainless steel in heat exchanger components in this environment for the PWR Steam Generator Blowdown System. The implementation of this augmented program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.

IV. Description of and Justification for Changes in Aging Management Programs

The following table describes the technical changes that were made to the Aging Management Programs in Chapters X and XI of GALL Revision 1. In GALL Rev. 1, the technical approach (such as visual, surface, and volumetric examination) for each of these AMPs is clearly defined. The following table describes the technical approach where there have been changes; otherwise, refer to GALL Rev. 1, Chapters X and XI for a given AMP. The following table generally does not include editorial changes.

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Y	Revised the Program Description to note that examples of critical component locations are identified in NUREG/CR-6260 Also revised the monitoring and trending section to indicate that the minimum sample of critical component locations includes the locations identified in NUREG/CR-6260. The revision to this section also allows proposing alternative locations based on plant-specific considerations in the event the locations identified in NUREG/CR-6260 are not applicable to the plant's configuration.	III, IV, V, VII, VIII
X.S1	Concrete Containment Tendon Prestress	N	N/A	II
X.E1	Environmental Qualification (EQ) of Electrical Components	Y	In GALL Rev.0, the program description stated the following "However, Generic Safety Issue (GSI) 168, which is related to low-voltage EQ instrumentation and control cables, is currently an open generic issue. NRC research is ongoing to provide information to resolve it. An applicant is to address GSI-168 in its application for Staff review." In GALL Rev.1, the reference to GSI-168 in the Program Description was deleted because it is no longer an open issue. GSI-168 was closed with NRC Regulatory Issue Summary 2003-09, "Environmental Qualification of Low-Voltage Instrumentation and Control Cables" dated May 2, 2003.	VI

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these newer editions.	IV
XI.M2	Water Chemistry	Y	A major change was in the AMP XI.M2 Program Description and Element 1 "Scope of Program" to allow industry guidelines such as BWRVIP-29 or later revisions and "water chemistry control in accordance to industry guidelines." This change was incorporated because later versions of these chemistry program guidelines are developed from collective operating experience using sound technical judgment, and are approved by the electric utility industry in an effort to constantly improve water chemistry and thereby manage or prevent aging effects. Element 3 "Parameters Monitored/Inspected" Consistent with revisions in the AMR line-item revisions and the definition of steel in GALL Rev.1 Chapter IX, the term 'steel' has been used to encompass carbon steel which is no longer specifically denoted. References have been updated to include the 2003 EPRI TR-1002884, *PWR Primary Water Chemistry Guidelines*, and the 2005 10 CFR Part 50.	III, IV, V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M3	Reactor Head Closure Studs	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: “An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.” References were changed accordingly to conform to these newer editions.	IV
XI.M4	BWR Vessel ID Attachment Welds	Y	Element 3 “Parameters Monitored/Inspected” was revised to state that an applicant may use the guidelines of BWRVIP-62 for inspection relief for vessel internal components with hydrogen water chemistry provided that such relief is submitted under the provisions of 10 CFR 50.55a and approved by the Staff. In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: “An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.” References were changed accordingly to conform to these newer editions.	IV

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M5	BWR Feedwater Nozzle	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: “An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.” References were changed accordingly to conform to these newer editions.	IV
XI.M6	BWR Control Rod Drive Return Line Nozzle	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: “An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.” Element 10 “Operating Experience” - NRC IN 2004-08 was added to further document that crack initiation and growth (referred to throughout the revised LRG documents as cracking) has occurred in several BWR plants. References were changed accordingly to conform to these newer information sources.	IV

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M7	BWR Stress Corrosion Cracking	Y	The Program Description and Element 1 "Scope of Program" were revised to indicate that this program also manages components made of nickel-based alloys. This program should also manage cast austenitic stainless steel (included in the definition of stainless steel as used in the context of these LRG documents). Element 2 "Preventive Actions" The sentence about reactor coolant water chemistry being monitored and maintained in accordance with the guidelines in BWRVIP-29 was deleted in GALL Rev.1. Instead, the Program Description, and evaluation and technical basis of monitoring and maintaining reactor water chemistry are addressed through implementation of Section XI.M2, "Water Chemistry." Element 6 "Acceptance Criteria" The reference to (ASME Code Section XI 1995 edition through the 1996 addenda) was revised to read:" As recommended in NRC GL 88-01, any indication detected is evaluated in accordance with the ASME Section XI, Subsection IWB-3600 (1986 edition) and the guidelines of NUREG-0313." Element 10 "Operating Experience" NRC IN 2004-08 was added to document operating experience with IGSCC. References were changed accordingly to conform to these revisions in information sources.	IV

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M8	BWR Penetrations	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: “An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code.” Nickel-based alloys are used for joint welds as well as for weld overlays in BWR reactor coolant pressure boundary piping. Nickel-based alloys are susceptible to IGSCC per Chapter IV of NUREG-1801. Specific discussions of inspection frequencies for nickel-based alloy materials are contained in applicable BWRVIP guidelines. In addition, GALL Rev.1 AMR line-items R-68 and R-21 specifically address this program and material. References were changed accordingly to conform to these revisions in information sources.	IV
XI.M9	BWR Vessel Internals	Y	Element 1 “Scope of Program” was significantly changed to better address BWRVIP guidance for top guide components. Relevant operating experience of cracking in top guide components was reported at the Oyster Creek, Cooper, and Quad Cities, Unit 1 nuclear plants in the early to mid 1990s. Recent operating experience with cracking in U.S. top guides has been reported as a result of augmented examinations that were conducted at the Nine Mile Point, Unit 1 nuclear plant in 2003 and 2005. Therefore, cracking of U.S. BWR top guides is considered to be relevant operating experience for the U.S BWR fleet and adequate aging management programs for managing cracking of BWR top guides should be proposed for any BWR license renewal application. Some of the top guide locations could experience high neutron	IV

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
			fluence exposures and are considered to be more susceptible to crack initiation and growth. In D/QC SER section 3.1.2.3.6, the applicant proposed and Staff has accepted additional inspections. As a result, the former summary of top-guide BWRVIP guidelines in GALL Rev.0 was replaced with the following words to clarify the intent of the AMP: "Additionally, for top guides with neutron fluence exceeding the IASCC threshold (5E20, E>lMeV) prior to the period of extended operation, inspect five percent (5%) of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation. An additional 5% of the top guide locations will be inspected within twelve years after entering the period of extended operation. Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5% of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5% of the top guide locations will be inspected within twelve years after the date projected for exceeding the threshold. The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold. The extent of the examination and its frequency will be based on a 10% sample of the total population, which includes all grid beam and beam-to-beam crevice slots." In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these revisions in information sources.	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M10	Boric Acid Corrosion	Y	The narrative emphasizes that potential improvements to boric acid corrosion program were identified as a result of recent operating experience with cracking of certain nickel alloy pressure boundary components (NRC Regulatory Issue Summary 2003-013). Element 1 "Scope of Program" GALL Rev.1 added to the scope of the GALL BAC program specific guidance for inspection of all components that contain boric acid where leakage could contact components, structures, and electrical components that are subject to aging management review. GALL Rev.1 added aluminum to materials affected. Element 4 "Detection of Aging Effects" GALL Rev.1 also added requirements for ensuring that boric acid leakage, however it is found, is to be evaluated in accordance with this program. References were changed accordingly to conform to these revisions in information sources GALL Rev.1 updated references to include applicable documents issued since 2001. The basis for adding systems/components beyond the scope of GL 88-05 to inspections and the interface with other (e.g., maintenance) activities is the operating experience accrued since 2001 as cited in the references added. A precedent exists for adding aluminum: In VCS SER Section 3.0.3.1.1, the Staff accepted the position that loss of material exhibited by aluminum in an air with borated water leakage environment is properly managed by the Boric Acid Corrosion AMP which provides engineering evaluations and corrective actions to ensure that boric acid corrosion does not lead to degradation of the leakage source or adjacent structures or components.	III, IV, V, VI, VII, VIII
XI.M11	Nickel-Alloy Nozzles and Penetrations	Y	This AMP has been replaced by AMP XI.M11-A. Guidance for the aging management of other nickel-alloy nozzles and penetrations is provided in the AMR lines of Chapter IV of GALL Rev.1, as appropriate.	Not Used in GALL Rev.1 AMR tables

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M11-A	Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors	New AMP	This program was established to ensure that augmented inservice inspections (ISI) of all nickel-alloy vessel head penetration (VHP) nozzles welded to the upper reactor vessel (RV) head of a PWR-designed light-water reactor will continue to be performed as mandated by the interim requirements in Order EA-03-009, “Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors,” as amended by the First Revision of the Order, or by any subsequent NRC requirements that may be established to supplement the requirements of Order EA-03-009.	IV
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	N	N/A	IV, V
XI.M13	Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)	N	N/A	IV
XI.M14	Loose Part Monitoring	N	N/A	Not Used in GALL Rev.1 AMR tables
XI.M15	Neutron Noise Monitoring	N	N/A	Not Used in GALL Rev.1 AMR tables
XI.M16	PWR Vessel Internals	Y	Reference to this program by the AMR line-items was replaced by specific guidance within the AMR line-items of Chapter IV, as appropriate.	Not Used in GALL Rev.1 AMR tables

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M17	Flow-Accelerated Corrosion	Y	Element 5 "Monitoring and Trending" was revised to indicate that Inspection results are evaluated to determine if additional inspections are needed to assure that the extent of wall thinning is adequately determined, identify corrective actions, and assure that intended function will not be lost. Plant Flow-Accelerated Corrosion programs typically use a threshold limit for sample expansion. A strict threshold based on measured degradation being more than predicted would require sample expansion where it is necessary. In a real world application, if the FAC program owner predicts the wear to be 5 mils over an 18-month period and the actual as-found wear is 6 mils then, per GALL Rev.0, sample expansion is necessary. Clearly, the wear is one consideration, but the minimum wall thickness is a critical input to the need for sample expansion. In this particular example, if the pipe wall is 0.25 inches and has a minimum allowable wall thickness of 0.15 inches, then the pipe will last 16 refueling cycles. Sample expansion in this case is not necessary. Thus in GALL Rev.0, Element 5, Monitoring and Trending, the statement "If degradation is detected such that the wall thickness is less than the minimum predicted thickness, additional examinations are performed in adjacent areas to bound the thinning" was replaced in GALL Rev.1 by "Inspection results are evaluated to determine if additional inspections are needed to assure that the extent of wall thinning is adequately determined, assure that intended function will not be lost, and identify corrective actions."	IV, V, VII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M18	Bolting Integrity	Y	This program was extensively revised to allow the AMP to include non-ASME bolting, and thus making the program more broadly applicable. The program description and scope were thus expanded. Significant changes include the following: • Better definitions for which aging mechanisms are managed by this AMP. • Better clarification on which type of bolting is within the scope of this program, including ASME Code Class 1, 2, and 3 bolting, structural bolting, and in-scope non-safety related bolting or safety-related non-ASME bolting. • Revised references to ASME Section XI Code C • Clarifications regarding the use of code editions identified in 10 CFR 50, Code Cases identified in RG 1.147, Code references for Class 3 bolting and reference to the operating experience with tee-quencher support bolts. • Revised Operating Experience section noting that leakage from bolted connections has been observed in reactor building closed cooling systems of BWRs (LER 50-341/2005-001).	III, IV, V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M19	Steam Generator Tube Integrity	Y	The following changes were made: • Eliminated the reference to “Staff review of NEI 97-06" & eliminated the requirement for NRC plant-specific review of a licensee’s steam generator tube integrity AMP - The Staff is reviewing generic revisions to the standard technical specifications, based on the provisions of NEI 97-06, which are intended to upgrade the standard technical specifications to assure the condition of the tubes remains adequate for the period of time between inspections. Also, considering that there is a framework in place, including Code of Federal Regulations, plant technical specifications, industry guidelines, and NRC oversight and review of plant’s steam generator integrity activities, makes the further review of this AMP unnecessary. • Element 1 “Scope of Program” clarified the inclusion of steam generator sleeves and plugs. This makes the AMP consistent with the line-item in GALL volume 2 section IV. • Included tube support lattice bars and tube support plates made of carbon steel in the AMP scope, and eliminated the requirement for plant-specific aging management program for these components - All PWR licensees have committed voluntarily to a SG degradation management program described in NEI 97-06. The Staff has concluded that if the steam generator tube integrity AMP includes the carbon steel tube supports, lattice bars and tube support plates in the program scope, references the licensee’s response to NRC GL 97-06 and the licensee’s intent to maintain steam generator secondary-side integrity in accordance with NEI 97-06 guidelines, a separate plant-specific program is not needed. In addition, subsequent NRC plant-specific review of the steam generator tube integrity AMP for these components is not necessary. GALL Rev.1 Chpt. IV AMR line-items R-41 and R-42 are examples where this AMP is applied to lattice bars.	IV

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.M20	Open-Cycle Cooling Water System	Y	Elastomers were added to the Parameters Monitored since they also are inspected, monitored, or tested by the program. CNP SER Section 3.3.2.3.2 acknowledged the potential for a change of material properties for elastomeric components exposed to a raw water environment in the open-cycle cooling water system. In CNP SER Section 3.3.2.1.2 the Staff accepted that hardening and loss of strength is adequately managed by AMP XI.M20. As an example of its use, the new AMR line-items AP-75 and AP-76 in GALL Rev.1 Chpt. VII were added to address the aging effects and mechanisms of hardening and loss of strength/elastomer degradation and loss of material/erosion of elastomers in a raw water environment and to reference AMP XI.M20. Although this program may be used to manage elastomers in the service water system, GL 89-13, on which AMP XI.M20 is based, does not specifically identify elastomers and recent applications such as Palisades and Oyster Creek do not manage elastomers with the open-cycle cooling water AMP. In response to RAI B2.1.20-1(c), Palisades specifically clarified that elastomers in the service water system are not considered long lived components.	V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M21	Closed-Cycle Cooling Water System	Y	Modified the first paragraph in the Program Description to clarify that the focus is on ensuring that intended functions are not compromised by aging. This paragraph was also revised to clarify the intent of guidance in EPRI TR-107396. The Program Description was changed to add cracking/stress corrosion cracking in addition to corrosion as aging mechanisms managed by this AMP. The EPRI guidelines referenced by this AMP include management of this aging effect. This change (the inclusion of stress corrosion cracking as an aging effect managed by the AMP) was also included in other sections of the AMP, where appropriate. Modified Element 4, Detection of Aging Effects, to delete “pump wear characteristics.” Pump wear characteristics are an active function outside the scope of license renewal. Modified Element 5, Monitoring and Trending, to remove incorrect attributions to EPRI TR-107396 and align better with the EPRI document with regard to the periodicity of testing depending on plant-specific considerations. Modified Element 6, Acceptance Criteria, to clarify that acceptance criteria are also in accordance with the plant operating license and licensing basis (in addition to the EPRI TR). Corrected the date of the EPRI TR in the references section.	IV, V, VII, VIII
XI.M22	Boraflex Monitoring	N	N/A	VII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Y	The Program Description was modified to delete the reference to the maintenance rule. The intent of this deletion is to focus the AMP on detection of aging effects of components associated with the crane within the scope of license renewal, rather than the active components which are outside the scope of license renewal. Operating experience was revised similarly to delete the reference to the maintenance rule. The Parameters Monitored/Inspected section was revised to delete the sentence related to number of lifts. Operating Experience has determined that this is not a parameter that is monitored. The number of lifts is typically significantly lower than what the crane is designed for. The Detection of Aging Effect section was revised to delete the sentence related to functional testing since this test is primarily performed to test the active portions of the crane, which is not within the scope of license renewal.	VII
XI.M24	Compressed Air Monitoring	N	N/A	VII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M25	BWR Reactor Water Cleanup System	Y	NRC Generic Letter 89-10 was added to the references since it is discussed in the scope of the program. In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these revisions in information sources.	VII
XI.M26	Fire Protection	Y	Element 3 "Parameters Monitored/Inspected" is revised based on guidance in ISG-4. In ISG-4, the Staff stated, "NUREG-1801, Chapter XI.M26, "Fire Protection," currently identifies the need to perform a functional test of the halon/carbon dioxide fire suppression systems to determine the suppression agent charge pressure and verify that the extinguishing agent supply valves are open and the system is in automatic mode. Section 54.21 of Title 10 of the Code of Federal Regulations (CFR) specifies that an aging management review is to be performed for those structures and components that perform an intended function without moving parts, or without a change in configuration or properties, and that are not subject to replacement based on a qualified life or specified time period. The Staff reviewed these items and determined that requiring a monthly valve lineup inspection, charging pressure inspection, and an automatic mode of operation verification are operational activities pertaining to system or component configurations or properties that may change, and therefore are not related to aging management. Consequently, the Staff position is to revise XI.M26 to continue the performance of functional testing, but	VII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			to eliminate the monthly halon/carbon dioxide system inspections for charging pressure, valve lineups, and automatic mode of operation.” Element 3 “Parameters Monitored/Inspected” was revised according to ISG-4. The visual inspection interval was changed from a defined interval to a plant-specific interval based on plant operating experience and engineering evaluation. As an example, in GALL Rev. 0, the AMP stated that hollow metal doors are visually inspected at least once bi-monthly for holes in the skin of the door. In GALL Rev.1, the AMP states that Fire-rated doors are visually inspected on a plant-specific interval to verify the integrity of door surfaces and for clearances. The plant-specific inspection intervals are to be determined by engineering evaluation in order to detect degradation of the fire doors prior to the loss of intended function. This change also affects Element 5, “Monitoring and Trending.” Element 4 “Detection of Aging Effects” was revised to replace prescriptive inspection requirements with a general requirement that inspectors are qualified. As an example, in GALL Rev.1, the AMP stipulates that visual inspection by fire protection qualified inspectors of approximately 10% of each type of seal in walkdowns is performed at least once every fueling cycle. GALL Rev. 0 did not stipulate the visual inspection be performed by fire protection qualified inspectors. This change was made to emphasize the importance of the training and knowledge of fire protection qualified inspectors.	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M27	Fire Water System	Y	In ISG-4, the Staff stated, "Internal inspections performed during each refueling cycle by disassembling portions of the FP piping, as stated in NUREG-1801, Chapter XI.M27, "Fire Water Systems," may not be the most effective means to detect this aging effect. Each time the system is opened, oxygen is introduced into the system, and this accelerates the potential for general corrosion. Therefore, the Staff recommends that the applicant perform a baseline pipe wall thickness evaluation of the fire protection piping using a non-intrusive means of evaluating wall thickness, such as volumetric inspection, to detect this aging effect before the current license term expires." ISG-4 also states, "The 50-year service life of sprinkler heads does not necessarily occur at the 50th year of operation in terms of licensing. The service life is defined from the time the sprinkler system is installed and functional. The Staff recommends, in accordance with NFPA 25, that sprinkler head testing should be performed at year 50 of sprinkler system service life, not at year 50 of plant operation, with subsequent sprinkler head testing every 10 years thereafter." Other appropriate changes were made per ISG-4. NFPA Code References in this program were revised to reflect the most current edition.	VII
XI.M28	Buried Piping and Tanks Surveillance	N	N/A	V, VII, VIII
XI.M29	Aboveground Carbon Steel Tanks	N	N/A	VII, VIII
XI.M30	Fuel Oil Chemistry	Y	The program was revised to indicate that its scope is focused on managing the conditions that cause general, pitting, and microbiologically influenced corrosion (MIC) of the diesel fuel tank internal surfaces in accordance with the plant's technical specifications (i.e., NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433) on fuel oil purity and the guidelines of ASTM Standards D1796, D2276, D2709, D6217, and D4057.	VII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M31	Reactor Vessel Surveillance	Y	Added the following paragraph to the Program Description: "All capsules in the reactor vessel that are removed and tested must meet the test procedures and reporting requirements of ASTM E 185-82 to the extent practicable for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including spare capsules, must be approved by the NRC prior to implementation. Untested capsules placed in storage must be maintained for future insertion." ASTM E-185 is referenced in 10 CFR Part 50, Appendix H.	IV
XI.M32	One-Time Inspection	Y	The Program Description was modified to clarify the purpose and role of one-time inspections. Added a sentence to indicate that Class 1 piping less than or equal to NPS 4 is now covered by a new AMP XI.M35, "One Time Inspection of ASME Code Class 1 Small Bore-Piping." Consistent with the requirements of 10 CFR 54.21(a)(1), the AMP XI.M35 stipulates a one-time volumetric examination of ASME Code Class 1 small-bore piping and includes pipes, fittings, and branch connections. See XI.M35 below for the basis for this new AMP. In the GALL Rev.0 Program Description of AMP XI.M32, the sentence "One-time inspection, or any other action or program, is to be reviewed by the Staff on a plant-specific basis" was clarified in GALL Rev.1 to state "One-time inspection, or any other action or program, created to verify the effectiveness of an AMP and confirm the absence of an aging effect, is to be reviewed by the Staff on a plant-specific basis." Modified Element 3, Parameters Monitored/Inspected, to clarify that qualified personnel are to perform inspections. Modified Element 4, Detection of Aging Effects, to clarify expectations regarding inspection techniques to be used for different aging effects/mechanisms. This included adding a new table associating acceptable NDE techniques with aging effects/mechanisms. Also added clarification regarding the	IV, V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
			considerations to be applied in establishing the timing/schedule of inspections. This is to ensure that the inspections provide reasonable assurance aging effects do not compromise intended functions at any point during the period of extended operation. Modified Element 5, Monitoring and Trending, to clarify that monitoring and trending requirements will depend on the results of the inspections and will be established in accordance with the corrective action process. Modified Element 10, Operating Experience, to clarify that this program applies to potential aging effects for which there is currently no operating experience indicating the need for an aging management program. Updated the ASME Section XI edition that applies.	
XI.M33	Selective Leaching of Materials	Y	The Scope of the Program was modified to include visual inspection and hardness measurements to be consistent with the Parameters Monitored/Inspected.	IV, V, VII, VIII
XI.M34	Buried Piping and Tanks Inspection	Y	Element 4 “Detection of Aging Effects” was revised to clarify the emphasis between periodic inspection and opportunistic inspection. In GALL Rev.1, the AMP XI.M34 added the following paragraph “The applicant’s program is to be evaluated for the extended period of operation. It is anticipated that one or more opportunistic inspections may occur within a ten-year period. Prior to entering the period of extended operation, the applicant is to verify that at least one opportunistic or focused inspection has been performed within the past ten years. Upon entering the period of extended operation, the applicant is to perform a focused inspection within ten years, unless an opportunistic inspection occurred within this ten-year period. Any credited inspection should be performed in areas with the highest likelihood of corrosion problems, and in areas with a history of corrosion problems.”	V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.M35	One-time Inspection of ASME Code Class 1 Small Bore-Piping	New AMP	This new program is applicable to small-bore ASME Code Class 1 piping and systems less than or equal to 4 inches nominal pipe size (NPS 4), which includes pipes, fittings, and branch connections. Consistent with the requirements of 10 CFR 54.21(a)(1), the AMP stipulates a one-time volumetric examination of ASME Code Class 1 small-bore piping. According to Table IWB-2500-1, Examination Category B-J Item No. B9.21 of the current ASME code, for small-bore Class 1 piping, a surface examination should be included for piping less than or equal to NPS 4 and greater than or equal to NPS 1. Also, Examination Category B-P requires system leakage and hydrostatic tests. However, for a one-time inspection to detect cracking resulting from thermal and mechanical loading or intergranular stress corrosion, the inspection should be a volumetric examination. This is to provide additional assurance that either aging of small-bore ASME Code Class 1 piping is not occurring or the aging is insignificant, such that an aging management program is not warranted. The AMP recommends that the applicant inspect a statistically significant sample size of small-bore ASME Code Class 1. This program is applicable only to plants that have not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal and mechanical loading. Should evidence of significant aging be revealed by a one-time inspection or previous operating experience, the applicant should propose and credit a plant-specific AMP to manage age-related degradation of its ASME Code Class 1 small-bore piping.	IV
XI.M36	External Surfaces Monitoring	New AMP	This aging management program is based on industry practice. Nuclear plants have been using a similar type of program for years. Most plants have used system engineering or operator walkdowns to monitor plant conditions and have maintained the plant through appropriate corrective actions.	V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			Approved precedents exist for adding this aging management program to GALL Rev.1 based on current industry practice. Each plant may have a different name for the program; however, the ten elements of their programs are similar to the ten elements of this program. For example, in FNP SER section 3.0.3.3.2, the Staff accepted a similar External Surfaces Monitoring program; in RNP SER section 3.0.3.11 and in Ginna SER section 3.0.3.11, the Staff accepted a similar Systems Monitoring Program and concluded that the applicant had demonstrated that the effects of aging would be adequately managed so that the intended functions would be maintained consistent with the CLB for the period of extended operation. This program is based on system inspections and walkdowns. This program consists of periodic visual inspections on external surfaces of steel components such as piping, piping components, ducting, and other equipment within the scope of license renewal and subject to aging management review in order to manage aging effects. The program manages aging effects through visual inspection of external surfaces for evidence of material loss and leakage. The program is based upon the expectation that any adverse loss of material condition will manifest itself in the form of visually detectable general corrosion or leakage long before the aging effect is reasonably expected to impair the component or structures ability to perform its intended safety function. Furthermore, this program is to be used only when other more specific programs are not identified for use. For example, the AMP XI.M10, Boric Acid Corrosion Program, performs monitoring for borated water leakage and manages the associated aging effects and the AMP XI.M29, “Aboveground Steel Tanks“, performs inspections on steel tanks and manages the associated aging effects. Surfaces that are inaccessible during plant operations are inspected during refueling outages. Surfaces that are inaccessible	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			during both plant operations and refueling outages are inspected during the performance of periodic surveillance tests or during preventive maintenance activities to provide reasonable assurance that effect of aging will be managed such that applicable components will perform their intended function during the period of extended operation. Additionally, surfaces that are insulated may be inspected when the insulation is removed and the external surface is exposed during routine maintenance operations, in accordance with industry guidelines concerning topics such as corrosion under insulation. The program may also be credited with managing loss of material from internal surfaces, for situations in which material and environment combinations are the same for internal and external surfaces such that external surface condition is representative of internal surface condition. For cases such as ducting when it can be demonstrated that the internal and external environments are the same, results from this program's inspection on external surfaces may be used to indicate the conditions on the internal surfaces. Since this new program is based on industry practice, has been implemented in nuclear plants over a number of years, and similar programs have been accepted by the NRC in previous application, no further evaluation is recommended for this program.	
XI.M37	Flux Thimble Tube Inspection	New AMP	This program was created based on current industry practice and to monitor for thinning of the flux thimble tube walls. The flux thimble tubes (also referred to as flux detector thimble tubes) provide a path for the incore neutron flux monitoring system detectors and form part of the RCS pressure boundary. Flux thimble tubes are subject to loss of material at certain locations in the reactor vessel where flow-induced fretting causes wear at discontinuities in the path from the reactor vessel instrument nozzle to the fuel assembly instrument guide tube.	IV

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
			An NDE methodology, such as eddy current testing (ECT) or other applicant-justified and NRC-accepted inspection method, is used to monitor for wear of the flux thimble tubes. This program implements the recommendations of NRC IE Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors." The scope of the program encompasses all of the flux thimble tubes that form part of the reactor coolant system pressure boundary. The flux thimble guide tubes are not in the scope of this program. Within the scope are the licensee responses to Bulletin 88-09, as accepted by the Staff in their closure letters on the Bulletin, and any amendments to the licensee responses as approved by the Staff. The program includes: (1) specific augmented inspections using ECT or other applicant-justified and NRC-accepted inspection technique for detecting wear in flux detector thimble tubes, (2) bases for establishing a base-line monitoring frequency for the augmented examinations of the flux detector thimble tube based on applicant's response to NRC Bulletin 88-09 and bases for amending the monitoring frequency based on actual plant-specific thimble tube wear rate results, (3) specific evaluation acceptance criteria to be used if loss of material by wear is detected in the flux detector thimble tubes, and (4) specific corrective actions to be taken if the acceptance criteria is exceeded. The program has been referenced in GALL Rev. 1 AMR line-item R-145 to manage loss of material due to wear in stainless steel instrumentation support structures and flux thimble tubes exposed to reactor coolant environment.	
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	New AMP	This aging management program is based on industry practice. Nuclear plants have years of experience using similar programs which use periodic surveillance or preventive maintenance activities to perform visual inspection of internal surfaces when they are accessible.	V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
			The program visually inspects internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (such as indoor uncontrolled air, condensation and steam) that are not included in other aging management programs for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillances, during maintenance activities or during scheduled outages. The scope of the inspection and inspection techniques are consistent with industry practice and Staff expectations. The program is based upon the expectation, based on both industry and NRC experience, that any adverse loss of material condition will manifest itself in the form of visually detectable general corrosion long before the aging effect is reasonably expected to impair the component or structures ability to perform its intended safety function. Results of the periodic inspections are monitored for indications of various corrosion mechanisms and fouling. Although this program is not credited for detecting fouling, should it be present, fouling could be visually detected. Therefore, fouling was included as a monitored condition and included in the acceptance criteria. Furthermore, these programs are to be used only when other more specific programs are not identified for use. For example, where specific AMPs such as XI.M27, “Fire Water System,” or XI.M24, “Compressed Air Monitoring,” is recommended in GALL Rev.1, those programs will be used. Approved precedents exist for adding this aging management program to GALL Rev.1 based on current industry practice. In ANO-2 SER section 3.0.3.3.7, the Staff accepted a similar program that performs visual inspection of components when the internal surfaces are accessible during performance of surveillance tests or preventive maintenance and concluded that the applicant had	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			demonstrated that the effects of aging would be adequately managed so that the intended functions would be maintained consistent with the CLB for the period of extended operation. The periodic surveillances and preventive maintenance are performed at routine intervals when internal surfaces become accessible for visual inspection. Since this program is based on industry practice, has been implemented in nuclear plants over a number of years, and similar programs have been accepted by the NRC in previous applications, no further evaluation is recommended for this program.	
XI.M39	Lubricating Oil Analysis	New AMP	An approved precedent exists for adding this aging management program to GALL Rev.1. In D/QC SER section 3.0.3.16.2, the Staff accepted a similar program that performs lubricating oil analysis and concluded that the applicant had demonstrated that the effects of aging would be adequately managed so that the intended functions would be maintained consistent with the CLB for the period of extended operation. This program ensures the oil environment in the mechanical systems is maintained to the required quality. The program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of inleakage and corrosion product buildup.	V, VII, VIII

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.S1	ASME Section XI, Subsection IWE	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these revisions in information sources.	II
XI.S2	ASME Section XI, Subsection IWL	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these revisions in information sources.	II

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.S3	ASME Section XI, Subsection IWF	Y	In GALL Rev.0, this AMP referred to older editions of the ASME Code Section XI (1995 Edition with 1996 Addenda) and 10 CFR Part 50 (2000). The GALL Rev.1 version was changed to refer to the ASME Code Section XI (2001 Edition with 2002 and 2003 Addenda) and the 2005 edition of 10 CFR Part 50. The following footnote was also added to identify the use of different versions of the ASME Code: "An applicant may rely on a different version of the ASME Code, but should justify such use. An applicant may wish to refer to the SOC for an update of 10 CFR § 50.55a to justify use of a more recent edition of the Code." References were changed accordingly to conform to these revisions in information sources.	III
XI.S4	10 CFR Part 50, Appendix J	N	N/A	II
XI.S5	Masonry Wall Program	N	N/A	III
XI.S6	Structures Monitoring Program	N	N/A	II, III, VI, VII
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	Y	In the Program Description, added a statement that aging management of certain structures and components may be included in the Structures Monitoring Program (XI.S6).	III
XI.S8	Protective Coating Monitoring and Maintenance Program	Y	Updated the references to the ASTM standards in the elements to this AMP.	II
XI.E1	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	N	N/A	VI

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.E2	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Y	Included “Connections” in the title, was missed in GALL Rev.0. Revised the AMP to allow two methods of identifying degradation. In the first method, calibration results or findings of surveillance testing programs are evaluated to identify the existence of cable aging degradation. In cases where calibration or surveillance program does not include the cabling system in the testing circuit, or as an alternative to the review of calibration results, the applicant will perform cable system testing. In this second method, direct testing of the cable system is performed. This incorporates the alternate method in the ISG-15. In GALL Rev.1, AMP XI.E2, the appropriate elements were revised to address these two methods discussed above. Clarified that this AMP applies to high-range-radiation and neutron flux monitoring instrumentation cables in addition to other cables used in high voltage, low-level signal applications that are sensitive to reduction in insulation resistance. For these cables XI.E1 does not apply. Element 7 “Corrective Actions” was revised to require engineering evaluation when acceptance criteria are not met.	VI

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.E3	Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Y	Noted in the Program Description that potential uncertainties involved with water trees exist even with duct banks that are sloped to minimize water accumulation. The above actions are not sufficient to assure that water is not trapped elsewhere in the raceways. For example, if duct bank conduit has low points in the routing, there could be potential for long term submergence at these low points. In addition, concrete raceways may crack due to soil settling over a long period of time and manhole covers may not be water tight. Additionally, in certain areas, the water table is high in seasonal cycles and therefore, the raceways may get refilled soon after purging. Element 2, Preventive Actions – Based on added information in the Program Description, deleted the sentence in Element 2 that stated that medium voltage cables for which inspecting for water collection in cable manholes and conduit, and draining water, was performed, did not need to be tested. In Element 4, Detection of Aging Effects, a second paragraph was added in GALL Rev.1 that clarified how to determine the conditions when the cables are exposed to significant moisture. This new paragraph states, “The inspection for water collection should be performed based on actual plant experience with water accumulation in the manhole. However, the inspection frequency should be at least once every two years. The first inspection for license renewal is to be completed before the period of extended operation.” These changes are also based on ISG-18.	VI

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
XI.E4	Metal Enclosed Bus	New AMP	This new AMP was based upon information from ISG-17. This is an inspection program that checks bolted connections, internal portions of bus ducts, bus insulating systems, and bus supports for signs of aging degradation. Per Ginna SER 3.6.2.4.4.2, and D/QC SER 3.6.2.4.1, the industry has proposed and the Staff has accepted plant-specific programs that are similar to this program. A sample of accessible bolted connections will be checked for loose connection by using thermography or by measuring connection resistance using a low range ohmmeter. MEB internal surfaces will be visually inspected for aging degradation of insulating material and for foreign debris and excessive dust buildup, and evidence of moisture intrusion. Bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. Internal bus supports will be visually inspected for structural integrity and signs of cracks. As an alternative to thermography or measuring connection resistance of bolted connections, for the accessible bolted connections that are covered with heat shrink tape, sleeving, insulating boots, etc., the applicant may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination. However, since the visual inspection is less effective than testing, this inspection is to be performed once every five years instead of once every 10 years. This AMP will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.	VI

Table IV. Justification for Changes in Aging Management Programs

GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
XI.E5	Fuse Holders	New AMP	This program addresses metallic clamp portion of fuse holders. Fuse holders within the scope of license renewal will be tested at least once every 10 years for aging degradation. Testing may include thermography, contact resistance testing, or other appropriate testing methods. This is an adequate period to preclude failures of the fuse holders since experience has shown that aging degradation is a slow process. A 10- year testing interval will provide two data points during a 20-year period, which can be used to characterize the degradation rate. Operating experience as discussed in NUREG-1760 (Aging Assessment of Safety-Related Fuses Used in Low- and Medium-Voltage Applications in Nuclear Power Plants) identified that aging stressors such as vibration, thermal cycling, electrical transients, mechanical stress, fatigue, corrosion, chemical contamination, or oxidation of the connections surfaces can result in fuse holder degradation. In VCS SER 3.6.2.3.1, the Staff has accepted a similar program. This AMP will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. ISG-5 was issued to define the fuse holders to be included within the scope of license renewal. This new AMP was written to address the aging management of these fuse holders.	VI
XI.E6	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	New AMP	This program addresses metallic parts of the cable connection. GALL AMP XI.E1 manages the aging of insulating material but not the metallic parts of the electrical connections. Connections associated with cables in scope of license renewal are part of this program, regardless of their association with active or passive components. Cable lugs are integral part of cables. Integrity of lugs can be verified by testing connections. Loosening of bolted connections is due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. GALL AMP XI.E1 manages connections in adverse	VI

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	**Title**	**AMP Revised (Y or N)**	**Summary of Change and its Basis**	**Referenced GALL Rev.1 Chapters**
			locations only and inspects insulation degradation. Most connections are not located in adverse locations. SAND 96-0344, "Aging Management Guidelines For Electrical Cable and Terminations," indicated that several plants identified terminations loosening. The major concern is that failures of a deteriorated cable system (cables, connections including fuse holders, and penetrations) might be induced during accident conditions. Since the connections are not subject to the environmental qualification requirements of 10 CFR 50.49, an aging management program is required to manage the aging effects. EPRI -TR-104213, "Bolted Joint maintenance & Application Guide," indicates that it is difficult to maintain tightness of electrical connections and good conductivity through a large temperature range if the materials for the bolt and the conductor are different and have different rates of thermal expansion. For example, copper and aluminum expand faster than most bolting materials. If thermal stress is added to stresses inherent at assembly, the joint members or fasteners can yield. If plastic deformation occurs during thermal loading when the connection cools, the joint will loosen. Some plants have been using thermography to detect weak connections and correct them as soon as possible. Operating experience has shown evidence of loosening of metallic parts of cable connections. Several licensees reported in their Licensee Event Report (LER) loose connections due to corrosion, vibration, thermal cycling, etc. LER-2541987023 dated 11/11/1987 at Quad Cities 1 - Corrosion, LER-2651998003 dated 6/28/1998 at Quad Cities 2 - Vibration, LER-2751985015 dated 5/20/1985 at Diablo Canyon 1 - Vibration LER-3741988008 dated 6/17/1988 at LaSalle 2 - Thermal Cycling LER-3211994005 dated 5/1/1994 at Hatch 1 & 2 - Not human error	

Table IV. Justification for Changes in Aging Management Programs				
GALL AMP	Title	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL Rev.1 Chapters
			LER-3681999002 dated 2/2/1999 at ANO-2 - Not human error LER-3731991016 dated 10/24/1991 at LaSalle 1 - Not human error) The program recommends a representative sample of cable connections to be tested. Testing may include thermography, contact resistance testing, or other appropriate testing methods. This AMP will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.	

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V. Justification for Changes to the SRP-LR

The following tables summarize changes that were made to the SRP-LR (NUREG-1800). The following tables identify the SRP Section in the revised SRP-LR, provide a summary of the changes, and the basis for the changes.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 1 Chapter 2.1 Chapter 2.3 Chapter 2.4 Chapter 2.5	Minor editorial changes	No basis is required for editorial changes.
Chapter 2.1	Revised Table 2.1-5, “Typical Structures, Components, and Commodity Groups, and 10 CFR 54.21(a)(1)(i) Determinations for Integrated Plant Assessment.” Revised Chapter 2.1.3.1.3, “Regulated Events,” to provide further guidance on scoping of equipment relied on to meet the requirements of the station blackout (SBO) rule (10 CFR 50.63) for license renewal (10 CFR 54.4(a)(3)).	This table was revised to reflect the current Staff guidance reflected in ISGs (e.g., ISG-7) and the current guidance to applicants in NEI 95-10. Further information regarding the basis for this change can be found in NEI 95-10. This revision is based on the guidance provided in ISG-02, “Staff Guidance on Scoping of Equipment Relied on to Meet the Requirements of the Station Blackout (SBO) rule (10 CFR 50.63) for License Renewal.”

Table V Summary of Changes to the SRP-LR		
SRP Section	**Summary of Changes**	**Basis**
Chapter 2.2	The Review Responsibilities defined at the beginning of Chapter 2.2 "Plant-Level Scoping Results" was changed from being defined as in SRP-LR, Rev.0 Primary – Branches responsible for systems Secondary – Branch responsible for electrical engineering To the new assignment in SRP-LR, Rev.1 of Primary – Plant Systems Branch Secondary – Branches responsible for systems and structures Revised the disposition for the recirculation cooling water system in Table 2.2-1 to remove the discussion regarding the fuel handling accident for the spent fuel pool cooling system.	The changes on primary and secondary reviewer responsibilities were made to reflect the roles and responsibilities of the Staff reviewers. These changes are consistent with the current review practices of the NRC Staff. The spent fuel pool cooling system is not safety-related, and, following a seismic event, the safety-related spent fuel pool structure and spent fuel pool makeup water supplies ensure the adequate removal of decay heat to prevent potential offsite exposures comparable to those described in 10 CFR Part 100. Therefore, the recirculation cooling water system is not within the scope of license renewal based on the spent fuel decay heat removal function. The Calvert Cliffs LRA places the service water system that cools the spent fuel pool cooling system in scope for the spent fuel decay heat removal function because the spent fuel cooling system is safety related and the pool structure is not designed for pool boiling. The St. Lucie LRA has only the safety-related makeup water supply to the spent fuel pool and the spent fuel pool structure within scope for the decay heat removal function because these systems are credited for decay heat removal following a seismic event or loss of the non-safety related spent fuel pool cooling loop.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 2.4	The Review Responsibilities defined at the beginning of Chapter 2.4 "Scoping and Screening Results: Structures" was changed from being defined as in SRP-LR, Rev.0 Primary – Branches responsible for plant systems Secondary – None To the new assignment in SRP-LR, Rev.1 of Primary – Mechanical and Civil Engineering Branch Secondary – None	The changes on primary and secondary reviewer responsibilities were made to reflect the roles and responsibilities of the Staff reviewers. These changes are consistent with the current review practices of the NRC Staff.
Chapter 3.0	Added new chapter 3.0 to more accurately reflect the roles and responsibilities of the Staff reviewers. This chapter also addresses applications with approved extended power uprates.	The changes to this chapter are consistent with the current review practices of the Staff and reflect the audit and review process used by the NRC for review of LRAs. The basis for addressing applications with approved extended power uprates is to ensure applicants perform an operating experience review and its impact on aging management programs for structures, and components before entering the period of extended operation.
Chapter 3.1 Chapter 3.2 Chapter 3.3 Chapter 3.4 Chapter 3.5 Chapter 3.6	The chapters were revised to reflect the changes that were made to the AMR line-items in Chapters II, III, IV, V, VI, VII, and VIII to Volume 2 of the GALL Report.	The basis for these changes is described in the individual chapters of this document (see Tables II.A, II.B, II.C, and Tables IIIA through IIIG).
Chapter 4.1 Table 4.1-3	Added "Ductility reduction of fracture toughness for the reactor vessel internals" as an additional example of plant-specific TLAAs as identified by the License Renewal Applicants (LRAs).	This TLAA was added to be consistent with TLAAs contained in LRAs.
Chapter 4.2 4.2.1 Areas of Review	Added a fifth area of review as follows: (5) other plant-specific TLAAs on reactor vessel neutron embrittlement	Some plants may have plant-specific TLAAs for neutron embrittlement analysis, such as RPV Reflood Reshock Analyses.

Table V Summary of Changes to the SRP-LR		
SRP Section	**Summary of Changes**	**Basis**
Chapter 4.2 4.2.2.1.1.2	Added the following for re-evaluation of USE: 10 CFR Part 50, Appendix G, Section IV.A.1 (the rule) requires licensees to take further corrective actions for those cases where the 75 ft-lb unirradiated USE (UUSE) criterion or 50 ft-lbs end-of-life USE criterion cannot be met (i.e., when the respective UUSE value falls below 75 ft-lb or the EOL USE falls below 50 ft-lb). When this occurs, the rule requires a licensee to submit a supplemental analysis for NRC approval for any case where the UUSE value is less than 75 ft-lb or where the projected USE value for a given material is projected to be less than the 50 ft-lb acceptance criteria at the expiration of the operating license. Thus, if the USE value for a PWR RV material, as projected to the expiration of the period of extended operation, falls below either the 50 ft-lb acceptance criterion or the USE value criterion specified in a previously NRC-approved EMA, or where the %-drop in USE value for a BWR RV material, as projected to the expiration of the period of extended operation, falls below that %-drop in USE value approved by the NRC in its safety evaluation of the BWRVIP's generic EMA for BWRs, an applicant will need to submit a plant-specific engineering analysis (usually an EMA) for NRC approval as supplemental information for license renewal. Otherwise, failure to meet the USE requirements of 10 CFR Part 50, Appendix for the RV materials as evaluated using the neutron fluence that are projected for the period of extended operation mandates imposition of additional commitments or license condition on USE for the license renewal application.	Provides more clarity on use of 10 CFR 54.21(c)(1)(ii) criteria for re-evaluation of USE for period of extended operation. Also indicates that the SER may impose a license condition if the end-of life USE criterion cannot be met.
Chapter 4.2 4.2.2.1.3 P-T limits	Added the following: P-T limits are TLAAs for the application if the plant currently has P-T limit curves approved for the expiration of the current period of operation (i.e., 32 EFPY or other licensed EFPY values at expiration of the current license). However, the P-T limits for the period of extended operation will not need to be submitted as part of the LRA since the P-T limits will need to be updated through the 10 CFR 50.90 licensing process when necessary for P-T limits that are located in the limiting conditions of operation (LCOs) of the Technical Specifications (TS). For those plants that have approved pressure-temperature limit reports (PTLRs), the P-T limits for the period of extended operation will be updated at the appropriate time through the plant's Administrative Section of the TS and the plant's PTLR process. In either case, the 10 CFR 50.90 or the PTLR processes, which constitute the current licensing basis will ensure that the P-T limits for the period of extended operation will be updated prior to expiration of the P-T limit curves for the current period of operation.	Provides information that the P-T limit curves for period of extended operation do not need to be submitted with the application. Also, provides information on how the P-T limit curves are updated.

Table V Summary of Changes to the SRP-LR		
SRP Section	**Summary of Changes**	**Basis**
Chapter 4.2 4.2.2.1.3.3	Deleted the phrase “not applicable and modified as follows: Updated P-T limits for the period of extended operation must be available prior to entering the period of extended operation. The 10 CFR 50.90 process for P-T limits located in the LCOs or the Administrative Controls Process for P-T limits that are administratively amended through a PTLR process can be considered to be adequate aging management programs within the scope of 10 CFR 54.21(c)(1)(iii) such that P-T limits will be maintained through the period of extended operation.	Clarifies that 10 CFR 50.90 process or the PTLR process is considered adequate aging management program for 10 CFR 54.21(c)(1)(iii) criteria.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 4.2 4.2.3.1.1.2 (Upper-Shelf Energy)	Added the following: The Staff should confirm that the applicant has provided sufficient information for all Upper Shelf Energy (USE) and/or equivalent margins analysis calculations for the period of extended operation as follows: Neutron Fluence: Identified the neutron fluence at the inside surface and the 1/4T location for each beltline material at the expiration of the license renewal period. Identified the methodology used in determining the neutron fluence and identified whether the methodology followed the guidance in Regulatory Guide (RG) 1.190 (Ref. 12). To confirm the USE analysis meets the requirements of Appendix G of 10 CFR Part 50 at the end of the license renewal period, the Staff should determine whether: 1. For each beltline material that is projected to exceed 50 ft-lb at the end of the license renewal period, the applicant has provided the unirradiated Charpy USE, the projected Charpy USE at the end of the license renewal period, whether the drop in Charpy USE was determined using the limit lines in Figure 2 of RG 1.99, Revision 2 or from surveillance data and the percentage copper. 2. If an equivalent margins analysis was required to demonstrate compliance with the USE requirements in Appendix G of 10 CFR Part 50, the applicant has provided the analysis or identified an approved topical report that contains the analysis. Information the Staff will require to assess the equivalent margins analysis includes: the unirradiated USE (if available) for the limiting material, its copper content, the fluence (1/4T and at 1 inch depth), the EOLE USE (if available), the operating temperature in the downcomer at full power, the vessel radius, the vessel wall thickness, the J-applied analysis for Service Level C and D, the vessel accumulation pressure, and the vessel bounding heatup/cooldown rate during normal operation. For Boiling Water Reactors, the Staff should confirm that the beltline materials are evaluated in accordance with Renewal Applicant Action Items 10, 11 and 12 in the Staff's SER, for BWRVIP-74 (Letter to C. Terry dated October 18, 2001) (Ref.11). The applicant should also identify whether there are two or more surveillance material available that are relevant to the RPV beltline materials. If there are two or more data points for a surveillance material, the applicant should provide analyses of the data to determine whether the data is consistent with the RG 1.99, Revision 2 methodology that was utilized in the BWRVIP-74 analyses.	Provides more information to the NRC Staff to assist in the review of license renewal application for the Upper Shelf Energy TLAA if the applicant chooses criteria 10 CFR 54.21(c)(1)(ii) for dispositioning the TLAA. Also provides a consistent guideline that the applicant can use for preparation of the license renewal application. ISG-16 was used, in part, for this change.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 4.2 4.2.3.1.2.2 (Pressurized Thermal Shock)	Added the following: To confirm that the Pressurized Thermal Shock analysis results in RT_{PTS} values below the screening criteria in 10 CFR 50.61 at the end of the license renewal period, the applicant should provide the following: 1. For each beltline material provide the unirradiated RT_{NDT}, the method of calculating the unirradiated RT_{NDT} (either generic or plant-specific), the margin, the chemistry factor, the method of calculating the chemistry factor, the mean value for the shift in transition temperature and the RT_{PTS} value. 2. If there are two or more data for a surveillance material that is from the same heat of material as the beltline material, provide analyses to determine whether the data are credible in accordance with RG 1.99, Revision 2 and whether the margin value used in the analysis is appropriate. 3. If a surveillance program does not include the vessel beltline controlling material, but two or more data seta are available from other beltline materials, then provide an analysis of the data in accordance with Regulatory Guide 1.99, Revision 2, Regulatory Position C.2.1, to show that the results either bound or are comparable to the values that would be calculated for the same materials using Regulatory Position C.1.1.	Provides more information to the NRC Staff to assist in the review of license renewal application for Pressurized Thermal Shock TLAA if the applicant chooses criteria 10 CFR 54.21(c)(1)(ii) for dispositioning the TLAA. Also provides a consistent guideline that the applicant can use for preparation of the license renewal application. ISG-16 was used, in part, for this change.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 4.2 subsection 4.2.3.1.2.3 (Pressurized Thermal Shock)	Deleted existing words and added the following: The license renewal application must provide an assessment of the current licensing basis TLAA for PTS, a discussion of the flux reduction program implemented in accordance with §50.61(b)(3), if necessary, and an identification of the viable options that exist for managing the aging effect in the future. A. The applicant should explain its core management plans (e.g., operation with a low leakage core design and/or integral burnable neutron absorbers) from now through the end of the period of extended operation. Based on this core management strategy, the applicant should: (1) Identify the material in the RPV which has limiting RT_{PTS} value, (2) Provide the projected fluence value for the limiting material at end of license extended (EOLE), (3) Provide the projected RT_{PTS} value for the limiting material at EOLE, and (4) Provide the projected date and fluence values at which the limiting material will exceed the screening criteria in §50.61. B. The applicant should discuss aging management programs that they intend to implement which will actively "manage" the condition of the facility's RPV, and hence, the risk associated with PTS. This discussion would be expected to address, at least, the facility's reactor pressure vessel material surveillance program. C. The applicant should briefly discuss the options that they are considering with respect to "resolving" the PTS issue through EOLE. It is anticipated that this discussion would include some or all of the following: (1) Plant modifications (e.g., heating of ECCS injection water) which could limit the risk associated with postulated PTS events [see §50.61(b)(4) and/or (b)(6)], (2) More detailed safety analyses (e.g., using Regulatory Guide 1.154) which may be performed to show that the PTS risk for the facility is acceptably low through EOLE [see §50.61(b)(4)], (3) More advanced material property evaluation (e.g., use of Master Curve technology) to demonstrate greater fracture resistance for the limiting material [applies to §50.61(b)(4)] and/or, (4) The potential for RPV thermal annealing in accordance with §50.66 [see §50.61(b)(7)].	Provides more information to the NRC Staff to assist in the review of license renewal application for Pressurized Thermal Shock TLAA if the applicant chooses criteria 10 CFR 54.21(c)(1)(iii) for dispositioning the TLAA. Also provides a consistent guideline that the applicant can use for preparation of the license renewal application.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 4.2 Table 4.2-1 FSAR Supplement	Added FSAR Supplement information for other miscellaneous TLAAs on RV neutron embrittlement	Provides an example of information to be included for miscellaneous TLAAs on RV neutron embrittlement. This item was added in section 4.2.1.
Chapter 4.3 subsections 4.3.1.1.1, 4.3.2.1.1.2, 4.3.3.1.1.2	Code limit for CUF was revised from "less than one" to "less than or equal to one."	The Code allows for a CUF equal to unity over the service life.
Chapter 4.4 subsections 4.4.1.2, 4.4.2.2, 4.4.3.2	Generic Safety Issue, GSI-168. Deleted the existing words and replaced as follows: Regulatory Issue Summary (RIS) 2003-09 was issued on May 2, 2003, (Ref. 16) to inform addressees of the results of the technical assessment of GSI-168, "Environmental Qualification of Electrical Equipment," (Ref. 10). This RIS requires no action on the part of the addressees. The need to perform a TLAA for certain mechanical equipment in accordance with Chapter 4.7, "Other Plant-Specific Time-Limited Aging Analyses," was also added.	The earlier version stated that GSI-168 was scheduled for resolution in March 2001 and that an applicant's consideration of GSI-168 for license renewal is an area of review. Since RIS 2003-09 was issued requiring no action on part of addressees, all reference to GSI-168 was deleted from section 4.4. Addressing the need to perform TLAAs for certain mechanical equipment was added for completeness.
Chapter 4.5 subsection 4.5.1	First paragraph, last sentence stated that it is necessary to perform TLAAs for the extended period of operation. The word "perform" was deleted and replaced with, "ensure that the applicant addresses existing"…	10 CFR 54 does not require TLAAs to be created to address this aging effect; however analyses/calculations to address the aging effect of loss of prestress in containment tendons generally exist and generally meet the definition of a TLAA as given by 10CFR54.3.
Chapter 4.5 subsections 4.5.2.1.1, 4.5.2.1.2, 4.5.3.1.2, Table 4.5-1	Updated acceptance criteria – replaced "predicted lower limit (PLL)" with "minimum required prestress force specified at anchorage"	The update meets the requirement per ASME Section XI, Sub-section IWL Acceptance Criteria.

Table V Summary of Changes to the SRP-LR

SRP Section	Summary of Changes	Basis
Chapter 4.6 subsections 4.6.1.1.1, 4.6.2.1.1.3, 4.6.3.1.1.3, Table 4.6-1	Revised Code limit for CUF from “less than one” to “less than or equal to one.”	Code allows CUF to be equal to 1.0 for the entire service life of the bellows. Many calculations on bellows are done to show that an extremely large number of the design cycles may be experienced without CUF = 1.0. In this case, there is no TLAA as the assumption is not based upon the original license term.
Chapter 4.7	Minor Editorial Changes	No basis is required for editorial changes
Chapter 4.7 Subsection 4.7.3	Modified the first paragraph to state: “For certain applicants, plant-specific analyses may meet the definition of a TLAA as given in 10CFR54.3. The concern for License Renewal is that these analyses may not have properly considered the length of the extended period of operation, the consideration of which may change conclusions with regard to safety and the capability of SSCs within the scope of the Rule to perform or one or more safety functions. The review of these TLAAs will provide the assurance that the aging effect is properly addressed through the period of extended operation.”	Editorial change to provide clarity for plant specific TLAAs.

VI. Abbreviations, Acronyms, and Designations

The following table presents definitions or explanations of the most common abbreviations, acronyms, and designations used within the SRP-LR, the GALL Report, and this document (i.e., NUREG-1800, NUREG-1801, and NUREG-1833).

Term	Definition/Explanation
A	ASTM nomenclature
ACI	American Concrete Institute
ACRS	Advisory Committee on Reactor Safeguards
ACSR	aluminum core steel reinforced
ADS	automatic depressurization system
AE/AM	aging effect/aging mechanism
AE/M	aging effect/mechanism
AFW	auxiliary feedwater
AISI	American Iron and Steel Institute
ALARA	as low as reasonably achievable
AMP	aging management program
AMR	aging management review
ANL	Argonne National Laboratory
ANO-1	Arkansas Nuclear One – Unit 1
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASM	American Society of Materials
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	anticipated transients without scram
B&PV	boiler and pressure vessel
B&W	Babcock and Wilcox
BAC	boric acid corrosion
BTP	Branch Technical Position (type of NRC communication)
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CB	core barrel
CCNP	Calvert Cliffs Nuclear Plant
CCCW	closed-cycle cooling water
CDF	core damage frequency
CE	Combustion Engineering
CEA	control element assembly
CEDM	control element drive mechanism
CFD	cumulative fatigue damage
CFR	Code of Federal Regulations
CFS	core flood system
CLB	current licensing basis
CNP	Cook Nuclear Plant
CRD	control rod drive
CRDM	control rod drive mechanism
CRDRL	control rod drive return line
CRGT	control rod guide tube
CUF	cumulative usage factor
CVCS	chemical and volume control system
D/QC	Dresden/Quad Cities NPP
DBA	design basis accident

Term	Definition/Explanation
DBE	design basis event
DC	direct current
DE	Division of Engineering (NRC organizational unit)
DG	Draft Regulatory Guide
DHR	decay heat removal
DIPM	Division of Inspection Program Management (NRC organizational unit)
DOR	Division of Operating Reactors (NRC organizational unit)
DRIP	Division of Regulatory Improvement Programs (NRC organizational unit)
DSCSS	drywell and suppression chamber spray system
DSSA	Division of System Safety Analysis (NRC organizational unit)
ECCS	emergency core cooling system
ECP	electrochemical potential
ECT	eddy current testing
EDG	emergency diesel generator
EDO	Executive Director for Operations (NRC organizational unit)
EFPD	effective full power day
EFPY	effective full power years
EOL	end of life
EOLE	end of license extended
EPRI	Electric Power Research Institute
EPU	extended power uprate
EQ	environmental qualification
ESF	Engineered Safety Features, Chapter V of GALL Report
Ext.	external surfaces of a structure or component. Separate environments may be seen by internal surfaces and external surfaces of components or structures
FAC	flow-accelerated corrosion
FCS	Fort Calhoun Station NPP
FE	further evaluation
FER	further evaluation required
FERC	Federal Energy Regulatory Commission
FNP	Farley Nuclear Plant
FP	fire protection
FR	Federal Register
FSAR	Final Safety Analysis Report
FW	feedwater
GALL	Generic Aging Lessons Learned
GE	General Electric
GL	generic letter
GSI	generic safety issue
GVI	GALL Volume 1
GV2	GALL Volume 2
HAZ	heat affected zone
HELB	high-energy line break
HMWPE	high molecular weight polyethylene
HP	high pressure
HPCI	high-pressure coolant injection
HPCS	high-pressure core spray
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and control
IAEA	International Atomic Energy Agency

Term	Definition/Explanation
IASCC	irradiation assisted stress corrosion cracking
IC	isolation condenser
ID	inside diameter
IEB	inspection and enforcement bulletin
IEEE	Institute of Electrical and Electronics Engineers
IGA	intergranular attack
IGSCC	intergranular stress corrosion cracking
IN	Information Notice (type of NRC generic communication)
INPO	Institute of Nuclear Power Operations
Int.	Internal surfaces of a structure or component. Separate environments may be seen by internal surfaces and external surfaces of components or structures
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
IR	insulation resistance
IRM	intermediate range monitor
ISG	Interim Staff Guidance (type of NRC communication)
ISI	inservice inspection
ITG	Issues Task Group
L	low carbon content in stainless steels, nominal 0.03%C maximum
LCD	liquid crystal display
LED	light-emitting diode
LER	licensee event report
LG	lower grid
LOCA	loss of coolant accident
LP	low pressure
LPCI	low-pressure coolant injection
LPCS	low-pressure core spray
LPM	loose part monitoring
LPRM	low-power range monitor
LPSI	low-pressure safety injection
LR	license renewal
LRA	License Renewal Application
LRG	License renewal guidance
LRGD	License Renewal Guidance Document
LRT	leak rate test
LTOP	low-temperature overpressure protection
LWR	light water reactor
MEA	materials, environments, and aging effects
MEAP	materials, environments, aging effects, and programs
MFW	main feedwater
MIC	microbiologically influenced corrosion
MRV	minimum required value
MS	main steam
MSR	moisture separator/reheater
MT	magnetic particle testing
NA/S	North Anna and Surry NPPs
NDE	nondestructive examination
NDT	nil-ductility temperature
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association

Term	Definition/Explanation
NG	nuclear grade, maximum carbon content of .02% C
NPAR	Nuclear Plant Aging Research
NPP	nuclear power plant
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NRMS	normalized root mean square
NRR	Office of Nuclear Reactor Regulation (NRC organizational unit)
NSA	National Specialty Alloys
NSAC	Nuclear Safety Analysis Center
NSR	nonsafety related system
NSSS	nuclear steam supply system
NUMARC	Nuclear Management and Resources Council
OCCW	open-cycle cooling water
OD	outside diameter
ODSCC	outside diameter stress corrosion cracking
OM	operation and maintenance
OTI	one-time inspection
OTSG	once through steam generator
P&ID	piping and instrument diagram
PA	plant assessment
PH	precipitation hardening
PLL	predicted lower limit
PM	project manager
POEO	period of extended operation
PRA	probabilistic risk analysis
PT	penetrant testing
P-T	pressure-temperature
PTLR	pressure-temperature limit report
PTS	pressurized thermal shock
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RAI	request for additional information
RCCA	rod control cluster assemblies
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RFE	requires further evaluation
RG	Regulatory Guide
RHR	residual heat removal
RICSIL	rapid information communication services information letter
RIS	Regulatory Issue Summary
RLEP	License Renewal and Environmental Impacts Program (NRC organizational unit)
RMS	root mean square
RNP	Robinson Nuclear Plant
RPV	reactor pressure vessel
RT	reference temperature
RWC, RWCU	reactor water cleanup
RWST	refueling water storage tank
RWT	refueling water tank

Term	Definition/Explanation
S/G	standards and guides
SA	ASME manufacturing specifications referring to product form and heat treatment
SAW	submerged arc weld
SBO	station blackout
SC	suppression chamber
SCC	stress corrosion cracking
SDC	shutdown cooling
SER	Safety Evaluation Report
SFP	spent fuel pool
SG	steam generator
SGTI	steam generator tube integrity
SIL	services information letter
SIT	safety injection tank
SLC	standby liquid control
SMP	Structures Monitoring Program
SOC	statements of consideration
SOER	significant operating experience report
SRM	source range monitor
SRM	Staff requirements memorandum
SRP	standard review plan
SRP-LR	standard review plan for license renewal
SR	safety related
SRS	safety-related system
SS	stainless steel
SSC	systems, structures, and components
SSE	safe shutdown earthquake
TGSCC	transgranular stress corrosion cracking
TLAA	time-limited aging analysis
TS	technical specifications
Type	AISI nomenclature
UCS	Union of Concerned Scientists
UFSAR	updated final safety analysis report
UHS	ultimate heat sink
UNS	Unified numbering system
USE	upper shelf energy
USI	unresolved safety issue
UT	ultrasonic testing
UV	ultraviolet
V V	vent valve
VCS	V.C. Summer Nuclear Station
VIP	vessel and internals project
WSLR	within scope of license renewal

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APPENDIX A
Standard Terminology

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Introduction

This Appendix provides definitions of terms used to describe systems, structures, and components; materials, environments, aging effects and aging mechanisms utilized in the GALL Report and the SRP-LR. It also provides listing of these various terms and where and how frequently they are used. Throughout these tables, when a column contains Roman numerals, they identify the chapter in GALL Vol. 2 that the parameter is associated with (i.e., “II” for Containment Structures, “III” for Structures and Component Supports, “IV” for Reactor Vessel, Internals, and Reactor Coolant Systems, “V” for Engineered Safety Features Systems, “VI” for Electrical Systems, “VII” for Auxiliary Systems, and “VIII” for Steam and Power Conversion Systems).

Finally this appendix provides in A.5 a listing of the way in which the **M**aterial, **E**nvironment, **A**ging Effect, and Aging Management **P**rograms (MEAP combinations) were used in GALL Vol. 2 and the SRP-LR.

It should be noted that the process used to develop these tables leaves the cells in a column blank if the entry would duplicate the entry in the row above. Therefore, to determine the value that applies where a cell is blank, the reader must scan back up the column to the previous non-blank cell. Similarly, if one or more cells do not have a lower border when the table spans a page, the absence of this border indicates the continuation of the cell’s value onto the following page.

A.1 Structures and/or Components

The GALL Report does not address scoping of structures and components for license renewal. Scoping is plant specific, and the results depend on the plant design and current licensing basis. The inclusion of a certain structure or component in the GALL Report does not mean that this particular structure or component is within the scope of license renewal for all plants. Conversely, the omission of a certain structure or component in the GALL Report does not mean that this particular structure or component is not within the scope of license renewal for any plants.

NUREG-1801 identifies aging management review results for many system components. Some components are identified in general terms while others are very specifically described. While the NUREG AMR results for a system identify a cross-section of typical components, many of the components that must be included for the corresponding system in the AMR results of a plant LRA are not addressed in the NUREG. To extend the NUREG-1801 AMR results to a broader range of plant components, the component descriptions have been generalized as much as possible while still retaining enough information to support the conclusions of the AMR results.

A.1.1 Listing and Location of Structures and/or Components

Table A.1.1 provides a complete listing of the identifiers and their locations of usage in the revised GALL Report. The table A.1.2 provides more insight to the usage of what can be called ‘roll-up’ terminology.

The Roman numeral in the first column identifies the chapter in GALL Vol. 2 that the structures and/or components are associated with (i.e., “II” for Containment Structures, “III” for Structures and Component Supports, “IV” for Reactor Vessel, Internals, and Reactor Coolant Systems, “V” for Engineered Safety Features Systems, “VI” for Electrical Systems, “VII” for Auxiliary Systems, and “VIII” for Steam and Power Conversion Systems).

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Baffle/former assembly Baffle and former plates
IV	Baffle/former assembly Baffle/former bolts
IV	Baffle/former assembly Baffle/former bolts and screws
V, VII, VIII	Bolting
IV	Bottom-mounted guide tube
III	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
VIII	Buried piping, piping components, piping elements, and tanks
VI	Cable Connections (Metallic Parts)
IV	CEA shroud assemblies
IV	CEA shroud assemblies CEA shroud extension shaft guides
IV	CEA shroud assemblies CEA shrouds bolts
IV	Class 1 piping, fittings and branch connections < NPS 4
IV	Class 1 piping, fittings, primary nozzles, safe ends, manways, and flanges
IV	Class 1 piping, piping components, and piping elements
IV	Class 1 pump casings and valve bodies
IV	Class 1 pump casings, and valve bodies and bonnets
IV, V, VII, VIII	Closure bolting
IV	Closure head Stud assembly
IV	Closure head Vessel flange leak detection line
VII	Compressed air system Piping, piping components, and piping elements
II	Concrete elements; All
III	Concrete: All
II	Concrete: Basemat
II	Concrete: Basemat, concrete fill-in annulus
II	Concrete: Basemat; reinforcing steel
III	Concrete: Below-grade exterior; foundation
II	Concrete: Containment; wall; basemat
II	Concrete: Dome; wall; basemat
II	Concrete: Dome; wall; basemat; reinforcing steel
II	Concrete: Dome; wall; basemat; ring girder; buttresses

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
II	Concrete: Dome; wall; basemat; ring girders; buttresses
II	Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel
III	Concrete: Exterior above- and below-grade; foundation
III	Concrete: Exterior above- and below-grade; foundation; interior slab
II, III	Concrete: Foundation; subfoundation
III	Concrete: Interior and above-grade exterior
VI	Conductor insulation for electrical cables and connections
VI	Conductor insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR)
VI	Conductor insulation for inaccessible medium-voltage (2kV to 35kV) cables (e.g., installed in conduit or direct buried)
VI	Connector contacts for electrical connectors exposed to borated water leakage
III	Constant and variable load spring hangers; guides; stops; sliding surfaces; design clearances; vibration isolators
V	Containment isolation piping and components external surfaces
V	Containment isolation piping and components internal surfaces
IV	Control rod drive head penetration Flange bolting
IV	Control rod drive head penetration Nozzle and welds
IV	Control rod drive head penetration Pressure housing
IV	Control rod guide tube (CRGT) assembly CRGT pipe and flange CRGT spacer casting CRGT rod guide tubes CRGT rod guide sectors
IV	Control rod guide tube (CRGT) assembly CRGT pipe and flange CRGT spacer casting CRGT spacer screws Flange-to-upper grid screws CRGT rod guide tubes CRGT rod guide sectors
IV	Control rod guide tube (CRGT) assembly CRGT spacer casting
IV	Control rod guide tube (CRGT) assembly CRGT spacer screws Flange-to-upper grid screws
IV	Control rod guide tube (CRGT) assembly Flange-to-upper grid screws

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Core barrel Core barrel (CB) CB flange (upper) CB outlet nozzles Thermal shield
IV	Core barrel assembly Baffle/former assembly Baffle/former bolts and screws
IV	Core barrel assembly Baffle/former bolts and screws
IV	Core barrel assembly Core barrel cylinder (top and bottom flange) Baffle plates and formers
IV	Core barrel assembly Core barrel cylinder (top and bottom flange) Lower internals assembly-to- core barrel bolts Core barrel-to-thermal shield bolts Baffle plates and formers
IV	Core barrel assembly Lower internals assembly-to-core barrel bolts Core barrel-to-thermal shield bolts
IV	Core shroud (including repairs) and core plate Core shroud (upper, central, lower)
IV	Core shroud (including repairs) and core plate Shroud support structure (shroud support cylinder, shroud support plate, shroud support legs)
IV	Core shroud and core plate LPCI coupling
IV	Core shroud and core plate Access hole cover (mechanical covers)
IV	Core shroud and core plate Access hole cover (welded covers)
IV	Core shroud and core plate Core plate Core plate bolts (used in early BWRs)
IV	Core shroud assembly Core shroud assembly bolts Core shroud tie rods
IV	Core shroud assembly Core shroud assembly bolts (later plants are welded)
IV	Core shroud assembly Core shroud tie rods (core support plate attached by welds in later plants)
IV	Core spray lines and spargers Core spray lines (headers) Spray rings Spray nozzles Thermal sleeves

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Core support barrel Core support barrel upper flange
IV	Core support barrel Core support barrel upper flange Core support barrel alignment keys
IV	Core support pads/ core guide lugs
IV	Core support shield assembly Core support shield cylinder (top flange) VV assembly locking device
IV	Core support shield assembly Core support shield cylinder (top and bottom flange) Core support shield-to-core barrel bolts Outlet and vent valve (VV) nozzles VV assembly locking device
IV	Core support shield assembly Core support shield cylinder (top and bottom flange) Core support shield-to-core barrel bolts VV retaining ring VV assembly locking device
IV	Core support shield assembly Core support shield cylinder (top and bottom flange) Outlet and vent valve (VV) nozzles VV body and retaining ring
IV	Core support shield assembly Core support shield-to-core barrel bolts
IV	Core support shield assembly Core support shield-to-core barrel bolts VV assembly locking device
IV	Core support shield assembly Outlet and vent valve nozzles VV body and retaining ring
VII	Cranes – rails
VII	Cranes – Structural girders
VII	Diesel engine exhaust Piping, piping components, and piping elements
V	Drywell and suppression chamber spray system (internal surfaces): Flow orifice Spray nozzles
V	Ducting
VII	Ducting and components
VII	Ducting and components external surfaces
V, VII	Ducting and components internal surfaces
V, VII	Ducting closure bolting
V	Ducting, piping and components external surfaces

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
III	Earthen water-control structures: Dams, Embankments, Reservoirs, Channels, Canals and ponds
VII	Elastomer lining
V, VII	Elastomer seals and components
VI	Electrical equipment subject to 10 CFR 50.49 EQ requirements
V	Encapsulation Components
IV, V, VII, VIII	External surfaces
VII	Fire barrier penetration seals
VII	Fire rated doors
IV	Flanges; nozzles; penetrations; pressure housings; safe ends; vessel shells, heads and welds
IV	Flow distributor assembly Flow distributor head and flange Incore guide support plate Clamping ring
IV	Flow distributor assembly Flow distributor head and flange Shell forging-to-flow distributor bolts Incore guide support plate Clamping ring
IV	Flow distributor assembly Shell forging-to-flow distributor bolts
IV	Fuel supports and control rod drive assemblies Control rod drive housing
IV	Fuel supports and control rod drive assemblies Orificed fuel support
VI	Fuse Holders (Not Part of a Larger Assembly); Insulation
VI	Fuse Holders (Not Part of a Larger Assembly); Metallic Clamp
V, VII, VIII	Heat exchanger components
III, V, VII, VIII	Heat exchanger tubes
VIII	
III	High strength bolting for NSSS component supports
VI	High voltage insulators
VII	High-pressure pump Casing
VII	High-pressure pump Closure bolting
IV	Instrument penetrations and primary side nozzles, safe ends, and welds
IV	Instrumentation Intermediate range monitor (IRM) dry tubes Source range monitor (SRM) dry tubes Incore neutron flux monitor guide tubes

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Instrumentation support structures Flux thimble guide tubes
IV	Instrumentation support structures Flux thimble tubes
IV	Isolation condenser components
IV	Jet pump assemblies Castings
IV	Jet pump assemblies Jet pump sensing line
IV	Jet pump assemblies Thermal sleeve Inlet header Riser brace arm Holddown beams Inlet elbow Mixing assembly Diffuser Castings
IV	Lower grid assembly Fuel assembly support pads Guide blocks
IV	Lower grid assembly Incore guide tube spider castings
IV	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid flow dist. Plate Orifice plugs Lower grid and shell forgings Guide blocks Shock pads Support post pipes Incore guide tube spider castings
IV	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid rib-to-shell forging screws Lower grid flow dist. Plate Orifice plugs Lower grid and shell forgings Lower internals assembly-to- thermal shield bolts Guide blocks and bolts Shock pads and bolts Support post pipes Incore guide tube spider castings

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid rib-to-shell forging screws Lower grid flow dist. Plate Orifice plugs Lower grid and shell forgings Lower internals assembly-to-thermal shield bolts Guide blocks and bolts Shock pads and bolts Support post pipes
IV	Lower grid assembly Lower grid rib-to-shell forging screws Lower internals assembly-to- thermal shield bolts Guide blocks bolts Shock pads bolts
IV	Lower grid assembly Lower grid rib-to-shell forging screws Lower internals assembly-to-thermal shield bolts
IV	Lower internal assembly Clevis insert bolts
IV	Lower internal assembly Core support column
IV	Lower internal assembly Core support plate Fuel alignment pins Lower support structure beam assemblies Core support column bolts Core support barrel snubber assemblies
IV	Lower internal assembly Core support plate Lower support structure beam assemblies Core support column Core support barrel snubber assemblies
IV	Lower internal assembly Fuel alignment pins Core support barrel snubber assemblies
IV	Lower internal Assembly Fuel alignment pins Core support column bolts
IV	Lower internal assembly Fuel alignment pins Lower support plate column bolts Clevis insert bolts
IV	Lower internal assembly Lower core plate
IV	Lower internal assembly Lower core plate Radial keys and clevis inserts

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Lower internal assembly Lower support casting Lower support plate columns
IV	Lower internal assembly Lower support forging Lower support plate columns
IV	Lower internal assembly Lower support forging or casting Lower support plate columns
IV	Lower internal assembly Lower support plate column bolts
IV	Lower internal assembly Radial keys and clevis Inserts
III	Masonry walls: All
III	Metal components: All structural members
VI	Metal enclosed bus Bus/connections
VI	Metal enclosed bus Enclosure assemblies
VI	Metal enclosed bus Insulation/insulators
V	Motor Cooler
VII	Non-regenerative heat exchanger components
IV	Nozzle safe ends (and associated welds) High pressure core spray Low pressure core spray Control rod drive return line Recirculating water Low pressure coolant injection or RHR injection mode
IV	Nozzle safe ends and welds: Inlet Outlet Safety injection
IV	Nozzles Control rod drive return line
IV	Nozzles Feedwater
IV	Nozzles Inlet Outlet Safety injection
IV	Nozzles Low pressure coolant injection or RHR injection mode
IV	Once-through steam generator components: Primary side nozzles Safe ends and welds
V	Orifice (miniflow recirculation)

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
V	Partially encased tanks with breached moisture barrier
II	Penetration sleeves
II	Penetration sleeves; Penetration bellows
IV	Penetrations Control rod drive stub tubes Instrumentation Jet pump instrument Standby liquid control Flux monitor Drain line
IV	Penetrations Head vent pipe (top head) Instrument tubes (top head)
IV	Penetrations Instrument tubes (bottom head)
II	Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms
II	Personnel airlock, equipment hatch, CRD hatch
VII	Piping and components external surfaces
IV	Piping and components external surfaces and bolting
V	Piping and components internal surfaces
V, VII, VIII	Piping elements
IV, V, VII, VIII	Piping, piping components, and piping elements
IV	Piping, piping components, and piping elements greater than or equal to 4 NPS
V	Piping, piping components, and piping elements internal surfaces
IV	Piping, piping components, and piping elements; flanges; heater sheaths and sleeves; penetrations; thermal sleeves; vessel shell heads and welds
V	Piping, piping components, piping elements internal surfaces, and tanks
V, VII	Piping, piping components, piping elements, and tanks
IV	Plenum cover and plenum cylinder Plenum cover assembly Plenum cylinder Reinforcing plates
IV	Plenum cover and plenum cylinder Plenum cover assembly Plenum cylinder Reinforcing plates Top flange-to-cover bolts Bottom flange-to-upper grid screws
IV	Plenum cover and plenum cylinder Top flange-to-cover bolts Bottom flange-to-upper grid screws
IV	Pressure boundary and structural Steam nozzle and safe end FW nozzle and safe end
IV	Pressure vessel support skirt and attachment welds
IV	Pressurizer Integral support
IV	Pressurizer Spray head
IV	Pressurizer components
IV	Pressurizer heater sheaths and sleeves, and heater bundle diaphragm plate

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Pressurizer instrumentation penetrations, heater sheaths and sleeves, heater bundle diaphragm plate, and manways and flanges
IV	Pressurizer relief tank Tank shell and heads Flanges and nozzles
IV	Pressurizer surge and steam space nozzles, and welds
II	Prestressing system: Tendons
II	Prestressing system: Tendons; anchorage components
IV	Primary side Divider Plate
IV	Primary side components Upper and lower heads Tube sheets and tube-to-tube sheet welds
IV	Pump and valve closure bolting
IV	Pump and valve seal flange closure bolting
V	Pump Casings
VIII	PWR heat exchanger components
IV	RCCA guide tube assemblies RCCA guide tube bolts RCCA guide tube support pins
IV	RCCA guide tube assemblies RCCA guide tubes
IV	Reactor coolant pressure boundary components
IV	Reactor coolant pressure boundary components: Piping, piping components, and piping elements; Flanges; Nozzles and safe ends; Pressurizer vessel shell heads and welds; Heater sheaths and sleeves; Penetrations; and Thermal sleeves
IV	Reactor coolant pressure boundary components: Piping, piping components, and piping elements
VII	Reactor coolant pump oil collection system Piping, tubing, valve bodies
VII	Reactor coolant pump oil collection system Tank
IV	Reactor coolant system piping and fittings Cold leg Hot leg Surge line Spray line

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Reactor vessel components: Flanges; Nozzles; Penetrations; Pressure housings; Safe ends; Thermal sleeves; Vessel shells, heads and welds
IV	Reactor vessel components: Flanges; Nozzles; Penetrations; Safe ends; Thermal sleeves; Vessel shells, heads and welds
IV	Reactor vessel internals components
IV	Reactor Vessel: Flanges, nozzles; penetrations; safe ends; vessel shells, heads and welds
IV	Recirculating steam generator components: Flanges; Penetrations; Nozzles; Safe ends, lower heads and welds
VII	Regenerative heat exchanger components
V	Safety injection tank (accumulator)
II, III	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)
IV	Secondary manways and handholes (cover only)
III	Sliding support bearings and sliding support surfaces
VII	Spent fuel storage racks Neutron-absorbing sheets – BWR
VII	Spent fuel storage racks Neutron-absorbing sheets – PWR
VII	Spent fuel storage racks Storage racks – BWR
VII	Spent fuel storage racks Storage racks – PWR
IV	Steam Dryers
IV	Steam generator Tube bundle wrapper
IV	Steam generator closure bolting
IV	Steam generator components FW and AFW nozzles and safe ends Steam nozzles and safe ends
IV	Steam generator components Shell assembly
IV	Steam generator components Such as secondary side nozzles (vent, drain, and instrumentation)

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Steam generator components Top head; Steam nozzle and safe end; Upper and lower shell; FW and AFW nozzle and safe end; FW impingement plate and support
IV	Steam generator components Upper and lower shell, and transition cone
IV	Steam generator feedwater impingement plate and support
IV	Steam generator structural Anti-vibration bars
IV	Steam generator structural Tube support lattice bars
IV	Steam generator structural Tube support plates
III	Steel components: All structural steel
III	Steel components: Fuel pool liner
III	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Other supports
III	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports
III	Steel components: Tank liner
II	Steel elements: Suppression chamber; drywell liner; drywell head; embedded shell; sand pocket region; support skirt; downcomer pipes; region shielded by diaphragm floor Note: Inspection of containment supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)
II	Steel elements: Drywell head; Downcomers
II	Steel elements: Drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; ECCS suction header Note: Inspection of containment supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)
II	Steel elements: Liner; Liner anchors; Integral attachments

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
II	Steel elements: Suppression chamber liner (interior surface)
II	Steel elements: Suppression chamber shell (interior surface)
II	Steel elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers
II	Steel elements: Vent header; Downcomers
II	Steel elements: Vent line bellows
VII	Structural fire barriers: Walls, ceilings and floors
VII	Structural Steel
III	Support members; welds; bolted connections; support anchorage to building structure
II	Suppression pool shell; unbraced downcomers
VI	Switchyard bus and connections
VII, VIII	Tanks
IV	Thermal shield
IV	Top guide
IV	Top head enclosure Closure studs and nuts
IV	Top head enclosure Vessel flange leak detection line
IV	Top head enclosure (without cladding) Top head Nozzles (vent, top head spray or RCIC, and spare)
VI	Transmission conductors and connections
IV	Tube plugs
IV	Tubes
IV	Tubes and sleeves
IV	Tubes and sleeves (exposed to phosphate chemistry)
IV	Upper assembly and separators Feedwater inlet ring and support
IV	Upper grid assembly Fuel assembly support pads Plenum rib pads
IV	Upper grid assembly Rib- to-ring screws
IV	Upper grid assembly Upper grid rib section Upper grid ring forging Fuel assembly support pads Plenum rib pads

A.1.1 Structures and/or Components: Listing and Location of Terms used in AMR Tables	
Referring Chapters in GALL Rev. 1	**Standardized Expression**
IV	Upper grid assembly Upper grid rib section Upper grid ring forging Fuel assembly support pads Plenum rib pads Rib-to-ring screws
IV	Upper internals assembly Fuel alignment plate Fuel alignment plate guide lugs and their lugs Hold-down ring
IV	Upper internals assembly Hold-down spring
IV	Upper internals assembly Upper core plate alignment pins
IV	Upper internals assembly Upper guide structure support plate Fuel alignment plate Fuel alignment plate guide lugs and guide lug inserts
IV	Upper internals assembly Upper support column
IV	Upper internals assembly Upper support column (only cast austenitic stainless steel portions)
IV	Upper internals assembly Upper support column bolts
IV	Upper internals assembly Upper support column bolts Upper core plate alignment pins Fuel alignment pins
IV	Upper internals assembly Upper support plate Upper core plate Hold-down spring
IV	Vessel shell Attachment welds
IV	Vessel shell Intermediate beltline shell Beltline welds
IV	Vessel shell Upper shell Intermediate and lower shell (including beltline welds)
IV	Vessel shell Vessel flange
III	Vibration isolation elements

A.1.2 Definition of Selected Terminology for Structures and Components

Table A.1.2 defines some of the structures and components referenced in the NUREG-1801, Rev. 1, AMR tables in Chapters II, III, IV, V, VI, VII, and VIII. Thus Table A.1.2 provides some illumination to the preceding Table A.1.1.

A.1.2 Definition of Selected Consolidated Structures and Components	
Term	**Definition as used in this document**
Bolting	Bolting can refer to either structural bolting or closure bolting. Within the scope of license renewal, both Class 1 and non-Class 1 systems and components contain bolted closures that are necessary for the pressure boundary of the components being joined/closed. Closure bolting in high-pressure or high-temperature systems is defined as that in which the pressure exceeds 275 psi or 200ºF (93ºC). Closure bolting is used to join pressure boundaries or where a mechanical seal is required; bolting includes closure bolting and all other bolting.
Ducting and components	Ducting and components include heating, ventilation, and air-conditioning (HVAC) components. Examples include ductwork, ductwork fittings, access doors, closure bolts, equipment frames and housing, housing supports, including housings for valves, dampers (including louvers and gravity dampers), and ventilation fans (including exhaust fans, intake fans, and purge fans). In some cases, this also includes piping.
Encapsulation Components/ Valve Chambers	These are airtight enclosures that function as a secondary containment boundary to completely enclose containment sump lines and isolation valves. Encapsulation components and features (in systems such as emergency core cooling system, containment spray system, and containment isolation system, and refueling water storage tank) can include encapsulation vessels, piping, and valves.
External surfaces	In the context of structures and components, the term “external surfaces” is used to represent the external surfaces of structures and components such as tanks that are not specifically listed elsewhere.
Heat exchanger components	A heat exchanger is a device that transfers heat from one fluid to another without the fluids coming in contact with each other. This includes air handling units and other devices that cool or heat fluids. Heat exchanger component examples may include, but are not limited to, air handling unit cooling and heating coils, piping/tubing, shell, tubesheets, tubes, valves, and bolting. Although tubes are the primary heat transfer component, heat exchanger internals including tubesheets and fins contribute to heat transfer and may be affected by reduction of heat transfer due to fouling [SAND 93-7070]. The inclusion of such components as tubesheets is dependent on manufacturer specifications.
High voltage insulators	An insulator is an insulating material in a form designed to support a conductor physically and separate the conductor electrically from other conductors or objects.

A.1.2 Definition of Selected Consolidated Structures and Components	
Term	**Definition as used in this document**
	The insulators evaluated for license renewal are those used to support and insulate high voltage electrical components in switchyards, switching stations and transmission lines.
Metal-enclosed bus	MEB is the IEEE and ANSI term for electrical buses installed on electrically-insulated supports that are constructed with all phase conductors enclosed in a separate metal enclosure or a common metal enclosure.
Piping, piping components, and piping elements	This general category includes various features of the piping system that are within the scope of license renewal. Examples include piping, fittings, tubing, flow elements/indicators, demineralizer, nozzles, orifices, flex hoses, pump casing and bowl, safe ends, spray head, strainers, thermowells, and valve body and bonnet. For reactor coolant pressure boundary components in Chapter IV that are subject to cumulative fatigue damage, this can also include flanges, nozzles and safe ends, penetrations, vessel head, shell, welds, stub tubes and miscellaneous Class 1 components, such as pressure housings.
Piping elements	This general category includes components made of glass, such as sight glasses and level indicators. This “piping elements” designation is used in the AMR tables only when the material is defined as glass.
Reactor Coolant Pressure Boundary Components	Reactor coolant pressure boundary components include, but are not limited to: piping, piping components, and piping elements; flanges; nozzles and safe ends; pressurizer vessel shell heads and welds; heater sheaths and sleeves; penetrations; and thermal sleeves.
Pressure housings	The term “pressure housing” only refers to pressure housing for the control rod drive (CRD) head penetration (as indicated in GALL Rev. 0, it is only of concern in Section A2 for PWR reactor vessels).
Seals, gaskets, and moisture barriers (calking, flashing, and other sealants)	Elastomer components used as sealant, or as gaskets.
Steel elements: Liner; liner anchors; integral attachments	Steel liners used in suppression pool or spent fuel pool.
Switchyard bus	Switchyard bus is uninsulated, unenclosed, rigid electrical conductor used in switchyards and switching stations to connect two or more elements of an electrical power circuit such as active disconnect switches and passive transmission conductors.
Tanks	Steel tanks with bottoms in a soil or concrete environment have general corrosion as the aging effect for the interface between soil or concrete and the bottom of the tank. Degradation of the tank bottoms in these aboveground steel tanks can be managed by AMP XI.M29.
Transmission conductors	Transmission conductors are uninsulated, stranded electrical cables used in switchyards, switching stations and transmission lines to connect two or more elements of an electrical power circuit such as active disconnect

A.1.2 Definition of Selected Consolidated Structures and Components	
Term	**Definition as used in this document**
	switches, power circuit breakers, and transformers and passive switchyard bus.
Vibration isolation elements	Non-steel supports used for supporting components prone to vibration

A.2 Materials

Materials were listed in various ways in GALL Rev. 0. In most cases, general material types (e.g., stainless steel, carbon steel, nickel alloy) were used, while in others (e.g., reactor vessels and some vendor internals), specific types of steel are identified. For some results, multiple general material types were listed together. The material column entry was restated such that the combined information of the component, material, and environment columns supported the conclusions of the AMR results. The replacement of specific types with general types was done extensively for the reactor vessel and internals tables and for the cranes table in auxiliary systems.

The general material types were determined on the basis of a common susceptibility to aging effects and mechanisms, shared with the specific material types replaced. For example, the specific material types listed in the first row of the reactor vessel table, A1, are SA302-Gr B, SA533-Gr B and SA336. Respectively, these materials are manganese-molybdenum alloy steel, carbon steel, and chromium-molybdenum alloy steel. The carbon steel and both the alloy steels are characterized as carbon steel because they are susceptible to general, pitting, and crevice corrosion in a wetted (reactor coolant) environment, a common aging susceptibility for carbon steel found throughout the GALL Report. Within the GALL Report, references to these specific material types refer to other aging susceptibilities consistent with carbon steel (e.g., loss of material due to boric acid corrosion, fatigue, neutron embrittlement, and wear). Therefore, these specific material types are considered carbon steel, and the description of carbon steel in the materials list in the attachments mentions alloy steels as a part of the general material type.

Composite materials (e.g., carbon steel clad with stainless steel) were not included unless the aging effect, such as fatigue, would apply to the composite material. Otherwise, each material of a composite was evaluated separately with its respective environment. For example, a carbon steel tank with stainless cladding containing borated water was evaluated as stainless steel in borated water, and carbon steel in air. The restatement of some GALL AMR results that included carbon (or low alloy) steel clad with stainless, addressed only the stainless portion since the environment and the aging management program were not applicable to the carbon steel portion. In these cases, the AMR results for exterior carbon steel surfaces (located elsewhere in the tables) address the balance of the component material.

The following tables define many of generalized materials utilized in the GALL AMR tables in Chapters II, III, IV, V, VI, VII, and VIII of NUREG-1801, Rev. 1.

A.2.1 Listing, Location and Frequency of Terms

Table A.2.1 provides a complete listing of the materials and their locations of usage in GALL Vol. 2. Table A.2.2 provides more information about how different materials are used in the context of nuclear power plant license renewal.

The Roman numeral in the second column identifies the chapter in GALL Vol. 2 that the specified materials are associated with (i.e., “II” for Containment Structures, “III” for Structures and Component Supports, “IV” for Reactor Vessel, Internals, and Reactor Coolant Systems, “V” for Engineered Safety Features Systems, “VI” for Electrical Systems, “VII” for Auxiliary Systems, and “VIII” for Steam and Power Conversion Systems). The number of times the term is used in that given chapter is shown in the third column.

A.2.1 Materials: Listing, Location, and Frequency of AMR Terms		
Material	**Referring Chapters**	**Total**
Aluminum	III	1
	V	3
	VII	7
	VIII	2
Aluminum, copper, bronze, stainless steel, galvanized steel	VI	1
Aluminum, steel	VI	1
Aluminum/ Silver Plated Aluminum Copper/ Silver Plated Copper; Stainless steel, steel	VI	1
Boraflex	VII	2
Boral, boron steel	VII	2
Cast austenitic stainless steel	IV	13
	V	2
Chrome plated steel; stainless steel; Nickel alloy	IV	2
Concrete	II	24
Concrete block	III	1
Concrete; porous concrete	II	1
Concrete; steel	II	4
Copper alloy	IV	1
	V	7
	VI	1
	VII	16
	VIII	10
Copper alloy <15% Zn	V	1
	VII	1
Copper alloy >15% Zn	IV	1
	V	3
	VII	6
	VIII	3
Elastomers	V	1
	VI	1
	VII	9
Elastomers such as EPDM rubber	III	1

A.2.1 Materials: Listing, Location, and Frequency of AMR Terms		
Material	**Referring Chapters**	**Total**
Elastomers, rubber and other similar materials	II	1
Galvanized steel	III	1
	V	1
	VII	1
Galvanized steel, aluminum	III	1
Galvanized steel, aluminum, stainless steel	III	1
Glass	V	5
	VII	7
	VIII	5
Gray cast iron	V	3
	VII	4
	VIII	3
High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 ksi)	IV	3
High-strength low-alloy steel, stainless steel	IV	1
High-strength steel	V	1
	VII	2
	VIII	1
Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	VI	2
Low alloy steel	IV	1
Low alloy steel, yield strength >150 ksi	III	2
Low-alloy steel SA 193 Gr. B7	IV	1
Low-alloy steel, stainless steel	IV	1
Lubrite®	III	3
Nickel alloy	IV	21
	V	1
	VII	2
	VIII	1
Nickel alloy or nickel alloy cladding	IV	1
Nickel alloy; stainless steel	IV	2
Nickel alloy; steel with nickel-alloy cladding	IV	2
Nickel-based alloys	VIII	1
Non-metallic (e.g., Rubber)	III	1

A.2.1 Materials: Listing, Location, and Frequency of AMR Terms		
Material	**Referring Chapters**	**Total**
Porcelain, Malleable iron, aluminum, galvanized steel, cement	VI	2
Porcelain, xenoy, thermo-plastic organic polymers	VI	1
Reinforced concrete	III	15
	VII	4
Reinforced concrete; Grout	III	1
Reinforced concrete; Porous concrete	III	1
SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	IV	1
Stainless steel	II	2
	III	5
	IV	81
	V	26
	VII	35
	VIII	25
Stainless steel with or without chrome plating	IV	1
Stainless steel; dissimilar metal welds	II	1
Stainless steel; nickel alloy	IV	49
Stainless steel; nickel alloy welds and/or buttering	IV	1
Stainless steel; steel	II	5
	III	1
	IV	6
	VII	1
Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	IV	2
Stainless steel; steel with stainless steel cladding	IV	6
	VII	5
Steel	II	8
	III	5
	IV	23
	V	34
	VII	43
	VIII	35

A.2.1 Materials: Listing, Location, and Frequency of AMR Terms		
Material	**Referring Chapters**	**Total**
Steel (with or without coating or wrapping)	V	1
	VII	1
	VIII	1
Steel (with or without lining/coating or with degraded lining/coating)	VII	1
Steel (with or without stainless steel cladding)	IV	4
Steel and non-steel materials (e.g., Lubrite® plates, vibration isolators, etc.)	III	1
Steel with elastomer lining	VII	1
Steel with elastomer lining or stainless steel cladding	VII	1
Steel with stainless steel cladding	IV	5
	V	2
	VII	1
Steel with stainless steel or nickel alloy cladding	IV	1
Steel with stainless steel or nickel alloy cladding; or stainless steel	IV	2
Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	IV	2
Steel, Stainless steel	VIII	1
Steel; copper alloys	III	1
Steel; dissimilar metal welds	II	1
Steel; galvanized steel	VI	1
Steel; stainless steel; dissimilar metal welds	II	4
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	IV	6
Various	III	1
Various metals used for electrical contacts	VI	2
Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	VI	3
Various polymeric and metallic materials	VI	1
Grand Total		682

A.2.2 Selected Descriptions of Materials

Table A.2.2 correlates what was referenced in GALL Rev. 0 to what is used in GALL Rev. 1 including reference to the nomenclature in the unified numbering system (UNS), when applicable.

References to materials have been simplified and streamlined. Where possible, different types of high-strength steel, for example, have been grouped together. The focus has been on grouping together categories where the dominant aging mechanisms will be similar. On this basis, copper alloys are separated between those containing under and more than 15% Zn.

A.2.2 Selected Descriptions of Materials

Standardized Expression	**Description and Technical Justification**
Boraflex	Boraflex is a material that is composed of 46% silica, 4% polydimethyl siloxane polymer and 50% boron carbide, by weight. It is a neutron absorbing material used as a neutron absorber in spent fuel storage racks; degradation of Boraflex panels under gamma radiation can lead to loss of the ability to absorb neutrons in spent fuel storage pools. The GALL AMP XI.M22 is used as a reference for Boraflex monitoring.
Boral, boron steel	Boron steel is steel with boron content ranging from one to several percent. Boron steel absorbs neutrons and thus is often used as a control rod to help control the neutron flux. Boral is material consisting of boron carbide sandwiched between aluminum. Boral refers to patented Aluminum-Boron master alloys; these alloys can contain up to 10% boron as AlB_{12} intermetallics.
Cast austenitic stainless steel (CASS)	CASS alloys, such as CF-3, CF-8, CF-3M, and CF-8M, have been widely used in LWRs. These CASS alloys are similar to wrought grades Type 304L, Type 304, Type 316L, and Type 316, except CASS typically contains 5 to 25% ferrite. CASS is susceptible to loss of fracture toughness due to thermal and neutron irradiation embrittlement.
Copper alloy <15% Zn	The broad purpose of this material category is to collect those copper alloys whose critical alloying elements are less than certain thresholds that keep the alloy from being susceptible to aging effects. For example, copper, copper nickel, brass, bronze <15% zinc, and aluminum bronze <8% aluminum are resistant to stress corrosion cracking, selective leaching and pitting and crevice corrosion. They may be identified simply as copper alloy when these aging mechanisms are not at issue.
Copper alloy >15% Zn	The broad purpose of this material category is to collect those copper alloys whose critical alloying elements are above certain thresholds that make the alloy susceptible to aging effects. Copper-zinc alloys >15% zinc are susceptible to stress corrosion cracking, selective leaching (except for inhibited brass), and pitting and crevice corrosion. Additional copper alloys may be susceptible, such as aluminum bronze > 8% aluminum. The elements that are most commonly alloyed with copper are zinc (referred to as brass), tin (referred to as bronze), nickel, silicon, aluminum (referred to as aluminum-bronze), cadmium and beryllium. Additional copper alloys may be susceptible to these aging effects above the threshold for the critical alloying element.

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
Elastomers	Elastomers are materials such as rubber, EPT, EPDM, PTFE, ETFE, viton, vitril, neoprene, and silicone elastomer. Hardening and loss of strength of elastomers can be induced by elevated temperature (over about 95°F (35°C), and additional aging factors such as exposure to ozone, oxidation, and radiation.
Galvanized steel	Steel coated with zinc (usually by immersion or electrodeposition); the Zn coating is capable of protecting the steel from atmospheric corrosion even when the surface is scratched, since the Zn is preferentially attacked by carbonic acid, forming a protective coat of basic zinc carbonate. The zinc coating in galvanized steel protects the underlying steel and the corrosion rate of zinc (coating the steel) in dry clean air is very low.
Glass	Any glass materials within the scope of license renewal. Glass is a hard, amorphous, brittle super-cooled liquid made by fusing together one or more of the oxides of silicon, boron, or phosphorous, with certain basic oxides (e.g., Na, Mg, Ca, K), and cooling the product rapidly to prevent crystallization or devitrification.
Gray cast iron	This form of cast iron is an iron alloy used in nuclear plants. Cast iron is made by adding larger amounts of carbon to molten iron than would be used to make steel. Most steels will have less than about 1.2% by weight carbon, while cast irons typically have between 2.5 to 4% by weight carbon. Gray cast iron has flat graphite flakes, which reduce its strength and act as crack formers, initiating mechanical failures. They also cause the metal to behave in a nearly brittle fashion, rather than experiencing the elastic, ductile behavior of steel. Fractures in this type of metal tend to take place along the flakes, which give the fracture surface a gray color, hence the name of the metal. Cast iron is susceptible to selective leaching resulting in a significant reduction of the material's strength due to the loss of iron from the microstructure, leaving a porous matrix of graphite.
Insulation materials (e.g. bakelite, phenolic melamine or ceramic, molded polycarbonate)	Electrical fuse holders are composed of insulation materials, e.g. bakelite, phenolic melamine or ceramic, and molded polycarbonate.
Low-alloy steel, yield strength >150 ksi	High-strength Fe-Cr-Ni-Mo low alloy steel bolting materials with maximum tensile strength <1172 MPa (<170 ksi) may be subject to stress corrosion cracking if the actual measured yield strength S_y = 150 ksi. Examples of high strength alloy steel designations that were earlier referenced in GALL Rev. 0 that comprise this category include SA540-Gr. B23/24, SA193-Gr. B8, and Grade L43 (AISI4340). Low-alloy steel SA 193 Gr. B7 is a ferritic low-alloy steel bolting material for high-temperature service. Low-alloy steel includes AISI steels 4140, 4142, 4145, 4140H, 4142H, and 4145H (UNS#: G41400, G41420, G41450, H41400, H41420, H41450). Bolting fabricated from high-strength (actual measured yield strength S_y = 150 ksi) low-alloy steel SA 193 Gr. B7 is susceptible to stress corrosion cracking.

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
Lubrite®	Lubrite® refers to a patented technology in which the bearing substrate (bronze is commonly used, but, in unusual environments, other materials, ranging from stainless steel and nodular-iron to tool-steel, are used) is fastened to lubricant. Lubrite® is often defined as bronze attached to ASTM B22, alloy 905, with G10 lubricant. Even though Lubrite® bearings are characterized as maintenance-free, because of the differences in installation, fineness of the surfaces, and lubricant characteristics, they can be subjected to mechanical wear and fretting.
Malleable iron	Malleable iron usually means malleable cast iron, characterized by exhibiting some elongation and reduction in area in a tensile test. Malleable iron is one of the materials in the suite of "Porcelain, Malleable iron, aluminum, galvanized steel, cement" used to define the high voltage insulators subject to degradation of insulator quality/presence of any salt deposits or surface contamination (AMR line-item LP-07) or loss of material/mechanical wear due to wind blowing on transmission conductors (AMR line-item LP-11).
Nickel alloys	Nickel alloys are used for a wide variety of applications, the majority of which involve corrosion resistance and/or heat resistance. Nickel and nickel alloys, like the stainless steels, offer a wide range of corrosion resistance. However, nickel can accommodate larger amounts of alloying elements, chiefly chromium, molybdenum, and tungsten, in solid solution than iron. Therefore, nickel-base alloys, in general, can be used in more severe environments than the stainless steels. Nickel-chromium-iron (molybdenum) alloys are those such as the Alloy 600 and 690. Examples of nickel alloy designations that were specifically referenced in GALL Rev. 0 that comprise this category include Alloy 182, Alloy 600, Alloy 690, Gr. 688 (X-750), Inconel 182, Inconel 82, NiCrFe, SB-166, SB-167, SB-168, X-750.
PH stainless steel	Precipitation hardened (PH) martensitic stainless steel. Combines excellent corrosion resistance, high strength and hardness, low temperature hardening and good fabricating characteristics, superior transverse ductility and toughness. Examples of steel designations that were specifically referenced in GALL Rev.0 that comprise this category include Type 15-5PH.
Polymer (e.g., rubber)	Vibration isolation elements in supports for the emergency diesel generator are fabricated from polymeric materials such as rubber and can be degraded by aging mechanisms such as radiation hardening, temperature, humidity, sustained vibratory loading. Polymers used in electrical applications include EPR, SR, EPDM, and XLPE. XLPE is cross linked polyethylene (XLPE) in the category of thermoplastic resins as polyethylene and polyethylene copolymers. EPR and EPDM are ethylene-propylene rubbers (EPR, EPDM) in the category of thermosetting elastomers.

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
Polymers used in electrical applications	Polymers used in electrical applications include EPR, SR, EPDM, XLPE. XLPE is cross-linked polyethylene in the category of thermoplastic resins as polyethylene and polyethylene copolymers. EPR and EPDM are ethylene-propylene rubbers in the category of thermosetting elastomers.
Porcelain	Hard-quality porcelain is used as an insulator for supporting high-voltage electrical insulators. Porcelain is a hard, fine-grained ceramic that essentially consists of kaolin, quartz, and feldspar that is fired at high temperatures. Porcelain is one of the materials in the category of "Porcelain, Malleable iron, aluminum, galvanized steel, cement" used to define the high voltage insulators subject to degradation of insulator quality/presence of any salt deposits or surface contamination (AMR line-item LP-07) or loss of material/mechanical wear due to wind blowing on transmission conductors (AMR line-item LP-11).
SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	Quenched and tempered vacuum treated carbon and alloy steel forgings for pressure vessels. Growth of intergranular separations (underclad cracks) in low-alloy steel forging heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process.
Stainless steel	Wrought or forged austenitic, ferritic, martensitic, precipitation hardened (PH) martensitic, or duplex stainless steel (Cr content >11%) are grouped for AMRs under the term "stainless steel." These materials are susceptible to a variety of aging effects and mechanisms, including loss of material due to pitting and crevice corrosion, and cracking due to stress corrosion cracking. In the context of license renewal, in some cases, when the recommended AMP is the same for PH stainless steel or cast austenitic stainless steel (CASS) as for stainless steel, PH stainless steel or CASS is included as a part of the stainless steel classification. However, CASS is susceptible to loss of fracture toughness due to thermal and neutron irradiation embrittlement. Therefore, when this aging effect is being considered, CASS is specifically designated in the AMR line-item. Steel with stainless steel cladding may also be considered stainless steel when the aging effect is associated with the stainless steel surface of the material, rather than the composite volume of the material. Examples of stainless steel designations that were earlier referenced in GALL Rev. 0 that comprise this category include A-286, SA193-Gr. B8, SA193-Gr. B8M, Gr. 660 (A-286), SA193-6, SA193-Gr. B8 or B-8M, SA453, Type 304, Type 304NG, Type 308, Type 308L, Type 309, Type 309L, Type 316, Type 347, Type 403, Type 15-5PH, and Type 416. Examples of CASS designations that were earlier referenced include CF-3, CF-8, CF-3M, and CF-8M. [ASME Section II: Part B]

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
Steel	For a given environment, carbon steel, alloy steel, cast iron, gray cast iron, malleable iron, and high strength low alloy steel are vulnerable to general, pitting, and crevice corrosion, even though the rates of aging may vary. Consequently, these metal types are generally grouped for AMRs under the broad term “steel.” Note that this does not include stainless steel. However, gray cast iron is also susceptible to selective leaching, and high strength low alloy steel is susceptible to stress corrosion cracking. Therefore, when these aging effects are being considered, these materials are specifically called out. Galvanized steel (zinc-coated carbon steel) is also included in this category of “steel” when exposed to moisture. Malleable iron is also specifically called out in the phrase “Porcelain, Malleable iron, aluminum, galvanized steel, cement” used to define the high voltage insulators in Chapter VI. Examples of steel designations that were earlier referenced in GALL Rev. 0 that comprise this category include ASTM A 36, ASTM A 285, ASTM A759, SA36, SA106-Gr. B, SA155-Gr. KCF70, SA193-Gr. B7, SA194 –Gr. 7, SA302-Gr B, SA320-Gr. L43 (AISI 4340), SA333-Gr. 6, SA336, SA508-64, class 2, SA508-Cl 2 or Cl 3, SA516-Gr. 70, SA533-Gr. B, SA540-Gr. B23/24, and SA582. [ASME Section II: Part A]

A.2.3 Metals Background for the GALL Update

In Table A.2.3 the first column provides the term used in the GALL Report, Rev 0 followed by the equivalent designation according to the Unified Numbering System (UNS). The UNS provides a means of correlating many nationally used metal and alloy numbering systems currently administered by societies, trade associations, and those individual users and producers of metals and alloys.

The second and third columns in the table below provide more information about the material and where it is referenced. The fourth column specifies the AMR line-item in GALL Rev. 0 that referenced the metal as found in column 1. The fifth column provides the term used in the GALL Rev. 1, Vol, 2 AMR line-items replacing the term in column 1. The last column below provides some explanation for the substitution, and is sometimes combined with the preceding column.

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
A7	ASTM Standard A7 ("Specifications for Steel for Bridges and Buildings") was withdrawn in 1967 and replaced by ASTM A36/A36M. (see below).	ASM datasheet	VII B1-a	Steel- For a given environment, carbon steel, alloy steel, and cast iron exhibit the same aging effects, even though the rates of aging may vary. Consequently, these metal types may be considered the same for aging management reviews. Gray cast iron is also susceptible to selective leaching and high-strength low-alloy steel is also susceptible to stress corrosion cracking. Therefore, when these aging effects are being considered, these materials are specifically mentioned; otherwise they are considered part of the general category of steel, which does NOT include stainless steel. Galvanized steel – (zinc coated carbon steel) is also included in this category.	
A36 **UNS#: K02600**	ASTM A36: Structural carbon steel. Covers carbon steel shapes, plates, and bars of structural quality for use in riveted, bolted, or welded construction	ASM datasheet	VII B1	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
A285 **UNS#: K02801**	ASTM A285: Carburizing and general purpose steel (equivalent to SAE 1026)	ASM datasheet	VII B1	Steel	As described for A7
A-286 **UNS#: S66286**	Iron-nickel-base superalloy A-286 has work-hardening characteristics similar to those of type 304 stainless steel and has slightly lower formability. Most other iron-base heat-resistant alloys are somewhat less formable. Also referenced as austenitic wrought stainless steel. – Iron based high temperature, high strength alloy. A-286 has 15% Cr, thus well above stainless steel threshold.	ASM datasheet (Note that Alloy A-286 is not to be confused with ASTM Standard A286 (“Specification for Heat-Treated Alloy-Steel Bars”), which was withdrawn in 1960. Alloy A-286 is covered by ASTM Standards A453, Grade 660 and A638, Grade 660.)	IVB4.4-d	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
A759 **UNS#: K07500**	Nonresulfurized carbon steel, (ASTM A759)	ASM datasheet	(added from Suppl. Database of GALL Rev. 0)	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Alloy 182 **UNS#: W86182**	Ni-base weld filler metal electrode used for gas-tungsten-arc, gas-metal-arc and submerged-arc welding of Ni-base alloys. Inconel Alloy 82 is the wire form of this same alloy. This alloy is also identified as AWS A5.14, ERNiCr-3 and ASME SFA-5.14, ERNiCr-3	ASM datasheet Replace the term Inconel wherever it shows up in GALL with Alloy.	IVB1.1 -	Nickel alloys are used for a wide variety of applications, the majority of which involve corrosion resistance and/or heat resistance. Nickel and nickel alloys, like the stainless steels, offer a wide range of corrosion resistance. However, nickel can accommodate larger amounts of alloying elements, chiefly chromium, molybdenum, and tungsten, in solid solution than iron. Therefore, nickel-base alloys, in general, can be used in more severe environments than the stainless steels. Nickel-chromium-iron (-molybdenum) alloys are those such as the Alloy 600 and 690.	
Alloy 600 **UNS#: N0660** **(first A-182 from list)**	Inconel Alloy 600: Corrosion and heat-resistant alloy nickel-base superalloy	ASM datasheet - replace the term Inconel wherever it shows up in GALL with Alloy.	IVA2.2	Nickel alloy	As described for Alloy 182
Alloy 690 **UNS#: N06690**	Inconel Alloy 690: Corrosion-resistant high chromium nickel alloy, nickel with chromium and/or iron, molybdenum	ASM datasheet - replace the term Inconel wherever it shows up in GALL with Alloy.	IVD1.2	Nickel alloy	As described for Alloy 182
CF-3M **UNS#: J92800**	Cast austenitic stainless steel (CASS), ASTM A 743 or A 744, Cr-Ni-Mo steel corresponding to wrought Type 316L SS	ASM datasheet	IVB4.3	CASS	Cast stainless steels containing ferrite in an austenitic matrix

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
CF-8 and CF-8M **UNS#: J92600 and J92900**	Cast Austenitic Stainless Steel (CASS), ASTM A 743 or A 744. CF-8 is a Cr-Ni steel corresponding to wrought Type 304 SS and CF-8M is a Cr-Ni-Mo steel corresponding to wrought Type 316 SS.	ASM datasheet	IVC2.3	CASS	Cast stainless steels containing ferrite in an austenitic matrix
Gr. B8 **UNS#: S30400**	SA-193, Gr. B8 austenitic steel, bolting material, comparable to AISI Type 304 SS	Datasheet on ASTM, SAE, and ISO Grade for Steel Fasteners	IVB4.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
Gr. B8M **UNS#: S31600**	SA-193, Gr. B8M austenitic steel, comparable to AISI Type 316 SS	Datasheet on ASTM, SAE, and ISO Grade for Steel Fasteners	IVB4.4	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
Gr. 660 (A-286) **UNS#: S66286**	(See A-286)	ASM datasheet	IVB4.4	Stainless steel.	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Gr. 688 (Inconel Alloy X-750) **UNS#: N07750**	Age-Hardening Nickel Alloy, Nickel with chromium and/or iron, molybdenum with good strength to 649°C (1200°F). The alloy shows good oxidation resistance. (ASME SB-637, Inconel X-750; Grade 688 is old term)	ASM datasheet	IVB4.4	Nickel alloy	As described for Alloy 182
Inconel 182 **UNS#: W86182**	See Alloy 182 above	Specialty Metals Manufacturing datasheet	IVA1.1 - replace the term Inconel wherever it shows up in GALL with Alloy.	Nickel alloy	As described for Alloy 182
Inconel 82 **UNS#: W86182**	See Alloy 182 above.	Specialty Metals Manufacturing datasheet	IVA1.4 – replace the term Inconel wherever it shows up in GALL with Alloy.	Nickel alloy	As described for Alloy 182
NiCrFe	Nickel alloy (for buttering, welds) – generic term	ASM datasheet on Nickel alloys	IV.A2.4	Nickel alloy	As described for Alloy 182
SA-36 **UNS#: K02600**	(See A36 above)	ASME BPVC Section IIA	IVA2.8	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-106, Gr. B **UNS#: K03006**	ASME SA106 Seamless carbon steel pipe for high-temperature service, in NPS 1/8 to NPS 48 inclusive, with nominal (average) wall thickness as given is ANSI B36.10; Grade B has 0.30% C max.	E-Pipe manufacturer datasheet	IVC1.1	Steel	As described for A7
SA155-Gr KCF70 **UNS#: unknown** Grade CF 70 was apparently intended standard for GALL Rev. 0.	SA-155 is not listed in recent editions of the ASME Code Section II, and ASTM A 155 ("Specification of electric-fusion welded steel pipe for high-pressure service") was withdrawn in 1978 and replaced by ASTM A671 ("Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures"). Among the pipe grades listed in ASTM A671 is Grade CF 70. This is apparently the standard intended here.	Database from Independent Pipe and Supply Corp	IVC1.1	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-182, F316 **UNS#: S31600**	Type 316 austenitic stainless steel pipe. Specification covers forged or rolled alloy-steel pipe flanges, forged fittings and valves and parts intended for high-temperature service	ASME Section II, CASTI Guidebook to ASME Sec II	IVC2.4	Steel	As described for A7
SA-193, Gr. B6 **UNS#: S41000**	AISI Type 410 SS bolting material for high-temperature service.	ASME BPVC Section IIA	IVA2.1	Stainless Steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
SA-193, Gr. B7 **UNS#: G41400, G41420, G41450, H41400, H41420, H41450**	Ferritic low-alloy steel bolting material for high-temperature service. Includes AISI steels 4140, 4142, 4145, 4140H, 4142H, and 4145H.	ASME BPVC Section IIA	IVA1.1	Steel	As described for A7
SA-193, Gr. B8 or B-8M **UNS#: 30400 and 31600**	Austenitic Stainless Steel. Grade B8 is Type 304 SS and Grade B8M is Type 316 SS.	ASME BPVC Section IIA	IVB4.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-194, Gr. 7 **UNS#: G41400, G41420, G41450, H41400, H41420, H41450**	SA-194 is specification for carbon and alloy steel nuts for bolts for high-pressure and high-temperature service; it also covers austenitic and martensitic stainless steel nuts. Thus it is imperative to specify the grade. Grade 7 is equivalent to AISI 4140, 4142, 4145, 4140H, 4152H, and 4145H high-strength low-alloy steels.	ASME BPVC Section IIA	IVA1.1	Steel	As described for A7
SA-302, Gr. B **UNS#: K12022**	Mn-Mo Alloy (Grade B) steel plates intended particularly for welded boilers and other pressure vessels (like early 533)	ASME BPVC Section IIA	IVA1.1	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-320, Gr. L43 (AISI 4340) **UNS#: G43400**	Alloy steel bolting materials for low-temperature service. Grade L43 (AISI 4340) is a high-strength low-alloy steel, Fe-Ni-Cr-Mo alloy ferritic steel – note that the B8 grades are austenitic so that the grade must be specified.	ASME BPVC Section IIA	IVA1.1	Steel	As described for A7
SA-333, Gr 6 **UNS#: K03006**	Nominal (average) wall seamless and welded carbon and alloy steel pipe intended for use at low temperatures. Several grades of ferritic steel are included, the Grade 6 means that the tensile test results indicate min. yield pt and tensile strength of 240 and 415MPa (34.8 and 60.2 ksi), respectively.	ASME BPVC Section IIA	IVC1.1	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-336 **UNS#: (depends on class)** SA-336, Class F1 was apparently the intended GALL Rev. 0 designation	Alloy steel forgings for pressure and high-temperature parts, covers both Ferritic and austenitic steel forgings – imperative to specify the class. Class F1 is a carbon steel containing 0.20-0.30wt%C. Thirteen other alloy steel classes exist for SA336.	HCWSS 332; ASME BPVC Section IIA	IVA1.1 – nowhere was the SA-336 grade specified in GALL, but throughout RCS systems in GALL, SA-336 was referred to as carbon steel.	Steel	As described for A7
SA-453 **UNS#: (depends on grade)**	Four grades of bolting material for use in high-temperature service such as fasteners for pressure vessels and valve flanges., Grade 651 is 19Cr-9Ni-Mo-W, Since all four grades have >11% Cr, they classify as stainless steels.	ASME BPVC Section IIA	IVA2.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
SA-508-64, Class 2 SA-508, Class 2 was the intended GALL Rev. 0 designation **UNS#: K12766**	SA508, Class 2 is a Cr-Mo low-alloy steel.	ASME BPVC Section IIA	IVA2.1-b	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-508, Cl 2 and Cl 3 **UNS#: K12766**	Quenched and tempered vacuum treated Carbon and alloy steel forgings for pressure vessels. Nomenclature changed in ’01; Class 2 is now called Grade 2 class 1 and Class 3 is called Grade 3 Class 1.	ASME BPVC Section IIA	IVA1.3	Steel	As described for A7
SA-516, Gr70 **UNS#: K02700**	Carbon steel plates intended primarily for service in welded pressure vessels where improved notch toughness is important. Gr. 70 has highest tensile strength of the four grades,	ASME BPVC Section IIA	IVA2.8	Steel	As described for A7
SA-533, Gr B **UNS#: 12539**	Mn-Mo-Ni Alloy steel plates for use in quenched and tempered condition for construction of welded pressure vessels	HCWSS 143; ASME BPVC Section IIA	IVA1.1	Steel	As described for A7
SA-540, Gr. B23 and B24 **UNS#: H43400**	High-strength Cr-Ni-Mo low-alloy steel bolting materials	ASME BPVC Section IIA	IVA1.1	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SA-540, Gr. B23 **UNS#: H43400**	High-strength Cr-Ni-Mo low alloy-steel bolting materials	ASME BPVC Section IIA	IV.C2.3	Steel	As described for A7
SA-582	SA-582 is not listed in recent editions of the ASME Code Section II. ASTM Standards A582 and A582M are a current standard for free-machining stainless steel bars.	Apparently an inconsistency in GALL Rev. 0.	IVC2.4 –a	Steel	As described for A7
SB-166 **UNS#: N06600, N06690**	Ni-Cr-Fe alloys and Ni-Cr-Co-Mo alloy in form of hot-finished and cold-work rod, bar, and wire.	ASME BPVC Section IIB	IVA1.4	Nickel alloy	As described for Alloy 182

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
SB-167 **UNS#: N06600,** **N06690**	nickel-chromium-iron alloys (US N06600, UNS N06601, N06690, N06025, and N06045) in cold-worked annealed, hot-worked annealed, hot-finished seamless pipe and tube intended for general corrosion resistant and heat resistant applications.	ASME BPVC Section IIB; E-Pipe manufacturer datasheet	IVA1.5	Nickel alloy	As described for Alloy 182
SB-168 **UNS#: N06600,** **N06690**	Nickel-Cr-Fe alloys and Ni-Cr-Co-Mo alloy plate, sheet, and strip	ASME BPVC Section IIB	IVA2.6	Nickel alloy	As described for Alloy 182
Type 15-5PH **UNS#: S15500**	Precipitation hardened (PH) martensitic stainless steel, Combines excellent corrosion resistance, high strength and hardness, low temperature hardening and good fabricating characteristics. Superior transverse ductility and toughness	ASM datasheet	IVB4.4	PH stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Type 304 **UNS#: S030400**	Austenitic stainless steel (SS) – Low carbon chromium nickel SS, Low carbon variation of Type 302, minimizes carbide precipitation during welding.	ASM database	IV.A2.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
Type 304 forging **UNS#: S30400**	Austenitic Stainless steel		IV.B4.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Type 304NG **UNS#: S30451** (UNS for Type 304 N)	Austenitic Stainless steel. Instead of the nominal 0.03% C maximum of the L-grade stainless steels, the Nuclear Grades (NG) are characterized by a maximum carbon content of 0.020%. The second important composition characteristic of type 304NG is the specification of 0.060 to 0.100% N. This modification is designed to recover the decrease in alloy strength due to the reduction of the carbon content.	ASMI database	IVC1.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
Type 308 **UNS#: S030800**	Austenitic Stainless steel, AISI Type 308 is an austenitic chromium nickel steel with corrosion and heat resistance superior to Type 304. The high Cr and Ni produce good heat/corrosion resistance. Used widely for welding rod.	ASMI database	IVA1.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Type 308L **UNS#: S030883**	Austenitic Stainless steel, This extra low carbon (reduced from 0.08% max in 308 to max of 0.03% C) modification is highly resistant to sensitization and is therefore used widely where welded construction is required to fabricate vessels for service under highly corrosive conditions.	ASMI database	IVA1.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials
Type 309 **UNS#: S30900**	Austenitic SS – AISI Type 309 is a chromium-nickel heat and corrosion resisting steel recommended for high-temperature applications in corrosive environments. It is intended primarily for high temperature applications at 1500°F or higher where resistance to oxidation and/or corrosion is required.	ASMI database	IVA1.1	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Type 309L **UNS#: S30983**	Austenitic SS – AISI Type 309 with Lowered carbon content (dropped from 0.20% max in 309 to nominal 0.03%C maximum)	ASMI database	IVA1.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials
Type 316 **UNS#: S31600**	Austenitic Stainless steel, AISI Type 316 is a molybdenum type 18-12 austenitic stainless steel having good resistance to acids. Mo improves general corrosion and pitting resistance and high-temperature strength.	ASMI database	IVA2.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials
Type 347 **UNS#: S34700**	Austenitic SS – low-carbon niobium-stabilized type, Fe-18Cr-10Ni-Nb Stabilized by the addition of niobium plus tantalum. This grade is nearly immune to intergranular precipitation of chromium carbide and its adverse effects on corrosion resistance.	ASMI database	IVB2.4	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%) and the associated welding materials

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition GALL Rev. 0	**Metal Description**	**Designation/ Specification Ref.**	**GALL Rev.0 Ref, orig. use**	**Materials Consolidation Term in GALL Rev. 1**	**Explanation for Use of Revised Term**
Type 403 **UNS#: S40300**	Martensitic Stainless steel – AISI Type 403 is a general purpose, heat-treatable stainless steel of the straight Cr type. It is adaptable for general purpose corrosion and heat resisting applications.	ASMI database	IVA2.2	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
Type 416 **UNS#: S41600**	Free-machining low-carbon chromium type stainless steel. (12-14% Cr)	ASMI database	IVC2.4	Stainless steel	Wrought or forged austenitic, ferritic, martensitic, or duplex stainless steel (Cr content >11%)
X-750 **UNS#: N07750**	See Gr. 688 (X-750) above.	ASMI database	IVB1.4	Nickel alloy	As described for A-182

A.3 Environments

The environment column entry was restated such that the combined information of the component, material, and environment columns supported the conclusions of the AMR results. The environments were revised to identify the pertinent aspects of the environment that influence the aging effects applicable to the material. The restated environments identify the general chemical content (e.g., treated borated water) and if necessary, a temperature range that determines the applicability of aging effects.

A.3.1 Listing, Location, and Frequency of Terms used in AMR Tables

The Roman numeral in the second column identifies the chapter in GALL Vol. 2 that the specified environments are associated with (i.e., "II" for Containment Structures, "III" for Structures and Component Supports, "IV" for Reactor Vessel, Internals, and Reactor Coolant Systems, "V" for Engineered Safety Features Systems, "VI" for Electrical Systems, "VII" for Auxiliary Systems, and "VIII" for Steam and Power Conversion Systems). The number of times the term is used in that given chapter is shown in the third column.

Table A.3.1 Environments: Listing, Location, and Frequency of AMR Terms

Environment	Referring Chapters	Total # references
Adverse localized environment caused by exposure to moisture and voltage	VI	1
Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	VI	2
Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	VI	1
Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	VI	1
Air	VII	1
	VIII	1
Air – indoor	VI	1
Air – indoor and outdoor	VI	5
Air – indoor controlled (External)	V	2
	VII	2
	VIII	1
Air – indoor uncontrolled	II	7
	III	7
	IV	1
	V	1
	VII	6
Air – indoor uncontrolled or air outdoor	II	2
Air – indoor uncontrolled (External)	III	2
	IV	2
	V	10

Table A.3.1 Environments: Listing, Location, and Frequency of AMR Terms		
Environment	**Referring Chapters**	**Total # references**
	VII	15
	VIII	7
Air – indoor uncontrolled (Internal)	V	4
	VII	1
Air – indoor uncontrolled (Internal/ External)	VII	1
Air – indoor uncontrolled (Internal/External)	V	1
	VI	1
Air – indoor uncontrolled or air – outdoor	II	18
	III	9
Air – indoor uncontrolled or air – outdoor; Water – flowing or water – standing	III	1
Air – indoor uncontrolled or treated water (as applicable)	II	4
Air – outdoor	II	3
	III	4
	VI	4
	VII	4
Air – outdoor (External)	V	2
	VII	5
	VIII	3
Air – outdoor (Internal)	VIII	1
Air with borated water leakage	III	3
	IV	2
	V	6
	VI	1
	VII	6
	VIII	2
Air with borated water leakage (Internal)	V	1
Air with leaking secondary-side water and/or steam	IV	1
Air with metal temperature up to 288°C (550°F)	IV	1
Air with reactor coolant leakage	IV	10
Air with reactor coolant leakage (Internal) or Reactor Coolant	IV	2
Air with steam or water leakage	V	2
	VII	3
	VIII	2

Table A.3.1 Environments: Listing, Location, and Frequency of AMR Terms		
Environment	**Referring Chapters**	**Total # references**
Air-indoor uncontrolled or air-outdoor	III	1
Any	II	5
Any	III	2
Closed cycle cooling water	IV	3
	V	11
	VII	11
	VIII	8
Closed cycle cooling water >60°C (>140°F)	V	1
	VII	2
	VIII	1
Concrete	IV	2
	V	2
	VII	2
	VIII	2
Condensation	VII	3
Condensation (External)	V	2
	VII	2
	VIII	1
Condensation (Internal)	V	3
	VII	4
	VIII	1
Diesel exhaust	VII	2
Dried Air	VII	3
Fuel oil	VII	6
Gas	IV	1
	V	3
	VII	4
	VIII	4
Ground water/soil	II	4
	III	3
Lubricating oil	III	1
	V	7
	VII	7
	VIII	8
Moist air or condensation (Internal)	VII	1
Raw water	V	9
	VII	22

Table A.3.1 Environments: Listing, Location, and Frequency of AMR Terms		
Environment	**Referring Chapters**	**Total # references**
	VIII	11
Reactor coolant	IV	150
Reactor coolant >250°C (>482°F)	IV	3
Reactor coolant >250°C (>482°F) and neutron flux	IV	9
Reactor coolant and neutron flux	IV	23
Reactor coolant and secondary feedwater/steam	IV	1
Reactor coolant/ steam	IV	2
Secondary feedwater	IV	1
Secondary feedwater/ steam	IV	18
Sodium pentaborate solution	VII	1
Sodium pentaborate solution >60°C (>140°F)	VII	1
Soil	II	3
	III	1
	V	3
	VII	3
	VIII	3
Steam	V	1
	VIII	10
Steam or treated water	VIII	1
System temperature up to 288°C (550°F)	IV	4
System temperature up to 340°C (644°F)	IV	2
Treated borated water	IV	1
	V	5
	VII	9
Treated borated water >250°C (>482°F)	V	1
Treated borated water >60°C (>140°F)	IV	1
	V	2
	VII	5
Treated water	V	10
	VII	15
	VIII	17
Treated Water < 60C (<140 F)	III	1
Treated water >250°C (>482°F)	V	1
Treated water >60°C (>140°F)	V	1
	VII	5
	VIII	4

Table A.3.1 Environments: Listing, Location, and Frequency of AMR Terms		
Environment	**Referring Chapters**	**Total # references**
Treated water or treated borated water	III	1
Various	III	1
Water – flowing	II	5
	III	3
Water – flowing Water – standing	III	1
Water – flowing under foundation	III	1
Water – standing	III	1
Grand Total		682

A.3.2 Selected Descriptions of Environments

The following table defines many of the standardized environments utilized in the GALL AMR tables in Chapters II, III, IV, V, VI, VII, and VIII of NUREG-1801, Rev. 1.

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Adverse localized environment caused by exposure to moisture and voltage	The conductor insulation used for electrical cables in instrumentation circuits can be subjected to an adverse localized environment caused by exposure to moisture and voltage.
Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	The conductor insulation used for electrical cables in instrumentation circuits can be subjected to an adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen.
Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	The conductor insulation used for electrical cables in instrumentation circuits can be subjected to an adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen. The term ">60-year service limiting temperature" refers to that which exceeds the temperature below which the material has a 60-year or greater service lifetime.
Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	Electrical components subject to 10 CFR 50.49 EQ requirements can be subjected to an adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage.
Aggressive environment	For steel in concrete. As described in NUREG-1557, this is defined as that occurring when concrete pH <11.5 or chlorides concentration >500 ppm). Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Inside or outside containment
Air – indoor	Uniquely used for the new AMR line-item LP-01 in Chapter VI for electrical systems, air-indoor is synonymous with "Air – indoor uncontrolled (internal/external)." Indoor air on systems with temperatures higher than the dew point, i.e., condensation can occur but only rarely, equipment surfaces are normally dry.
Air – indoor controlled	The environment to which the specified internal or external surface of the component or structure is exposed: indoor air in a humidity controlled (e.g., air conditioned) environment.

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Air – indoor uncontrolled	Indoor air on systems with temperatures higher than the dew point – Condensation can occur but only rarely – equipment surfaces are normally dry. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Ambient temperature air Ambient environment inside buildings Inside or outside containment Indoors: exposed to variable temperature and humidity inside the auxiliary building or fuel handling building Air, moisture, and humidity < 100°C (212°F)
Air – indoor uncontrolled >35°C (>95°F) (Internal/External)	The environment to which the internal or external surface of the component or structure is exposed. This also applies to indoor air above thermal stress threshold for elastomers. If ambient is <95°F, then any resultant thermal aging of organic materials can be considered insignificant over the 60-yr period of interest [Gillen & Clough, 1981; Peckner & Bernstein, 1977]. Although 95°F is a recognized threshold, temperature is not the only factor for aging of elastomers. Elastomers are also subject to aging effects from other factors such as exposure to ozone, oxidation, and radiation. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Internal: occasional exposure to moist air; external: ambient plant air environment
Air – outdoor	The outdoor environment consists of moist, possibly salt-laden atmospheric air, ambient temperatures and humidity, and exposure to weather, including precipitation and wind. The component is exposed to air and local weather conditions including salt spray where applicable. A component is considered susceptible to a wetted environment when it is submerged, has the potential to pool water, or is subject to external condensation. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Weather exposed Outside containment

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Air with borated water leakage	Air and untreated borated water leakage on indoor or outdoor systems with temperatures above or below the dew point. The water from leakage is considered to be untreated, due to the potential for water contamination at the surface. This is germane to PWRs. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Inside PWR containment Air, leaking and dripping chemically treated borated water up to 340°C (644°F) Air, leaking chemically treated borated water
Air with leaking secondary-side water and/or steam	Steel components in the pressure boundary and structural parts of the once-through steam generator may be exposed to an environment consisting of air with leaking secondary-side water and/or steam.
Air with metal temperature up to 288°C (550°F)	Synonymous with system temperature up to 288°C (550°F). Used in GALL update to describe environment to which the steel and stainless steel pressurizer integral support in the PWR reactor coolant system are exposed.
Air with reactor coolant leakage	Air and reactor coolant or steam leakage on high temperature systems. This is germane to BWRs Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Air, leaking reactor coolant water and/or steam at 288°C (550°F)
Air with steam or water leakage	Air and untreated steam or water leakage on indoor or outdoor systems with temperatures above or below the dew point Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Air, moisture, humidity, and leaking fluid
Air, dry	Air that has been treated to reduce the dew point well below the system operating temperature
Air, moist	Air with enough moisture to facilitate loss of material in steel caused by general, pitting, and crevice corrosion. Moist air in the absence of condensation is also potentially aggressive, e.g., under conditions where hygroscopic surface contaminants are present.
Any	Could be any environment indoors or outdoors, aging effect not dependent on environment. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Inside or outside containment

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Closed cycle cooling water	Treated water subject to the closed-cycle cooling water chemistry program. Closed cycle cooling water >60°C (>140°F) allows the possibility of stainless steel SCC. Examples of environment descriptors that comprise this category can include, but are not limited to chemically treated borated water; and treated component cooling water demineralized water on one side; closed-cycle cooling water (treated water) on the other side chemically treated borated water on tube side and closed-cycle cooling water on shell side.
Concrete	Components embedded in concrete
Condensation (Internal/External)	The environment to which the internal or external surface of the component or structure is exposed. Condensation on the surfaces of systems with temperatures below the dew point is considered raw water, due to potential for surface contamination. For the purposes of GALL Rev. 1, under certain circumstances, the GALL Rev. 0 terms “moist air” or “warm moist air” are enveloped by condensation to describe an environment where there is enough moisture for corrosion to occur.
Containment environment (inert)	The drywell is made inert with hydrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation.
Diesel Exhaust	Gases, fluids, particulates present in a diesel engine exhaust Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Hot diesel engine exhaust gases containing moisture and particulates
Fuel oil	Fuel oil used for combustion engines with possible water contamination
Gas	Internal gas environments from dry air, inert or non-reactive gases. As used in GALL Rev. 1 AMR line-items, this generic term, standing on its own, is used only in “Common Miscellaneous Material/Environment” sections where aging effects are not expected to degrade the ability of the structure of component to perform its intended function for the extended period of operation. In such “none-none” AMR line-items, no AMPs are required. In the context of GALL Rev. 1, this term “gas” subsequently is not meant to envelope gases in the fire suppression system. The GALL AMP XI.M26 “Fire Protection” is used for the periodic inspection and test of the halon/carbon dioxide fire suppression system.
Groundwater/soil	Groundwater is the water beneath the surface that can be collected with wells, tunnels, or drainage galleries, or that flows naturally to the earth’s surface via seeps or springs. Soil is a mixture of inorganic materials produced by the weathering of rocks and clays, and organic material produced by the decomposition of vegetation. Voids containing air and moisture occupy ~50% of the soil volume. Concrete subjected to a groundwater/soil environment can be vulnerable to Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack.

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Lubricating oil	Lubricating oils within the scope of license renewal are low to medium viscosity hydrocarbons used for bearing, gear, and engine lubrication. This lubricating oil used for plant equipment has the possibility of water contamination. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Lubricating oil (with contaminants and/or moisture)
Moist air	In the emergency diesel generator system, the steel diesel engine starting air subsystem and the diesel engine combustion air intake subsystem can be exposed to moist air resulting in loss of material caused by general, pitting, and crevice corrosion. The description of condensation (internal/external) envelopes moist air.
Raw water	Raw, untreated fresh, salt, or ground water. Floor drains and reactor buildings and auxiliary building sumps may be exposed to a variety of untreated water that is thus classified as raw water, for the determination of aging effects. Raw water may contain contaminants, including oil and boric acid, depending on the location, as well as originally treated water that is not monitored by a chemistry program. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Flowing water open-cycle cooling water (raw water)
Reactor coolant	Water in the reactor coolant system and connected systems at or near full operating temperature – includes steam for BWRs. For aging effect of cumulative fatigue damage, no temperature threshold of concern. In context of PWR reactor vessel, reactor coolant was more appropriate description of environment. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated borated water or steam up to 340°C (644°F) Up to 288°C (550°F), reactor coolant water
Reactor coolant >250°C (>482°F) and neutron flux	Water in the reactor coolant system and connected systems above thermal embrittlement threshold for CASS. Since CASS and the AMP XI.M13 are referenced, both environments are listed in single cell as well as the temperature threshold. Wherever there is thermal aging of CASS, 482°F applies. Wherever there is neutron irradiation, Neutron Flux applies. If components other than CASS are included, then the limitations do not apply for the other components. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated borated water up to 340°C (644°F) fluence $>10^{17}$ n/cm^2 (E >1 MeV)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Reactor coolant >250°C (>482°F)	Treated water above thermal embrittlement threshold for CASS. Address environment specifications of concern for specific aging effect. Here thermal embrittlement of CASS is addressed. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: 25–288°C (77-550°F) demineralized water
Reactor coolant and high fluence (>1 x 10E21 n/cm2 E >0.1 MeV)	The PWR reactor vessel internals (such as baffle/former assembly and associated baffle/former bolts) will be subjected to a reactor coolant environment and also a high fluence (>1 x 10E21 n/cm2 E >0.1 MeV). Subsequently, SCC and IASCC aging mechanisms can cause cracking.
Reactor coolant and neutron flux	Reactor core environment for ferritic materials that will result in a neutron fluence exceeding 10^{17} n/cm^2 (E >1 MeV) at the end of the license renewal term. Since the material is steel and the aging effect/mechanism is loss of fracture toughness/ neutron irradiation embrittlement, the only environment of concern in this context is the neutron flux. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: 288°C (550°F) reactor coolant water $5x10^8$ – $5x10^9$ n/cm^2·s Chemically treated borated water up to 340°C (644°F) neutron fluence greater than 10^{17} n/cm^2 (E >1 MeV)
Reactor coolant and secondary feedwater/steam	For PWR systems, it is reasonable to combine these environments into one cell. Water in the reactor coolant system and connected systems at or near full operating temperature and the PWR feedwater or steam at or near full operating temperature subject to the secondary water chemistry program. Nickel-alloy tubes and sleeves are subject to cumulative fatigue damage and managed by TLAA. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: ID chemically treated borated water up to 340°C (644°F); OD up to 300°C (572°F) secondary-side water chemistry
Secondary feedwater	Within the context of the recirculating steam generator, components such as steam generator feedwater impingement plate and support may be subjected to loss of material due to erosion in a secondary feedwater environment. More generally, the environment of concern is a secondary feedwater/steam combination.
Secondary feedwater/steam	PWR feedwater or steam at or near full operating temperature subject to the secondary water chemistry program. In IV, this is the descriptor for SCC of secondary side nozzles in pressure boundary and structural components of steam generator (once-through) constructed of Alloy 600 Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Up to 300°C (572°F) secondary-side water chemistry at 5.3-7.2 MPa

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Sodium pentaborate solution	Treated water that contains a mixture of borax and boric acid. Although it has been referenced that sodium pentaborate approximates basic treated water in aggressivity, this is a fairly concentrated solution. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Sodium pentaborate solution at 21 – 32 °C (70 – 90°F) (˜24,500 ppm B)
Soil	External environment for components buried in the soil, including groundwater in the soil. Environment where settlement could occur – includes changes in groundwater condition. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Soft soil; changes in groundwater conditions (III) Soil (VII) Soil and ground water (VIII)
Steam	Steam, subject to BWR water chemistry program or PWR secondary plant water chemistry program. Defining temperature of steam is not considered necessary for analysis Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: 288°C (550°F) steam Up to 300°C (572°F) steam
System temperature up to 288°C (550°F)	Metal temperature outside the recirculation pump and valves associated with BWR reactor coolant pressure boundary Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Air with metal temperature up to 288°C (550°F)
System temperature up to 340°C (644°F)	Maximum metal temperature associated with reactor coolant pump, valves, and pressurizer integral support for PWR reactor coolant or PWR steam generators. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Air Air with metal temperature up to 340°C (644°F)
Treated borated water	Borated (PWR) water. Since material of concern is Boraflex, no need to specify temperature threshold. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated oxygenated (BWR) or borated (PWR) water

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Treated borated water >60°C (>140°F)	Treated water with boric acid above SCC threshold for stainless steel. [2,3] borated (PWR) water, when dealing with SCC of stainless steel, then list > 140°F Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated borated water at temperature <93°C (200°F) Chemically treated oxygenated (BWR) or borated (PWR) water
Treated borated water >250°C (>482°F)	Treated water with boric acid above thermal embrittlement threshold for CASS. Only environmental temperature of concern is that above the embrittlement threshold – specifying full temp range is counterproductive. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated borated water at temperature 25–340°C (77-644°F)
Treated water	Treated water is demineralized water, which is the base water for all clean systems. Depending on the system, this demineralized water may require additional processing. Treated water could be deaerated and include corrosion inhibitors, biocides, or some combination of these treatments. Unlike the PWR reactor coolant environment (treated borated water), the BWR reactor coolant environment (i.e., treated water) does not contain boron, a recognized corrosion inhibitor. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: <90°C (<194°F) treated water 25–288°C (77-550°F) demineralized water Chemically treated oxygenated (BWR) or borated (PWR) water Secondary side treated water Treated water side (condensate side) Treated water (BWRs: reactor coolant; PWRs: secondary side water) Treated water side (other side of steam generator blowdown)
Treated water >60°C (>140°F)	Treated water above SCC threshold for stainless steel. This is Chemically treated oxygenated (BWR) water, when dealing with stress corrosion cracking (SCC) of stainless steel, then include temperature threshold > 140°F. Treated water in the reactor coolant system and connected systems above SCC threshold for stainless steel. [2,3] In context of SCC of SS components in PWR reactor vessel, then list >140°F Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Chemically treated oxygenated (BWR) or borated (PWR) water Chemically treated borated water up to 340°C (644°F)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Water – flowing	Water that is refreshed, thus having larger impact on leaching – this can be raw water, groundwater, or flowing water under a foundation. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: include: Flowing water under foundation
Water – standing	Water that is stagnant and unrefreshed, thus possibly resulting in increased ionic strength of solution up to saturation. Examples of environment descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: Exposed to water

A.3.3 Temperature Thresholds

The restructuring of the NUREG-1801 mechanical systems tables is not intended to alter the generic AMR results. The intent is to clarify those results and extend their applicability to a broader range of equipment to permit better comparisons to the results found in a typical plant AMR. New temperature thresholds for aging effects in common use by the industry, are presented in Table A.3.2 to further clarify applicability of the results.

A.3.3 Temperature Thresholds Expressed in Environmental Descriptors		
Temperature	**Threshold**	**Description and Technical Justification**
95°F	Thermal stresses for elastomers	In general, if the ambient temperature is less than about 95°F, then thermal aging may be considered not significant for rubber, butyl rubber, neoprene, nitrile rubber, silicone elastomer, fluoroelastomer, EPR, and EPDM. [Gillen & Clough, 1981] Although 95°F is a recognized threshold, temperature is not the only factor for aging of elastomers. Elastomers are also subject to aging effects from other factors such as exposure to ozone, oxidation, and radiation.
140°F	SCC for stainless steel	In general, SCC very rarely occurs in austenitic stainless steels below 140°F. Although SCC has been observed in stagnant, oxygenated borated water systems at lower temperatures than this 140°F threshold, all of these instances have identified a significant presence of contaminants (halogens, specifically chlorides) in the failed components. With a harsh enough environment (significant contamination), SCC can occur in austenitic stainless steel at ambient temperature. However, these conditions are considered event driven, resulting from a breakdown of chemistry controls. [Peckner & Bernstein, 1977; Metals Handbook, 1988]
482°F	Thermal embrittlement for CASS	CASS materials subjected to sustained temperatures below 250°C (482°F) will not result in a reduction of room temperature Charpy impact energy below 50 ft-lb for exposure times of approximately 300,000 hours (for CASS with ferrite content of 40%) and approximately 2,500,000 hours for CASS with ferrite content of 14%) [Figure 2 in Chopra & Sather, 1990]. For a maximum exposure time of approximately 420,000 hours (48 EFPY), a screening temperature of 482°F is conservatively chosen because (1) the majority of nuclear grade materials are expected to contain a ferrite content well below 40%, and (2) the 50 ft-lb limit is very conservative when applied to cast austenitic materials. It is typically applied to ferritic materials (e.g., 10 CFR 50 Appendix G). For CASS components in the reactor coolant pressure boundary, this threshold is supported by NUREG-1801 XI.M12, with the exception of niobium-containing steels which require evaluation on a case-by-case basis.

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A.4. Aging Effects and Aging Mechanisms

NUREG-1801 lists aging effects along with one or more aging mechanisms. The aging mechanisms, while useful to describe the considerations used in the generic aging management review, are generally not useful when comparing the plant AMR results to the NUREG-1801 results. Although aging mechanisms are considered during the plant AMR, the results are reported in terms of aging effects. The suitability of an aging management program is determined primarily on its ability to detect or prevent the overall aging effect rather than the individual aging mechanism.

The following tables define many of the standardized aging effects and aging mechanisms descriptors utilized in the GALL AMR tables in Chapters II, III, IV, V, VI, VII, and VIII of NUREG-1801, Rev. 1.

A.4.1 Listing, Location, and Frequency of Aging Effect/ Aging Mechanism Terms

Table A.4.1 provides a complete listing, occurrence, and frequency of the aging effect/aging mechanisms found in NUREG-1801, Rev. 1. The Roman numeral in the second column identifies the chapter in GALL Vol. 2 that the structures and/or components are associated with (i.e., “II” for Containment Structures, “III” for Structures and Component Supports, “IV” for Reactor Vessel, Internals, and Reactor Coolant Systems, “V” for Engineered Safety Features Systems, “VI” for Electrical Systems, “VII” for Auxiliary Systems, and “VIII” for Steam and Power Conversion Systems).

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1

Aging Effect/ Aging Mechanism	Referring Chapters	Total # references
Changes in dimensions/ void swelling	IV	27
Concrete cracking and spalling/ aggressive chemical attack, and reaction with aggregates	VII	1
Concrete cracking and spalling/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	VII	1
Corrosion of connector contact surfaces/ intrusion of borated water	VI	1
Crack growth/ cyclic loading	IV	1
Cracking due to expansion/ reaction with aggregates	II	5
	III	2
Cracking due to restraint shrinkage, creep, and aggressive environment	III	1
Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	II	4
	III	3
Cracking/ cyclic loading	IV	7
Cracking/ cyclic loading (CLB fatigue analysis does not exist)	II	4
Cracking/ cyclic loading, stress corrosion cracking	V	1
	VII	2
	VIII	1
Cracking/ flow-induced vibration	IV	1

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Cracking/ intergranular attack	IV	1
Cracking/ outer diameter stress corrosion cracking	IV	1
Cracking/ primary water stress corrosion cracking	IV	11
Cracking/ stress corrosion cracking	II	3
	III	1
	IV	15
	V	3
	VII	11
	VIII	7
Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	III	2
Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	IV	7
	V	1
Cracking/ stress corrosion cracking, cyclic loading	VII	3
Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	IV	1
	VII	1
Cracking/ stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical loading	IV	1
Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	IV	1
Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	IV	10
Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	IV	24
Cracking/ stress corrosion cracking, primary water stress corrosion cracking	IV	5
Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	IV	11
Cracking/ stress corrosion cracking, thermal and mechanical loading	IV	1
Cracks and distortion due to increased stress levels from settlement	II	3
	III	1
Cumulative fatigue damage/ fatigue	IV	14
	V	2
	VII	5
	VIII	2
Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	II	4
	III	1
Degradation of insulator quality/presence of any salt deposits or surface contamination	VI	1
Denting/ corrosion of carbon steel tube support plate	IV	2

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation (Thermal/ thermoxidative) of organics/thermoplastics, radiation-induced oxidation, moisture intrusion and ohmic heating	VI	1
Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation of organics (Thermal/ thermoxidative), radiolysis and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation, and moisture intrusion	VI	2
Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ thermal/thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation; moisture/debris intrusion, and ohmic heating	VI	1
Fatigue/ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	VI	1
Fretting or lockup/ mechanical wear	II	1
Hardening and loss of strength/ elastomer degradation	V	1
	VI	1
	VII	4
Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	II	4
	III	3
Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	III	2
Increase in porosity, permeability/ leaching of calcium hydroxide	II	4
Increased hardness, shrinkage and loss of strength/ weathering	VII	2
Ligament cracking/ corrosion	IV	1
Localized damage and breakdown of insulation leading to electrical failure/ moisture intrusion, water trees	VI	1
Lock-up/ wear	III	1
Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	VI	1
Loosening of bolted connections/ thermal cycling and ohmic heating	VI	1
Loss of fracture toughness/ neutron irradiation embrittlement	IV	7
Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	IV	16
Loss of fracture toughness/ thermal aging and neutron irradiation embrittlement	IV	9
Loss of fracture toughness/ thermal aging embrittlement	IV	3
	V	2
Loss of leak tightness/ mechanical wear of locks, hinges and closure mechanisms	II	1

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Loss of material (spalling, scaling) and cracking/ freeze-thaw	II	3
	III	2
Loss of material, loss of form/ erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	III	1
Loss of material/ pitting and crevice corrosion (only for steel after lining degradation)	VII	1
Loss of material/ abrasion; cavitation	III	1
Loss of material/ boric acid corrosion	III	2
	IV	1
	V	4
	VII	4
	VIII	2
Loss of material/ cladding breach	V	1
	VII	1
Loss of material/ corrosion	II	1
	III	1
Loss of material/ corrosion of embedded steel	VII	2
Loss of material/ crevice corrosion and fretting	IV	1
Loss of material/ erosion	IV	2
	V	1
	VII	1
Loss of material/ erosion, general, pitting, and crevice corrosion	IV	1
Loss of material/ fretting and wear	IV	1
Loss of material/ general (steel only), pitting and crevice corrosion	III	1
	IV	1
	VII	1
	VIII	1
Loss of material/ general and pitting corrosion	III	2
	VII	1
Loss of material/ general corrosion	III	1
	V	10
	VI	1
	VII	8
	VIII	4
Loss of material/ general corrosion and fouling	V	1

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Loss of material/ general, pitting, and crevice corrosion	II	6
	III	1
	IV	4
	V	8
	VII	15
	VIII	11
Loss of material/ general, pitting, crevice and boric acid corrosion	V	1
Loss of material/ general, pitting, crevice, and (for drip pans and drain lines) microbiologically influenced corrosion	VII	1
Loss of material/ general, pitting, crevice, and galvanic corrosion	V	1
	VII	1
	VIII	2
Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	V	1
	VII	1
	VIII	2
Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	V	1
	VII	3
	VIII	1
Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation	VII	1
Loss of material/ general, pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	V	1
	VII	1
	VIII	1
Loss of material/ mechanical wear due to wind blowing on transmission conductors	VI	1
Loss of material/ microbiologically influenced corrosion	VII	1
Loss of material/ pitting and crevice corrosion	III	1
	IV	6
	V	12
	VII	17
	VIII	14
Loss of material/ pitting and crevice corrosion (only for steel after lining/cladding degradation)	VII	1
Loss of material/ pitting and crevice corrosion, and fouling	VII	2
Loss of material/ pitting, crevice, and galvanic corrosion	IV	1
	V	2
	VII	3
	VIII	1

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Loss of material/ pitting, crevice, and microbiologically influenced corrosion	V	1
	VII	6
	VIII	4
Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	V	2
	VII	2
	VIII	1
Loss of material/ pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	VII	1
Loss of material/ selective leaching	IV	1
	V	5
	VII	9
	VIII	6
Loss of material/ wastage and pitting corrosion	IV	1
Loss of material/ wear	IV	15
	VII	5
Loss of material/ wind induced abrasion and fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	VI	2
Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; elastomer hardening	III	3
Loss of preload/ stress relaxation	IV	13
Loss of preload/ thermal effects, gasket creep, and self-loosening	IV	3
Loss of preload/ thermal effects, gasket creep, and self-loosening	IV	1
	V	1
	VII	1
	VIII	1
Loss of prestress/ relaxation; shrinkage; creep; elevated temperature	II	1
Loss of sealing/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	III	1
Loss of sealing; Leakage through containment/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	II	1
None	III	4
	IV	6
	V	18
	VI	1
	VII	23
	VIII	15
Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	III	1

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	II	1
	III	1
Reduction of heat transfer/ fouling	III	1
Reduction of heat transfer/ fouling	V	8
	VII	6
	VIII	10
Reduction of neutron-absorbing capacity and loss of material/ general corrosion	VII	2
Reduction of neutron-absorbing capacity/ boraflex degradation	VII	2
Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	II	5
	III	1
Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	III	1
Various degradation/ various mechanisms	VI	1
Wall thinning/ flow-accelerated corrosion	IV	5
	V	2
	VIII	2
Grand Total		683

A.4.2 Aging Effects

Table A.4.2 defines many of the standardized aging effects descriptors utilized in the GALL AMR tables in Chapters II, III, IV, V, VI, VII, and VIII of NUREG-1801, Rev. 1.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
Changes in dimensions	Changes in dimension can result from void swelling
Concrete cracking and spalling	Concrete cracking and spalling can result from freeze-thaw, aggressive chemical attack, and reaction with aggregates.
Corrosion of connector contact surfaces	Corrosion of exposed connector contact surfaces can be caused by borated water intrusion.
Crack growth	Increase in crack size, attributable to cyclic loading. For example, the vessel shell (including beltline welds) fabricated of SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process when subjected to a reactor coolant environment can experience a crack growth aging effect caused by cyclic loading.
Cracking	This term is used in this document to be synonymous with the phrase “crack initiation and growth” where used in reference to metallic substrates. Nonductile failure of a component due to stress corrosion, fatigue, or embrittlement. Aging mechanisms that can result in cracking include: • Cyclic loading • Stress corrosion cracking • Intergranular attack • Outer diameter stress corrosion cracking • Primary water stress corrosion cracking • Intergranular stress corrosion cracking • Irradiation-assisted stress corrosion cracking • Thermal and mechanical loading Examples of aging effect descriptors that were specifically referenced in GALL Rev. 0 that comprise this category include: • Crack initiation and growth Cracking in concrete can be caused by restraint shrinkage, creep, and aggressive environment.
Cracking, loss of bond, and loss of material (spalling, scaling)	Cracking, loss of bond, and loss of material (spalling, scaling) can be caused by corrosion of embedded steel in concrete.
Cracks; distortion; increase in component stress level	Within concrete structures, cracks, distortion, and increase in component stress level can be caused by settlement.
Cumulative fatigue damage	Cumulative fatigue damage is due to fatigue

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
Degradation of insulator quality	The decrease in insulating capacity can result from the presence of salt deposits or surface contamination. Although this derives from an aging mechanism (presence of salt deposits or surface contamination as noted in LP-07) that may be due to temporary, transient environmental conditions, the net result may be long-lasting and cumulative.
Denting	Denting can result from corrosion of carbon steel tube support plates.
Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance, electrical failure can result from mechanisms such as thermal or thermoxidative degradation of organics; radiation-induced oxidation, radiolysis and photolysis (UV sensitive materials only) of organics; moisture intrusion; and ohmic heating.
Expansion and cracking	Within concrete structures, expansion and cracking can result from reaction with aggregates
Fatigue	Fatigue in copper fuse holder clamps can result from ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation.
Fretting or lockup	Fretting is an aging effect due to accelerated deterioration at the interface between contacting surfaces as the result of corrosion and slight oscillatory movement between the two surfaces. In essence both fretting and lockup are due to mechanical wear.
Hardening and loss of strength	Hardening and loss of strength can result from elastomer degradation of seals and other elastomeric components. Elastomers can experience increased hardness, shrinkage, and loss of strength, due to weathering.
Increase in porosity and permeability, cracking, loss of material (spalling, scaling)	Concrete can increase in porosity and permeability, cracking, loss of material (spalling, scaling) due to aggressive chemical attack. In concrete, loss of material (spalling, scaling) and cracking can result from freeze-thaw processes.
Increase in porosity and permeability, loss of strength	Concrete can increase in porosity and permeability, with loss of strength due to leaching of calcium hydroxide
Increased resistance of connection	Increased resistance of connection in electrical transmission conductors and connections can be caused by oxidation or loss of preload. Loss of conductor strength in electrical transmission lines can result from corrosion.
Ligament cracking	Steel tube support plates can experience ligament cracking due to corrosion.
Localized damage and breakdown of insulation leading to electrical failure	Localized damage in polymeric electrical conductor insulation leading to electrical failure is due to moisture intrusion, and the formation of water trees.
Lock-up	Lock-up of steel elements in the drywell head downcomers can be attributed to mechanical wear.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
Loosening of bolted connections	The loosening of bolted bus duct connections due to thermal cycling can result from ohmic heating
Loss of fracture toughness	Loss of fracture toughness can result from various aging mechanisms including thermal aging, thermal aging embrittlement, and neutron irradiation embrittlement.
Loss of leak tightness	Steel airlocks can experience loss of leak tightness in closed position resulting from mechanical wear of locks, hinges, and closure mechanisms.
Loss of material	Loss of material may be due to general corrosion, boric acid corrosion, pitting corrosion, galvanic corrosion, crevice corrosion, erosion, fretting, flow-accelerated corrosion, MIC, selective leaching, wastage, wear, and aggressive chemical attack. In concrete structures, loss of material can also be caused by abrasion or cavitation or corrosion of embedded steel. For high voltage insulators, loss of material can be attributed to mechanical wear or wind-induced abrasion and fatigue due to wind blowing on transmission conductors. Loss of material due to general corrosion is an aging effect requiring management for low alloy steel, carbon steel, and cast iron in outdoor environments.
Loss of material (spalling, scaling) and cracking	In concrete, loss of material (spalling, scaling) and cracking can result from freeze-thaw processes.
Loss of material, loss of form	In earthen water-control structures, the loss of material, and loss of form can result from erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, and seepage.
Loss of mechanical function	Loss of mechanical function in ASME Class 1 piping and components (such as constant and variable load spring hangers, guides, stops, sliding surfaces, design clearances, vibration isolators) fabricated from steel or other materials such as Lubrite® can experience loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads, or elastomer hardening.
Loss of preload	Loss of preload due to gasket creep, thermal effects (including differential expansion and creep or stress relaxation), and self-loosening (which includes vibration, joint flexing, cyclic shear loads, thermal cycles) is an aging effect/mechanism accepted by industry as being within the scope of license renewal.
Loss of prestress	Loss of prestress in structural steel anchorage components can result from relaxation, shrinkage, creep, or elevated temperatures.
Loss of sealing; leakage through containment	Loss of sealing and leakage through containment in materials such as seals, elastomers, rubber and other similar materials can result from deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) Loss of seal in elastomeric phase bus enclosure assemblies can result from moisture intrusion.
None	Certain structures and components made of corrosion-resistant materials may in certain environments be subject to no aging mechanisms and thus there are also no relevant aging effects.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
Reduction in concrete anchor capacity due to local concrete degradation	Reduction in concrete anchor capacity due to local concrete degradation can result from a service-induced cracking or other concrete aging mechanisms.
Reduction in foundation strength, cracking, differential settlement	Reduction in foundation strength, cracking, and differential settlement can result from erosion of porous concrete subfoundation.
Reduction of heat transfer	Reduction of heat transfer from fouling by the buildup, from whatever source, on the heat transfer surface. Although in heat exchangers, the tubes are the primary heat transfer component, heat exchanger internals including tubesheets and fins contribute to heat transfer and may be affected by the reduction of heat transfer due to fouling. Although GALL Rev. 1 does not include reduction of heat transfer for any heat exchanger surfaces other than tubes, reduction in heat transfer is of concern for other heat exchanger surfaces.
Reduction of neutron-absorbing capacity	Reduction of neutron-absorbing capacity can result from Boraflex degradation.
Reduction of neutron-absorbing capacity and loss of material	Reduction of neutron-absorbing capacity can result from Boraflex degradation.
Reduction of strength and modulus	In concrete, reduction of strength and modulus can be attributed to elevated temperatures (>150°F general; >200°F local).
Reduction or loss of isolation function	Reduction or loss of isolation function in polymeric vibration isolation elements can result from Radiation hardening, temperature, humidity, sustained vibratory loading.
Various degradation effects	Electrical equipment subjected to adverse localized environment can be subject to various degradation effects due to various mechanisms (see L-05).
Wall thinning	This is the term used throughout GALL Rev. 1 to describe the specific version of loss of material due to flow-accelerated corrosion.

A.4.3 Aging Mechanisms

An aging mechanism is considered to be significant when it may result in aging effects that produce a loss of functionality of a component or structure during the current or license renewal period if allowed to continue without mitigation. Table A.4.3 presents the aging mechanisms identified in GALL.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Abrasion	As water migrates over a concrete surface it may transport material that can abrade the concrete. The passage of water may also create a negative pressure at the water – air to concrete interface that can result in abrasion and cavitation degradation of the concrete. This may result in pitting or aggregate exposure due to loss of cement paste. [NUMARC Report 90-06]
Aggressive chemical attack	Concrete, being highly alkaline (pH> 12.5) is degraded by strong acids. Chlorides, and sulfates of potassium, sodium, and magnesium may attack concrete depending concentration in soil/ground water. Exposed surfaces of Class 1 structures may be subject to sulfur-based acid-rain degradation. Minimum degradation thresholds are 500 ppm chlorides and 1500 ppm sulphates. [NUMARC Report 90-06]
Boraflex Degradation	Boraflex degradation may involve gamma radiation-induced shrinkage of Boraflex and the potential to develop tears or gaps in the material. A more significant potential degradation is the gradual release of silica and the depletion of boron carbide from Boraflex following gamma irradiation and long-term exposure to the wet pool environment. The loss of boron carbide from Boraflex is characterized by slow dissolution of the Boraflex matrix from the surface of the Boraflex and a gradual thinning of the material. The boron carbide loss, of course, can result in a significant increase in the reactivity of the storage racks. An additional consideration is the potential for silica transfer through the fuel transfer canal into the reactor core during refueling operations and its effect on the fuel clad heat transfer capability. [NRC GL 96-04]
Borated Water Intrusion	Influx of borated water.
Boric acid corrosion	Corrosion by boric acid, which can occur where there is borated water leakage in an environment described as air with borated water leakage. See also Corrosion.
Cavitation	Formation and instantaneous collapse of innumerable tiny voids or cavities within a liquid subjected to rapid and intense pressure changes. Cavitation caused by severe turbulent flow often leads to cavitation damage.
Chemical contamination	Degradation due to presence of chemical constituents.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Cladding breach	This refers to the aging mechanisms comprising breach of the stainless steel cladding via any applicable process. Unique problems with stainless cladding have been identified for HHSI pumps as discussed in NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks.” In GALL Rev. 1, it is only used in new AMR line-items in the Engineered Safety Features (EP-49) and Auxiliary System (VII AP-85) to describe the loss of material in PWR emergency core cooling system pump casing constructed of steel with stainless steel cladding (EP-49) and the PWR chemical and volume control system pump casing constructed of steel with stainless steel cladding (AP-85).
Cladding degradation	This refers to the degradation of the stainless via any applicable degradation process. In GALL Rev. 1, it is only used in VII A-40 to describe the loss of material due to pitting and crevice corrosion (only for steel after lining/cladding degradation) of piping, piping components, and piping elements fabricated from steel, with elastomer lining or stainless steel cladding.
Corrosion	Chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties.
Corrosion of carbon steel tube support plate	Corrosion (as defined above) of the carbon steel tube support plates which are plate-type component providing tube-tube mechanical support for the tubes in the tube bundle of the steam generator (recirculating) system of a PWR. The tubes pass through drill holes in the plate. The secondary coolant flows through the tube supports via flow holes between the tubes. [Shah & Macdonald, 1993; Gavrilas, et. Al., 2000]
Corrosion of embedded steel	If pH of the concrete in which steel is embedded is reduced (pH< 11.5) by intrusion of aggressive ions (e.g., chlorides > 500 ppm) in the presence of oxygen, embedded steel corrosion may occur. A reduction in pH may be caused by the leaching of alkaline products through cracks, entry of acidic materials, or carbonation. Chlorides may also be present in the constituents of the original concrete mix. The severity of the corrosion is affected by the properties and types of cement, aggregates, and moisture content. [NUMARC 90-01]
Creep	Creep for metallic materials refers to a time-dependent continuous deformation process under constant stress. It is an elevated temperature process and is not a concern for low alloy steel below 700 ^{0}F, for austenitic alloys below 1000 ^{0}F, and Ni-based alloy below 1800 ^{0}F. [NUMARC 90-07; ASTM Standards, 1976] Creep in concrete is related to the loss of absorbed water from the hydrated cement paste. It is a function of modulus of elasticity of the aggregate. It may result in loss of prestress in the tendons used in prestressed concrete containment. [Shah & Macdonald, 1993]

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Crevice Corrosion	Localized corrosion of a metal surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity between the metal and the surface of another material. Crevice corrosion occurs in a wetted or buried environment when a crevice or area of stagnant or low flow exists that allows a corrosive environment to develop in a component. It occurs most frequently in joints and connections, or points of contact between metals and non-metals, such as gasket surfaces, lap joints, and under bolt heads. Carbon steel, cast iron, low alloy steels, stainless steel, copper, and nickel base alloys are all susceptible to crevice corrosion. Steel can be subject to crevice corrosion in some cases after lining/cladding degradation (e.g., A-40).
Cyclic loading	One source of cyclic loading is due to periodic application of pressure loads and forces due to thermal movement of piping transmitted through penetrations and structures to which penetrations are connected. The typical results of cyclic loads on metal components is fatigue cracking and failure, however the cyclic loads may also cause deformation that results in functional failure.
Deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) are subject to loss of sealing and leakage through containment caused by aging degradation of these components.
Distortion	The aging mechanism of distortion can be caused by time-dependent strain, or gradual elastic and plastic deformation, of metal that is under constant stress at a value lower than its normal yield strength.
Elastomer degradation	Elastomer materials are substances whose elastic properties similar to that of natural rubber. The term elastomer sometimes is used technically to distinguish synthetic rubbers and rubber-like plastics from natural rubber. Degradation may include cracking, crazing, fatigue breakdown, abrasion, chemical attacks, and weathering. [Davis, 2000; ASTM Standards, 2004]
Electrical transients	Electrical transients are one of the aging mechanisms that can cause fatigue in copper fuse holder clamps.
Elevated temperature	In concrete, reduction of strength and modulus can be attributed to elevated temperatures (>150°F general; >200°F local)
Erosion	Progressive loss of material from a solid surface due to mechanical interaction between that surface and a fluid, a multicomponent fluid, or solid particles carried with the fluid. Examples include loss of material in components such as copper alloy heat exchanger tubes due to erosion. Erosion is an applicable aging mechanism for various components including heat exchanger tubes that are exposed to high velocity fluids containing particles such as raw water. Refer to SAND 93-7070, AMP XI. M20, Open-Cycle Cooling Water System, and GL 89-13.
Erosion of porous concrete subfoundation	Erosion (as defined above) of the concrete subfoundation

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Erosion settlement	Erosion (as defined above). Settlement of containment structure may occur during the design life due to changes in the site conditions (e.g., due to erosion or changes in the water table). The amount of settlement depends on the foundation material and is generally determined by survey.
Erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	In earthen water-control structures, the loss of material and loss of form can result from erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, and seepage.
Fatigue	Phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material. Fatigue fractures are progressive and grow under the action of the fluctuating stress.
Fatigue due to vibratory and cyclic thermal loads	Structural degradation that can occur as a result of repeated stress/strain cycles caused by fluctuating loads (e.g., from vibratory loads) and temperatures (giving rise to thermal loads). After repeated cyclic loading of sufficient magnitude, microstructural damage may accumulate, leading to macroscopic crack initiation at the most vulnerable regions. Subsequent mechanical or thermal cyclic loading may lead to growth of the initiated crack. Vibration may result in component cyclic fatigue, as well as in cutting, wear, and abrasion, if left unabated. Vibration is generally induced by external equipment operation. It may also result from flow resonance or movement of pumps or valves in fluid systems. Crack initiation and growth resistance is governed by factors including stress range, mean stress, loading frequency, surface condition and the presence of deleterious chemical species.
Flow-accelerated corrosion (FAC)	Also termed erosion-corrosion. A co-joint activity involving corrosion and erosion in the presence of a moving corrosive fluid, leading to the accelerated loss of material. Susceptibility may be determined using the review process outlined in Section 4.2 of NSAC-202L-R2 recommendations for an effective FAC program.
Fouling	An accumulation of deposits. This term includes accumulation and growth of aquatic organisms on a submerged metal surface and also includes the accumulation of deposits, usually inorganic, on heat exchanger tubing. Biofouling, as a subset of fouling, can be caused by either macro-organisms (such as barnacles, Asian clams, zebra mussels, and others found in fresh and salt water) or micro-organisms (e.g., algae). Fouling can also be categorized as particulate fouling (sediment, silt, dust, and corrosion products), marine biofouling, or macrofouling, e.g., peeled coatings, debris, etc. Fouling in a raw water system can occur on the piping, valves, and heat exchangers. Fouling can result in a reduction of heat transfer, loss of material, or a reduction in the system flow rate (this last aging effect is considered active and thus is not in the purview of license renewal).

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Freeze-Thaw, Frost action	Repeated freezing and thawing is known to be capable of causing severe degradation to the concrete characterized by scaling, cracking, and spalling. The cause of this phenomenon is water freezing within the pores of the concrete, creating hydraulic pressure which if unrelieved will lead to freeze-thaw degradation. Factors that enhance the resistance of concrete to freeze-thaw degradation are a) adequate air content (e.g., within ranges specified in ACI 301-84), b) low permeability, c) protection until adequate strength has developed, and surface coating applied to frequently wet-dry surfaces.
Fretting	Aging effect due to accelerated deterioration at the interface between contacting surfaces as the result of corrosion and slight oscillatory movement between the two surfaces.
Galvanic Corrosion	Accelerated corrosion of a metal because of an electrical contact with a more noble metal or nonmetallic conductor in a corrosive electrolyte. Also called bimetallic corrosion, contact corrosion, dissimilar metal corrosion, or two-metal corrosion. Galvanic corrosion is an applicable aging mechanism for steel materials coupled to more noble metals in heat exchangers; galvanic corrosion of copper is of concern when coupled with the nobler stainless steel
General corrosion	Also known as uniform corrosion, corrosion proceeds at approximately the same rate over a metal surface. Loss of material due to general corrosion is an aging effect requiring management for low alloy steel, carbon steel, and cast iron in outdoor environments. Some potential for pitting and crevice corrosion may exist even when pitting and crevice is not explicitly listed in the aging effects/aging mechanism column in GALL Rev. 1 AMR line-items and when the descriptor may only be loss of material due to general corrosion. For example, the new AMP XI.M36 “External Surfaces Monitoring” inspects for general corrosion of steel and manages aging effects through visual inspection of external surfaces for evidence of material loss and leakage. It acts as a de facto screening for pitting and crevice corrosion, since the symptoms of general corrosion will be first noticed. Wastage is thinning of component walls due to general corrosion.
Intergranular attack (IGA)	In austenitic stainless steels, the precipitation of chromium carbides, usually at grain boundaries, on exposure to temperatures of about 550-850°C, leaving the grain boundaries depleted of Cr and therefore susceptible to preferential attack (intergranular attack) by a corroding (oxidizing) medium.
Intergranular Stress Corrosion Cracking (IGSCC)	Stress corrosion cracking in which the cracking occurs along grain boundaries.
Irradiation-assisted stress corrosion cracking (IASCC)	Failure by intergranular cracking in aqueous environments of stressed materials exposed to ionizing radiation has been termed irradiation assisted stress corrosion cracking (IASCC). Irradiation by high-energy neutrons can promote stress corrosion cracking by affecting material microchemistry (e.g., radiation-induced segregation of elements such as P, S, Si, and Ni to the grain boundaries), material composition and microstructure (e.g., radiation hardening), as well as water chemistry (e.g., radiolysis of the reactor water to make it more aggressive).

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Leaching of calcium hydroxide	Water passing through cracks, inadequately prepared construction joints, or areas that are not sufficiently consolidated during placing may dissolve some calcium-containing products, of which calcium hydroxide is the most-readily soluble, in concrete. Once the calcium hydroxide has been leached away, other cementatious constituents become vulnerable to chemical decomposition, finally leaving only the silica and alumina gels behind with little strength. The water's aggressiveness in the leaching of calcium hydroxide depends on its salt content and temperature. This leaching action is effective only if the water passes through the concrete.
Mechanical loading	Applied loads of mechanical origins rather than from other sources such as thermal.
Mechanical wear	Degradation of copper clamps in fuse holders can be partially attributed to frequent manipulation, which is a subset of mechanical wear, as referenced in LP-01. Other examples include mechanical wear of electrical lines due to wind blowing on transmission conductors as referenced in LP-11. Another example is the mechanical wear of locks, hinges, and closure mechanisms
Microbiologically influenced corrosion (MIC)	Any of the various forms of corrosion influenced by the presence and activities of such microorganisms as bacteria, fungi, and algae, and/or the products produced in their metabolism. Degradation of material that is accelerated due to conditions under a biofilm or microfouling tubercle, for example, anaerobic bacteria that can set up an electrochemical galvanic reaction or inactivate a passive protective film, or acid-producing bacterial that might produce corrosive metabolites.
Moisture Intrusion	Influx of moisture through any viable process.
Neutron irradiation embrittlement	Irradiation by neutrons results in embrittlement of carbon and low alloy steels. It may produce changes in mechanical properties by increasing tensile and yield strengths with corresponding decrease in fracture toughness and ductility. The extent of embrittlement depends on neutron fluence, temperature, and trace material chemistry.
Ohmic heating	Ohmic heating is induced by current flow through a conductor and can be calculated using first principles of electricity and heat transfer. Ohmic heating is a thermal stressor and can be induced in situations, such as conductors passing through electrical penetrations. Ohmic heating is especially significant for power circuit penetrations.
Outer Diameter Stress Corrosion Cracking (ODSCC)	Stress corrosion cracking initiating in the outer diameter (secondary side) surface of steam generator tubes. This differs from PWSCC which describes inner diameter (primary side) initiated cracking.
Overload	Overload is one of the aging mechanisms that can cause loss of mechanical function in ASME Class 1 piping and components (such as constant and variable load spring hangers, guides, stops, sliding surfaces, design clearances, vibration isolators) fabricated from steel or other materials such as Lubrite®
Oxidation	Two types of reactions: a) reaction in which there is an increase in valence resulting from a loss of electrons, or b) a corrosion reaction in which the corroded metal forms an oxide.
Photolysis	Chemical reactions induced or assisted by light.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Pitting corrosion	Localized corrosion of a metal surface, confined to a point or small area, which takes the form of cavities called pits.
Plastic deformation	Time-dependent strain, or gradual elastic and plastic deformation, of metal that is under constant stress at a value lower than its normal yield strength.
Presence of any salt deposits	The surface contamination resulting from the aggressive environment associated with the presence of any salt deposits can be an aging mechanism causing the aging effect of degradation of insulator quality. Although this aging mechanism may be due to temporary, transient environmental conditions, the net result may be long-lasting and cumulative.
Primary water stress corrosion cracking (PWSCC)	PWSCC is an intergranular cracking mechanism which requires the presence of high applied and/or residual stress, susceptible tubing microstructures (few intergranular carbides), and high temperature. For conditions of concern in context of license renewal, this aging mechanism is most likely for nickel alloys in PWR environment.
Radiation hardening, temperature, humidity, sustained vibratory loading.	Reduction or loss of isolation function in polymeric vibration isolation elements can result from a combination of radiation hardening, temperature, humidity, sustained vibratory loading.
Radiation-Induced oxidation	Two types of reactions that are affected by radiation: a) reaction in which there is an increase in valence resulting from a loss of electrons, or a corrosion reaction in which the corroded metal forms an oxide. This is a very limited form of oxidation and is referenced in LP-05 for MEB insulation.
Radiolysis and photolysis (UV sensitive materials only) of organics	Chemical reactions induced or assisted by radiation. Radiolysis and photolysis aging mechanisms can occur in UV-sensitive organic materials.
Reaction With Aggregate	For concrete reactions with aggregates are possible due to the presence in the concretes of alkalis. These alkalis are introduced mainly by cement, but also may come from admixtures, salt-contamination, seawater penetration, or solutions of deicing salts. These reactions include alkali-silica reactions, cement-aggregate reactions, and aggregate-carbonate reactions. These reactions may lead to expansion and cracking.
Relaxation	Relaxation in structural steel anchorage components can be an aging mechanism contributing to the aging effect of loss of prestress.
Restraint shrinkage	Restraint shrinkage can cause cracking in concrete transverse to the longitudinal construction joint.
Selective leaching	Also known as dealloying, (e.g., dezincification or graphitic corrosion). Selective corrosion of one or more components of a solid solution alloy. The selective leaching process involves the preferential removal of one of the alloying elements from the material, which leads to the enrichment of the remaining alloying elements. Dezincification (loss of zinc from brass greater than 15% zinc) and graphitization (removal of iron from cast iron) and removal of aluminum from aluminum-bronze (greater than 8% aluminum) are examples of such a process. Susceptible materials, high temperatures, stagnant-flow conditions, and corrosive environment such as acidic solutions, for example, for brasses with high zinc content, and dissolved oxygen, are conducive to selective leaching.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Service-induced cracking or other concrete aging mechanisms	Cracking of concrete under load over time of service (e.g., from shrinkage or creep) or other concrete aging mechanisms which may include freeze-thaw, leaching, aggressive chemicals, reaction with aggregates, corrosion of embedded steels, elevated temperatures, irradiation, abrasion and cavitations.
Settlement	Settlement of containment structure may occur during the design life due to changes in the site conditions (e.g., the water table). The amount of settlement depends on the foundation material and is generally determined by survey.
Stress corrosion cracking (SCC)	Cracking of a metal produced by the combined action of corrosion and tensile stress (applied or residual).
Stress relaxation	Many of the bolts in reactor internals are stressed to a cold initial preload. When subject to high operating temperatures, over time, these bolts may loosen and the preload may be lost. Radiation can also cause stress relaxation, in highly stressed members such as bolts.
Surface contamination	Contamination of the surfaces by corrosive constituents.
Sustained vibratory loading	Vibratory loading over time.
Thermal Aging	See Thermal aging embrittlement.
Thermal aging embrittlement	Also termed thermal aging or thermal embrittlement. At operating temperatures of 500 to 650°F, cast austenitic stainless steels (CASS) exhibit a spinoidal decomposition of the ferrite phase into ferrite-rich and chromium-rich phases. This may give rise to significant embrittlement, i.e., reduction in fracture toughness, depending on the amount, morphology, and distribution of the ferrite phase and the composition of the steel. Thermal aging of materials other than CASS is a time- and temperature-dependent degradation mechanism that decreases material toughness. It includes temper embrittlement and strain aging embrittlement. Ferritic and low alloy steels are subject to both of these embrittlement, but wrought stainless steel is not affected by either of the processes.
Thermal effects, gasket creep, and self-loosening	Loss of preload due to gasket creep, thermal effects (including differential expansion and creep or stress relaxation), and self-loosening (which includes vibration, joint flexing, cyclic shear loads, thermal cycles).
Thermal and mechanical loading	Loads (stress) due to mechanical or thermal (temperature) sources.
Thermal cycling	Cycling of the thermal (temperature) loads.
Thermal degradation of organic materials	This category includes both short-term thermal degradation and long-term thermal degradation. Thermal energy absorbed by polymers can result in cross linking and chain scission. Cross linking will generally result in increased tensile strength and hardening of material, with some loss of flexibility and eventual decrease in elongation-at-break (and increased compression set). Scission generally reduces tensile strength. Other reactions that may occur include crystallization and chain depolymerization.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
Thermal fatigue	Thermal (temperature) fatigue can result from phenomena such as thermal loading, thermal cycling, where there is cycling of the thermal loads and thermal stratification and turbulent penetration. Thermal stratification is a thermo-hydraulic condition with definitive hot and cold water boundary inducing thermal fatigue of the piping. Turbulent penetration is a thermo-hydraulic condition where hot and cold water mix as a result of turbulent flow conditions, leading to thermal fatigue of the piping. The GALL AMP XI.M32 "One-Time Inspection" inspects for cracking induced by thermal stratification, and for turbulent penetration via volumetric (RT or UT) techniques.
Thermoxidative degradation of organics/thermoplastics	Degradation of organics/thermoplastics via oxidation reactions (loss of electrons by a constituent of a chemical reaction) and thermal means. See Thermal degradation of organic materials.
Vibration	Vibration may result in component cyclic fatigue as well as cutting, wear, and abrasion if left unabated. Vibration is generally induced by external equipment operation. It may also result from flow resonance or movement of pumps or valves in fluid systems.
Void Swelling	Vacancies created in reactor (metallic) materials as a result of irradiation may accumulate into voids which may, in turn lead to dimensional changes (swelling) of the material. Void swelling may occur after an extended incubation period.
Wastage and pitting corrosion	Wastage is thinning of component walls due to general corrosion. For pitting corrosion see pitting corrosion.
Water trees	Water trees occur when the insulating materials are exposed to long-term, continuous electrical stress and moisture; these trees eventually result in breakdown of the dielectric and ultimate failure. The growth and propagation of water trees is somewhat unpredictable. Water treeing is a degradation and long-term failure phenomenon.
Wear	Wear is defined as the removal of surface layers due to relative motion between two surfaces or under the influence of hard abrasive particles. Wear occurs in parts that experience intermittent relative motion or in clamped joints where relative motion is not intended but may occur due to a loss of the clamping force.
Weathering	Degradation of external surfaces of materials when exposed to outside environment.
Wind induced abrasion	See abrasion. Carrier of abrading particles is wind rather than water/liquids.

A.5 Aging Management Programs

As shown in Chapter IV of NUREG-1833, a number of changes were made to AMPs to reflect decisions made through the ISG process. The following table explains how these AMPs are referenced in the GALL Rev. 1 AMR tables.

A.5.1 Listing, Location, and Frequency of AMPs

Table A.5.1 presents a listing of the listing, location, and frequency of amps used in AMR tables. The Roman numeral in the second column identifies the chapter in GALL Vol. 2 that the structures and/or components are associated with (i.e., "II" for Containment Structures, "III" for Structures and Component Supports, "IV" for Reactor Vessel, Internals, and Reactor Coolant Systems, "V" for Engineered Safety Features Systems, "VI" for Electrical Systems, "VII" for Auxiliary Systems, and "VIII" for Steam and Power Conversion Systems).

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	2
Chapter XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	VI	1
Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	1
Chapter XI.E4, "Metal Enclosed Bus"	VI	2
Chapter XI.E5, "Fuse Holders"	VI	1
Chapter XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components	IV	12
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 2 components	IV	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies.	IV	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry" for BWR water	IV	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for BWR water	IV	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	6

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water Because cracking initiated in crevice regions is not amenable to visual inspection, for BWRs with a crevice in the access hole covers, an augmented inspection is to include ultrasonic testing (UT) or other demonstrated acceptable inspection of the access hole cover welds.	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water 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 periodically inspected as part of the ISI program, the existing AMP is adequate for managing the effect of pressurizer clad cracking.	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 2 components and Chapter XI.M2, “Water Chemistry,” for PWR secondary water. As noted in NRC IN 90-04, if general and pitting corrosion of the shell is known to exist, the AMP guidelines in Chapter XI.M1 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.	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water. The AMP in Chapter XI.M1 is to be augmented to detect cracking due to stress corrosion cracking 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 is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and For nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	IV	3

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and Comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	IV	3
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water and Chapter XI.M11-A, “Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)”	IV	2
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for BWR water and XI.M35, “One-Time Inspection of ASME Code Class 1 Small-bore Piping”	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR water and XI.M35, “One-Time Inspection of ASME Code Class 1 Small-bore Piping”	IV	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components The AMP in Chapter 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 is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	IV	1
Chapter XI.M2, “Water Chemistry,” for BWR water	VII	1
	VIII	2
Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	5
	V	3
	VII	4
Chapter XI.M2, “Water Chemistry,” for PWR secondary water	VIII	4
Chapter XI.M2, “Water Chemistry,” for PWR primary water The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	VII	2

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M2, "Water Chemistry," for PWR primary water. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading, or loss of material due to pitting and crevice corrosion. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	VII	1
Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	1
	VIII	2
Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	3
	VII	1
	VIII	5
Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	1
Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	1
Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	3
	V	1
	VII	7
	VIII	6
Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	1
Chapter XI.M2, "Water Chemistry," for PWR primary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	1
	VIII	1
Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	1
	VIII	5
Chapter XI.M2, "Water Chemistry," and Chapter XI.M32 "One-Time Inspection" and For nickel alloy welded spray heads, provide a commitment in the FSAR supplement to submit a plant-specific AMP delineating commitments to Orders, Bulletins, or Generic Letters that inspect stipulated components for cracking of wetted surfaces.	IV	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M2, “Water Chemistry,” and Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” and, For nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	IV	1
Chapter XI.M2, “Water Chemistry,” and Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” and, Comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	IV	1
Chapter XI.M2, “Water Chemistry” and Chapter XI.M32 “One-Time Inspection” and, For nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	IV	1
Chapter XI.M2, “Water Chemistry” and Chapter XI.M32 “One-Time Inspection” or Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD.”	IV	1
Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later) minimize the potential of SCC, and material selection according to NUREG-0313, Rev. 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 guidelines, a plant-specific aging management program is to be 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.	IV	1
Chapter XI.M2, “Water Chemistry” for PWR primary water. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M2, "Water Chemistry" for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	33
Chapter XI.M2, "Water Chemistry," for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	1
Chapter XI.M2, "Water Chemistry," for BWR water, and Chapter XI.S3, "ASME Section XI, Subsection IWF"	III	1
Chapter XI.M2, "Water Chemistry" and, Monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	III	1
Chapter XI.M3, "Reactor Head Closure Studs"	IV	3
Chapter XI.M4, "BWR Vessel ID Attachment Welds," and Chapter XI.M2, "Water Chemistry," for BWR water	IV	1
Chapter XI.M5, "BWR Feedwater Nozzle"	IV	1
Chapter XI.M6, "BWR Control Rod Drive Return Line Nozzle"	IV	1
Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water	IV	3
	V	1
	VII	1
Chapter XI.M8, "BWR Penetrations," and Chapter XI.M2, "Water Chemistry," for BWR water	IV	1
Chapter XI.M9, "BWR Vessel Internals," for core plate and Chapter XI.M2, "Water Chemistry" for BWR water	IV	1
Chapter XI.M9, "BWR Vessel Internals," for core shroud and Chapter XI.M2, "Water Chemistry" for BWR water	IV	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M9, “BWR Vessel Internals,” for lower plenum and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	2
Chapter XI.M9, “BWR Vessel Internals,” for shroud support and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	1
Chapter XI.M9, “BWR Vessel Internals,” for jet pump assembly and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	1
Chapter XI.M9, “BWR Vessel Internals,” for the LPCI coupling and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	1
Chapter XI.M9, “BWR Vessel Internals,” for core spray internals and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	1
Chapter XI.M9, “BWR Vessel Internals,” for top guide and Chapter XI.M2, “Water Chemistry,” for BWR water. For top guides with neutron fluence exceeding the IASCC threshold (5E20, E>1 MeV) inspect ten (10) percent of the top guide locations using enhanced visual inspection technique, EVT-1 within 12 years, one-half of the inspections (5% of locations) to be completed within 6 years. Locations selected for examination will be areas that have exceeded the neutron fluence threshold in the areas of highest projected neutron fluence. The extent and frequency of examination of the top guide is similar to the examination of the control rod drive housing guide tube in BWRVIP-47.	IV	1
Chapter XI.M10, “Boric Acid Corrosion”	III	2
	IV	1
Chapter XI.M10, “Boric Acid Corrosion”	V	4
	VI	1
	VII	4
	VIII	2
Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	IV	2
	V	2
Chapter XI.M13, “Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)”	IV	9
Chapter XI.M17, “Flow-Accelerated Corrosion”	IV	3
	V	2
	VIII	2
Chapter XI.M18, “Bolting Integrity”	III	2
	IV	10
	V	5
	VII	6

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
	VIII	5
Chapter XI.M18, “Bolting Integrity.” The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	VII	1
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	2
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	IV	9
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water.	IV	1
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water. For plants that could experience denting at the upper support plates, the applicant should evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02, “Rapidly Propagating Cracks in SG Tubes.”	IV	1
Chapter XI.M20, “Open-Cycle Cooling Water System”	V	7
	VII	14
	VIII	7
Chapter XI.M21, “Closed-Cycle Cooling Water System”	IV	2
	V	9
	VII	11
	VIII	8
Chapter XI.M22, “Boraflex Monitoring”	VII	2
Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	VII	2
Chapter XI.M24, “Compressed Air Monitoring”	VII	2
Chapter XI.M25, “BWR Reactor Water Cleanup System”	VII	1
Chapter XI.M26, “Fire Protection”	VII	5
Chapter XI.M26, “Fire Protection,” and Chapter XI.M30, “Fuel Oil Chemistry”	VII	1
Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	VII	4
Chapter XI.M27, “Fire Water System”	VII	3
Chapter XI.M28, “Buried Piping and Tanks Surveillance,” or Chapter XI.M34, “Buried Piping and Tanks Inspection”	V	1
	VII	1
	VIII	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.M29, "Aboveground Steel Tanks"	VII	1
	VIII	1
Chapter XI.M30, "Fuel Oil Chemistry" The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	4
Chapter XI.M31, "Reactor Vessel Surveillance"	IV	3
Chapter XI.M33, "Selective Leaching of Materials"	IV	1
	V	5
	VII	9
	VIII	6
Chapter XI.M36, "External Surfaces Monitoring"	V	7
	VII	9
	VIII	3
Chapter XI.M37, "Flux Thimble Tube Inspection"	IV	1
Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	V	5
	VII	2
	VIII	2
Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented to evaluate the thickness of the lower portion of the tank. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	1
Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	III	1
	V	6
	VII	5
	VIII	7
No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	56
A plant-specific aging management program is to be evaluated.	III	1
	IV	4
	V	5
	VI	3

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables

Aging Management Program (AMP)	Ref. Chpt.	Total Refs.
	VII	14
A plant-specific aging management program is to be evaluated.	VIII	2
A plant-specific aging management program is to be evaluated. Reference NRC IN 91-19, “Steam Generator Feedwater Distribution Piping Damage.”	IV	1
A plant-specific aging management program that determines and assesses the qualified life of the linings in the environment is to be evaluated.	VII	2
A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks.”	V	1
	VII	1
A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	V	1
A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	IV	2
A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	V	1
A plant-specific aging management program is to be evaluated for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution).	VI	1
Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	1
Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 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 which are allowed to have increased temperatures not to exceed 200°F.	III	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Plant-specific aging management program 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 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 this reduction is applied to the design allowables.	II	4
Plant-specific aging management program 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 this reduction is applied to the design allowables.	II	1
Chapter XI.S1, “ASME Section XI, Subsection IWE”	II	1
Chapter XI.S1, “ASME Section XI, Subsection IWE“ and Chapter XI.S4, “10 CFR Part 50, Appendix J”	II	2
Chapter XI.S1, “ASME Section XI, Subsection IWE” Leak tightness will be monitored by 10 CFR Part 50, Appendix J Leak Rate Tests for pressure boundary, seals and gaskets (including O-rings).	II	1
Chapter XI.S1, “ASME Section XI, Subsection IWE,” (Note: IWE examination category E-F, surface examination of dissimilar metal welds, is recommended) Chapter XI.S4, “10 CFR Part 50, Appendix J”	II	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S1, “ASME Section XI, Subsection IWE ” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	II	2
Chapter XI.S1, “ASME Section XI, Subsection IWE” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: Transgranular Stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Section XI, Subsection IWE covers inspection of these items under examination categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B & E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.	II	1
Chapter XI.S1, “ASME Section XI, Subsection IWE” For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary. Chapter XI.S4, “10 CFR Part 50, Appendix J”	II	2

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S1, "ASME Section XI, Subsection IWE" 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 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. 3. 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. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary. Chapter XI.S4, "10 CFR Part 50, Appendix J"	II	1
Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: Stress corrosion cracking (SCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Code 1995 edition, with addenda through 1996, ASME Section XI, Subsection IWE covers inspection of these items under Examination Categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B and E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.	II	1
Chapter XI.S2, "ASME Section XI, Subsection IWL"	II	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S2, “ASME Section XI, Subsection IWL” Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	II	4
Chapter XI.S2, “ASME Section XI, Subsection IWL.” Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R.Therefore, if these conditions are satisfied, aging management is not necessary.	II	5
Chapter XI.S2, “ASME Section XI, Subsection IWL” Accessible areas: Inspections performed in accordance with IWL will indicate the presence of loss of material (spalling, scaling) and surface cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	II	3

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S2, “ASME Section XI, Subsection IWL.” Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	3
Chapter XI.S2, “ASME Section XI, Subsection IWL.” Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S2, “ASME Section XI, Subsection IWL.” Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, surface cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	4
Chapter XI.S3, “ASME Section XI, Subsection IWF”	III	2
Chapter XI.S3, “ASME Section XI, Subsection IWF” or Chapter XI.S6, “Structures Monitoring Program”	III	1
Chapter XI.S4, “10 CFR Part 50, Appendix J” and Plant Technical Specifications	II	1
Chapter XI.S5, “Masonry Wall Program”	III	1
Chapter XI.S6, “Structures Monitoring Program”	III	7
	VI	2
	VII	1
Chapter XI.S6, “Structures Monitoring Program” 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 period of extended operation.	II	3
	III	1
Chapter XI.S6, “Structures Monitoring Program” If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	III	1
Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	III	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections performed in accordance with Structures Monitoring Program will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	III	1
Chapter XI.S6, “Structures Monitoring Program” Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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 period of extended operation.	II	1
	III	1
Chapter XI.S6, “Structures Monitoring Program” Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	III	1
Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with the Structures Monitoring Program will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	III	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and water-to-cement ratio of 0.35-0.45, and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig.1.	III	1
Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the cracking, loss of bond, or loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	1
Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs.	III	2

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections/evaluations performed in accordance with "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	III	1
Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs Accessible Areas: Inspections performed in accordance with Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide Inaccessible Areas: As described in NUREG-1557, leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Even if reinforced concrete is exposed to flowing water, such leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed with the guidance of ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	III	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance with “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider: (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	1
Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance with Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, or in above- and below-grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day-inch/yr) or moderate (100-500 day-inch/yr), provided that the concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. The weathering index is defined in ASTM C33-90, Table 3, Footnote E. Fig. 1 of ASTM C33-90 illustrates the various weathering index regions throughout the U.S.	III	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible areas: As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	1
Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. If protective coatings are relied upon to manage the effects of aging, this AMP is to include provisions to address protective coating monitoring and maintenance.	III	1
EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, “Environmental Qualification (EQ) of Electrical Equipment,” for acceptable methods for meeting the requirements of 10 CFR 54.21I(1)(i) and (ii). See Chapter X.E1, “Environmental Qualification (EQ) of Electric Components,” of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	VI	1
Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	III	1
Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	7
	V	2
	VII	4
	VIII	2

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, “Containment Liner Plate and Penetration Fatigue Analysis” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	II	4
Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	6
Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation; check ASME Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	1
Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for structural girders of cranes that fall within the scope of 10 CFR 54. See the Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses,” for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	VII	1
Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant’s pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. See the Standard Review Plan, Section 4.2 “Reactor Vessel Neutron Embrittlement” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	IV	1
Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant’s pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. The applicant may choose to demonstrate that the materials in the inlet, outlet, and safety injection nozzles are not controlling for the TLAA evaluations.	IV	1

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	IV	1
Neutron irradiation embrittlement is a time dependent aging mechanism to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1017 n/cm2 (E >1 MeV) at the end of the license renewal term. Aspects of this evaluation may involve a TLAA. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. Additionally, the applicant is to monitor axial beltline weld embrittlement. One acceptable method is to determine that the mean RTNDT of the axial beltline welds at the end of the extended period of operation is less than the value specified by the Staff in its March 7, 2000 letter (ADAMS ML031430372). See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	IV	1
Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, 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.	II	1
Growth of intergranular separations (underclad cracks) in low-alloy steel forging heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating an underclad flaw is in accordance with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. See the Standard Review Plan, Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis," for generic guidance for meeting the requirements of 10 CFR 54.21(c).	IV	1
None	III	4
	IV	6
	V	18
	VII	24

A.5.1 Listing, Location, and Frequency of AMPs used in GALL Rev. 1 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total Refs.**
	VIII	15
Grand Total		681

A.6. Summary of MEAP Combinations

Table A.6 presents a summary of MEAP combinations contained in the GALL Vol. 2 AMR tables. In column 6 of this table the SRP-LR ID is a row identifier useful in matching the information presented in the corresponding table in the corresponding chapter of the SRP-LR. In column 7, the related item identifies the item number in Volume 2, Chapters II through VIII, presenting the detailed information summarized by this row. The new AMR line-items are identified by nomenclature such as AP-36. The first letter identifies the discipline(s) that the precedent is associated with (i.e., “A” for Auxiliary Systems, “C” for Containment Structures, “E” for Engineered Safety Features Systems, “L” for Electrical Systems, R” for Reactor Coolant Systems, “S” for Steam and Power Conversion Systems, and “T” for “Structures and Component Supports). When present, the second letter “P” identifies that there is a precedent for this new MEAP combination. Thus AP-36 is the 36th new AMR line-item that is applied for Auxiliary Systems in Chapter VII, Section J. Blank entries in a cell within a column represent a continuation of the same characteristic from the non-blank cell above it. For example, all of the rows in the table at the bottom of this page refer to Aluminum as the material.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Aluminum	Air – indoor controlled (External)	None	None	VII	95	AP-36	J.
	Air – indoor uncontrolled	None	None	III	56	TP-8	B1.1. B1.2. B1.3. B2. B3. B4. B5.
	Air – indoor uncontrolled (Internal/External)	None	None	V	50	EP-3	F.
	Air with borated water leakage	Loss of material/ boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	V	45	EP-2	D2.
				VII	88	AP-1	A3. E1.
	Condensation	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	VII	27	AP-74	F1. F2. F3. F4.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Fuel oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	32	AP-35	H1. H2.
	Gas	None	None	VII	97	AP-37	J.
				VIII	44	SP-23	I.
	Raw water	Loss of material/ pitting and crevice corrosion	Chapter XI.M26, “Fire Protection”	VII	62	AP-83	G.
	Treated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	24	AP-38	A4. E3. E4.
				VIII	14	SP-24	D1. D2. E. F. G.
			Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	5	EP-26	D2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Aluminum, copper, bronze, stainless steel, galvanized steel	Air – outdoor	Loss of material/ wind induced abrasion and fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated.	VI	12	LP-09	A.
Aluminum, steel	Air – outdoor	Loss of material/ wind induced abrasion and fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	A plant-specific aging management program is to be evaluated.	VI	12	LP-08	A.
Aluminum/ Silver Plated Aluminum Copper/ Silver Plated Copper; Stainless steel, steel	Air – indoor and outdoor	Loosening of bolted connections/ thermal cycling and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	VI	7	LP-04	A.
Boraflex	Treated borated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Chapter XI.M22, “Boraflex Monitoring”	VII	87	A-86	A2.1-a
	Treated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Chapter XI.M22, “Boraflex Monitoring”	VII	36	A-87	A2.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Boral, boron steel	Treated borated water	Reduction of neutron-absorbing capacity and loss of material/ general corrosion	A plant-specific aging management program is to be evaluated.	VII	13	A-88	A2.1-b
	Treated water	Reduction of neutron-absorbing capacity and loss of material/ general corrosion	A plant-specific aging management program is to be evaluated.	VII	13	A-89	A2.1-b
Cast austenitic stainless steel	Reactor coolant	Cracking/ stress corrosion cracking	Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later) minimize the potential of SCC, and material selection according to NUREG-0313, Rev. 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 guidelines, a plant-specific aging management program is to be 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.	IV	24	R-05	C2.1-e C2.2-g C2.5-i
	Reactor coolant >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	IV	57	R-52	C1.1-g C2.1-f C2.2-e C2.5-l
						R	A2.2-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Reactor coolant >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies. Alternatively, the requirements of ASME Code Case N-481 for pump casings are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings.	IV	55	R-08	C1.2-c C1.3-b C2.3-c C2.4-c
	Reactor coolant >250°C (>482°F) and neutron flux	Loss of fracture toughness/ thermal aging and neutron irradiation embrittlement	Chapter XI.M13, “Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)”	IV	51	R-101	B1.4-c
						R-103	B1.5-a
					80	R-111	B2.1-g
						R-140	B2.5-m
						R-153	B3.2-e
						R-171	B3.5-f
						R-183	B4.3-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
						R-191	B4.4-g
						R-206	B4.6-e
	Treated borated water >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	V	47	E-47	D1.1-b
	Treated water >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Chapter XI.M12, “Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)”	V	20	E-11	D2.1-d
Chrome plated steel; stainless steel; Nickel alloy	Secondary feedwater/ steam	Cracking/ stress corrosion cracking	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	IV	74	RP-14	D1.
		Loss of material/ crevice corrosion and fretting	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	IV	74	RP-15	D1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Concrete	Air – indoor uncontrolled or air – outdoor	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program 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 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 this reduction is applied to the design allowables.	II	4	C-33	B3.2.1-h
						C-34	A2.2-h
						C-35	B2.2.1-g B1.2.
						C-50	B3.1.2-g
				II	4	C-08	A1.1-h

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air – outdoor	Loss of material (spalling, scaling) and cracking/ freeze-thaw	Chapter XI.S2, "ASME Section XI, Subsection IWL" Accessible areas: Inspections performed in accordance with IWL will indicate the presence of loss of material (spalling, scaling) and surface cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspection did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	II	14	C-01	A1.1-a
						C-28	A2.2-a
						C-29	B3.2.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Concrete	Any	Cracking due to expansion/ reaction with aggregates	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R.Therefore, if these conditions are satisfied, aging management is not necessary.	II	15	C-04	A1.1-d
						C-38	A2.2-d
						C-39	B2.2.1-c B1.2.
						C-40	B3.2.1-d
						C-51	B3.1.2-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Concrete	Ground water/soil or air-indoor uncontrolled or air-outdoor	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, surface cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	1	C-03	A1.1-c
						C-26	B.2.2.1-b B.1.2.
						C-27	B3.2.1-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Concrete	Ground water/soil	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, surface cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	1	C-25	A2.2-c B.3.1.2-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Concrete	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, "Structures Monitoring Program" 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 period of extended operation.	II	2	C-06	B2.2.1-e B3.2.1-f B1.2.
						C-36	A2.2-f B3.1.2-e
						C-37	A1.1-f
	Water – flowing	Increase in porosity, permeability/ leaching of calcium hydroxide	Chapter XI.S2, "ASME Section XI, Subsection IWL" Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	II	15	C-02	A1.1-b
						C-32	B3.2.1-b
						C-30	A2.2-b B3.1.2-a
						C-31	B2.2.1-a B1.2.
Concrete block	Air – indoor uncontrolled or air – outdoor	Cracking due to restraint shrinkage, creep, and aggressive environment	Chapter XI.S5, "Masonry Wall Program"	III	43	T-12	A1.3-a A2.3-a A3.3-a A5.3-a A6.3-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Concrete; porous concrete	Water – flowing	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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 period of extended operation.	II	3	C-07	A1.1-g A2.2-g B2.2.1-f B3.1.2-f B3.2.1-g B1.2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Concrete; steel	Air – indoor uncontrolled or air – outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S2, “ASME Section XI, Subsection IWL.” Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	II	1	C-05	A1.1-e
						C-41	B2.2.1-d B1.2.
						C-42	B3.2.1-e
				II	1	C-43	A2.2-e B3.1.2-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Copper alloy	Air – indoor	Fatigue/ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E5, "Fuse Holders"	VI	6	LP-01	A.
	Air – indoor uncontrolled (External)	None	None	V	53	EP-10	F.
				VIII	41	SP-6	I.
	Closed cycle cooling water	Loss of material/ pitting, crevice, and galvanic corrosion	Chapter XI.M21, “Closed-Cycle Cooling Water System”	IV	54	RP-11	C2.
				V	29	EP-13	A. D1. D2.
						EP-36	A. B. D1. D2.
				VII	51	AP-12	A3. A4. C2. E1. E3. E4. F1. F2. F3. F4. H1. H2.
						AP-34	E1. F1. F3.
				VIII	26	SP-8	E. F. G.
		Reduction of heat transfer/ fouling	Chapter XI.M21, “Closed-Cycle Cooling Water System”	V	30	EP-39	A.
				VII	52	AP-80	C2. F1. F2. F3.
				VIII	27	SP-57	E.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Condensation (External)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	VII	25	A-46	F1.2-a F2.2-a F3.2-a F4.2-a
	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	VII	28	AP-78	G.
	Dried Air	None	None	VII	98	AP-8	J.
	Fuel oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	32	AP-44	H1. H2. G.
	Gas	None	None	V	56	EP-9	F.
				VII	97	AP-9	J.
				VIII	44	SP-5	I.
	Lubricating oil	Loss of material/ pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	6	EP-45	A. D1. D2.
				VII	26	AP-47	C1. C2. E1. E4. G. H2.
				VIII	17	SP-32	A. D1. D2. E. G.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	9	EP-47	A. D1. D2.
				VIII	9	SP-53	G.
	Raw water	Loss of material/ pitting and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	78	A-43	C3.1-a C3.2-a
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	80	AP-45	H2.
				VIII	32	SP-31	A. E. F. G.
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	Chapter XI.M27, "Fire Water System"	VII	70	A-45	G.6-b
			Chapter XI. M20, "Open-Cycle Cooling Water System"	VII	81	A-44	C1.1-a C1.2-a
		Loss of material/ pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	82	A-65	C1.3-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Reduction of heat transfer/ fouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	VII	83	A-72	C1.3-b
				VIII	34	SP-56	E. F. G.
	Treated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	14	SP-61	A. F.
		Loss of material/ pitting, crevice, and galvanic corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	31	AP-64	A4. E3. E4.
		Reduction of heat transfer/ fouling	Chapter XI.M2, “Water Chemistry” The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	8	SP-58	E. F. G.
Copper alloy <15% Zn	Air with borated water leakage	None	None	V	57	EP-12	F.
				VII	99	AP-11	J.
		Loss of material/ boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	V	45	EP-38	E.
				VII	88	AP-66	I.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Closed cycle cooling water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	IV	56	RP-12	C2.
				V	41	EP-27	A. B. D1. D2.
						EP-37	A. B. D1. D2.
				VII	84	AP-43	A3. A4. C2.E1. E3. E4. F1. F2. F3. F4. H1. H2.
				VIII	35	SP-29	E. F. G.
	Raw water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	VII	84	A-47	C1.1-a C1.2-a C3.1-a C3.2-a G.6-b H2.
						A-66	C1.3-a
				VIII	35	SP-30	A. E. F. G.
	Treated water	Loss of material/ selective leaching	Chapter XI.M33, "Selective Leaching of Materials"	VII	84	AP-32	A4. C2. E3. E4.
						AP-65	E1. F1. F3.
				VIII	35	SP-55	E. F. G.
Elastomers	Air – indoor and outdoor	Hardening and loss of strength/ elastomer degradation	Chapter XI.S6, "Structures Monitoring Program"	VI	10	LP-10	A.
	Air – indoor uncontrolled	Hardening and loss of strength/ elastomer degradation	A plant-specific aging management program is to be evaluated.	V	11	E-06	B.1-b B.2-b
		Increased hardness, shrinkage and loss of strength/ weathering	Chapter XI.M26, "Fire Protection"	VII	61	A-19	G.1-a G.2-a G.3-a G.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Air – indoor uncontrolled (External)	Loss of material/ wear	A plant-specific aging management program is to be evaluated.	VII	34	A-73	F1.1-c F2.1-c F3.1-c F4.1-c
	Air – indoor uncontrolled (Internal)	Loss of material/ wear	A plant-specific aging management program is to be evaluated.	VII	34	A-18	F1.1-c F2.1-c F3.1-c F4.1-c
	Air – indoor uncontrolled (Internal/ External)	Hardening and loss of strength/ elastomer degradation	A plant-specific aging management program is to be evaluated.	VII	11	A-17	F1.1-b F1.4-b F2.1-b F2.4-b F3.1-b F3.4-b F4.1-b
	Air – outdoor	Increased hardness, shrinkage and loss of strength/ weathering	Chapter XI.M26, "Fire Protection"	VII	61	A-20	G.1-a G.2-a G.3-a G.4-a
	Raw water	Hardening and loss of strength/ elastomer degradation	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	75	AP-75	C1.
		Loss of material/ erosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	75	AP-76	C1.
	Treated borated water	Hardening and loss of strength/ elastomer degradation	A plant-specific aging management program that determines and assesses the qualified life of the linings in the environment is to be evaluated.	VII	12	A-15	A3.2-a A3.2-d A3.3-a A3.3-d A3.5-a A3.5-c
	Treated water	Hardening and loss of strength/ elastomer degradation	A plant-specific aging management program that determines and assesses the qualified life of the linings in the environment is to be evaluated.	VII	12	A-16	A4.2-a A4.2-b A4.3-a A4.3-b A4.5-a A4.5-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Elastomers such as EPDM rubber	Various	Loss of sealing/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Chapter XI.S6, “Structures Monitoring Program”	III	44	TP-7	A6.5.
Elastomers, rubber and other similar materials	Air – indoor uncontrolled or air – outdoor	Loss of sealing; Leakage through containment/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	Chapter XI.S1, “ASME Section XI, Subsection IWE” Leak tightness will be monitored by 10 CFR Part 50, Appendix J Leak Rate Tests for pressure boundary, seals and gaskets (including O-rings).	II	16	C-18	A3.3-a B4.3-a
Galvanized steel	Air – indoor controlled (External)	None	None	V	51	EP-14	F.
	Air – indoor uncontrolled	None	None	III	56	TP-11	B1.1. B1.2. B1.3. B2. B3. B4. B5.
				VII	92	AP-13	J.
Galvanized steel, aluminum	Air with borated water leakage	Loss of material/ boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	III	55	TP-3	B1.1. B1.2. B1.3. B2. B3. B4. B5.
Galvanized steel, aluminum, stainless steel	Air – outdoor	Loss of material/ pitting and crevice corrosion	Chapter XI.S6, “Structures Monitoring Program”	III	50	TP-6	B2. B4.
Glass	Air	None	None	VII	93	AP-48	J.
				VIII	40	SP-33	I.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Air – indoor uncontrolled (External)	None	None	V	52	EP-15	F.
				VII	93	AP-14	J.
				VIII	40	SP-9	I.
	Fuel oil	None	None	VII	93	AP-49	J.
	Lubricating oil	None	None	V	52	EP-16	F.
				VII	93	AP-15	J.
				VIII	40	SP-10	I.
	Raw water	None	None	V	52	EP-28	F.
				VII	93	AP-50	J.
				VIII	40	SP-34	I.
	Treated borated water	None	None	V	52	EP-30	F.
				VII	93	AP-52	J.
	Treated water	None	None	V	52	EP-29	F.
				VII	93	AP-51	J.
				VIII	40	SP-35	I.
Gray cast iron	Closed cycle cooling water	Loss of material/ selective leaching	Chapter XI.M33, “Selective Leaching of Materials”	V	42	EP-52	D1.
				VII	85	A-50	C2.3-a F3.
	Raw water	Loss of material/ selective leaching	Chapter XI.M33, “Selective Leaching of Materials”	VII	85	A-51	C1.5-a C3. G. H2.
				VIII	36	SP-28	A. G.
	Soil	Loss of material/ selective leaching	Chapter XI.M33, “Selective Leaching of Materials"	V	43	EP-54	B. D1. D2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
				VII	85	A-02	C1.1-c C3. G. H1. H2.
				VIII	36	SP-26	E. G.
	Treated water	Loss of material/ selective leaching	Chapter XI.M33, “Selective Leaching of Materials”	V	44	E-43	A. D1.
				VII	85	AP-31	A3. A4. C2. E1. E3. E4. F1. F2. F4. G.
				VIII	36	SP-27	A. E. F. G.
High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 ksi)	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Chapter XI.M3, “Reactor Head Closure Studs”	IV	71	R-71	A2.1-c
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Chapter XI.M3, “Reactor Head Closure Studs”	IV	50	R-60	A1.1-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Loss of material/ wear	Chapter XI.M3, "Reactor Head Closure Studs"	IV	71	R-72	A2.1-d
High-strength low-alloy steel, stainless steel	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	IV	52	R-11	C2.3-e C2.4-e C2.5-n
High-strength steel	Air with steam or water leakage	Cracking/ cyclic loading, stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	V	21	E-03	E.2-b
				VII	41	A-04	I.2-b
				VIII	21	S-03	H.2-b
			Chapter XI.M18, "Bolting Integrity." The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	VII	10	A-104	E1.5-a
Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation (Thermal/ thermoxidative) of organics/thermoplastics, radiation-induced oxidation, moisture intrusion and ohmic heating	Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	2	LP-03	A.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air – indoor uncontrolled (Internal/External)	None	None	VI	14	LP-02	A.
Low alloy steel	Air with reactor coolant leakage	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	7	R-73	A2.1-e
Low alloy steel, yield strength >150 ksi	Air – indoor uncontrolled (External)	Cracking/ stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	III	51	T-27	B1.1.2-a
		Loss of material/ general corrosion	Chapter XI.M18, "Bolting Integrity"	III	51	TP-9	B1.1
Low-alloy steel SA 193 Gr. B7	System temperature up to 288°C (550°F)	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	IV	52	R-27	C1.2-e C1.3-f
Low-alloy steel, stainless steel	Air with reactor coolant leakage	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, "Bolting Integrity"	IV	52	R-12	C2.3-g C2.4-g C2.5-p
Lubrite®	Air – indoor uncontrolled	Lock-up/ wear	Chapter XI.S3, "ASME Section XI, Subsection IWF" or Chapter XI.S6, "Structures Monitoring Program"	III	30	T-13	A4.2-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S6, "Structures Monitoring Program"	III	52	TP-1	B2. B4.
	Air – outdoor	Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S6, "Structures Monitoring Program"	III	52	TP-2	B2. B4.
	Air–indoor uncontrolled or air–outdoor	Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	Chapter XI.S3, "ASME Section XI, Subsection IWF"	III	57	T-32	B1.1.3-a B1.2.2-a B1.3.2-a
Nickel alloy	Air – indoor uncontrolled (External)	None	None	IV	85	RP-03	E.
				V	53	EP-17	F.
				VII	94	AP-16	J.
				VIII	41	SP-11	I.
	Raw water	Loss of material/ pitting and crevice corrosion	Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	78	AP-53	C1. C3.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and Provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	R-89	A2.7-a
			Chapter XI.M2, “Water Chemistry,” and Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" and, Provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	R-88	A2.6-a
			Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	73	R-40	D1.2-i D1.2-j D2.2-f D2.2-g

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
						R-44	D1.2-a D2.2-a
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water and Chapter XI.M11-A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)"	IV	65	R-75	A2.2-a
						R-90	A2.7-b
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	41	R-21	C1.1-f
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals,” for shroud support and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	44	R-96	B1.1-f
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	46	R-95	B1.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water Because cracking initiated in crevice regions is not amenable to visual inspection, for BWRs with a crevice in the access hole covers, an augmented inspection is to include ultrasonic testing (UT) or other demonstrated acceptable inspection of the access hole cover welds.	IV	49	R-94	B1.1-d
	Reactor coolant and secondary feedwater/steam	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	6	R-46	D1.2-d D2.2-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Reactor coolant/ steam	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and Provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	RP-22	C2.
			Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry" for PWR primary water and Provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	RP-31	C2.
	Secondary feedwater/ steam	Cracking/ intergranular attack	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	IV	72	R-48	D1.2-c D2.2-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Cracking/ outer diameter stress corrosion cracking	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	IV	72	R-47	D1.2-b D2.2-b
		Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry" and Chapter XI.M32 "One-Time Inspection" or Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD.”	IV	84	R-36	D2.1-i
		Denting/ corrosion of carbon steel tube support plate	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water.	IV	75	R-226	D2.
			Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water. For plants that could experience denting at the upper support plates, the applicant should evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02, “Rapidly Propagating Cracks in SG Tubes."	IV	79	R-43	D1.2-g

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ fretting and wear	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	IV	72	R-49	D1.2-e D2.2-d
		Loss of material/ wastage and pitting corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	IV	77	R-50	D1.2-f
Nickel alloy or nickel alloy cladding	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and For nickel alloy, provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	R-06	C2.5-k C2.5-s C2.5-m
Nickel alloy; stainless steel	Reactor coolant	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, "BWR Vessel Internals," for jet pump assembly and Chapter XI.M2, "Water Chemistry," for BWR water	IV	44	R-100	B1.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M32 "One-Time Inspection" and For nickel alloy welded spray heads, provide a commitment in the FSAR supplement to submit a plant-specific AMP delineating commitments to Orders, Bulletins, or Generic Letters that inspect stipulated components for cracking of wetted surfaces.	IV	36	R-24	C2.5-j
Nickel alloy; steel with nickel-alloy cladding	Reactor coolant	Cracking/ primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	81	RP-21	D1.
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and For nickel alloy, provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	31	R-01	D1.1-i D1.1-j D2.1-h
Nickel-based alloys	Steam	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for PWR secondary water	VIII	37	SP-18	B1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Non-metallic (e.g., Rubber)	Air – indoor uncontrolled or air – outdoor	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	Chapter XI.S6, “Structures Monitoring Program”	III	41	T-31	B4.2-a
					57	T-33	B1.1.3-a B1.2.2-a B1.3.2-a
Porcelain, Malleable iron, aluminum, galvanized steel, cement	Air – outdoor	Degradation of insulator quality/presence of any salt deposits or surface contamination	A plant-specific aging management program is to be evaluated for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution).	VI	11	LP-07	A.
		Loss of material/ mechanical wear due to wind blowing on transmission conductors	A plant-specific aging management program is to be evaluated.	VI	11	LP-11	A.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Porcelain, xenoy, thermo-plastic organic polymers	Air – indoor and outdoor	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ thermal/thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation; moisture/debris intrusion, and ohmic heating	Chapter XI.E4, "Metal Enclosed Bus"	VI	8	LP-05	A.
Reinforced concrete	Air – indoor uncontrolled	Concrete cracking and spalling/ aggressive chemical attack, and reaction with aggregates	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	VII	65	A-90	G.1-b G.2-b G.3-b G.4-b G.5-a
		Loss of material/ corrosion of embedded steel	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	VII	67	A-91	G.1-c G.2-c G.3-c G.4-c G.5-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 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 which are allowed to have increased temperatures not to exceed 200°F.	III	33	T-10	A1.1-j A2.1-j A3.1-j A4.1-c A5.1-j
	Air – indoor uncontrolled or air – outdoor	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	III	23	T-04	A1.1-d A2.1-d A3.1-d A4.1-d A5.1-d A7.1-d A9.1-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible areas: As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and	III	34	T-18	A6.1-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.				
	Air – outdoor	Concrete cracking and spalling/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	VII	66	A-92	G.1-b G.2-b G.3-b G.4-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material (spalling, scaling) and cracking/ freeze-thaw	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and water-to-cement ratio of 0.35-0.45, and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig.1.	III	26	T-01	A1.1-a A2.1-a A3.1-a A5.1-a A7.1-a A8.1-a A9.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance with Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, or in above- and below-grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day-inch/yr) or moderate (100-500 day-inch/yr), provided that the	III	35	T-15	A6.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. The weathering index is defined in ASTM C33-90, Table 3, Footnote E. Fig. 1 of ASTM C33-90 illustrates the various weathering index regions throughout the U.S.				
		Loss of material/ corrosion of embedded steel	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	VII	67	A-93	G.1-c G.2-c G.3-c G.4-c
	Air-indoor uncontrolled or air-outdoor	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with Structures Monitoring Program will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	III	24	T-06	A1.1-f A2.1-f A3.1-f A4.1-a A5.1-f A7.1-f A9.1-f

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Any	Cracking due to expansion/ reaction with aggregates	Chapter XI.S6, “Structures Monitoring Program” Accessible Areas: Inspections/evaluations performed in accordance with the Structures Monitoring Program will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	III	27	T-03	A1.1-c A2.1-c A3.1-c A4.1-b A5.1-c A7.1-c A8.1-c A9.1-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections/evaluations performed in accordance with “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	III	36	T-17	A6.1-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Ground water/soil	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the cracking, loss of bond, or loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	31	T-05	A1.1-e A2.1-e A3.1-e A5.1-e A7.1-e A8.1-d A9.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	III	31	T-07	A1.1-g A2.1-g A3.1-g A5.1-g A7.1-g A8.1-e A9.1-g
			Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance	III	34	T-19	A6.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			with “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider: (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.				

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Soil	Cracks and distortion due to increased stress levels from settlement	Chapter XI.S6, “Structures Monitoring Program” 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 period of extended operation.	III	28	T-08	A1.1-h A2.1-h A3.1-h A5.1-h A6.1-f A7.1-h A8.1-f A9.1-h
	Water – flowing	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	III	32	T-02	A1.1-b A2.1-b A3.1-b A5.1-b A7.1-b A8.1-b A9.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs Accessible Areas: Inspections performed in accordance with Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide Inaccessible Areas: As described in NUREG-1557, leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Even if reinforced concrete is exposed to flowing water, such leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and	III	37	T-16	A6.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed with the guidance of ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.				
		Loss of material/ abrasion; cavitation	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs.	III	45	T-20	A6.1-h
Reinforced concrete; Grout	Air – indoor uncontrolled or air – outdoor	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	Chapter XI.S6, “Structures Monitoring Program”	III	40	T-29	B1.1.4-a B1.2.3-a B1.3.3-a B2.2-a B3.2-a B4.3-a B5.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Reinforced concrete; Porous concrete	Water – flowing under foundation	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. NRC IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. If a de-watering system is relied upon for control of erosion of cement from porous concrete subfoundations, the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	III	29	T-09	A1.1-i A2.1-i A3.1-i A5.1-i A6.1-g A7.1-i A8.1-g A9.1-i

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	Reactor coolant	Crack growth/ cyclic loading	Growth of intergranular separations (underclad cracks) in low-alloy steel forging heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating an underclad flaw is in accordance with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. See the Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis,” for generic guidance for meeting the requirements of 10 CFR 54.21(c).	IV	21	R-85	A2.5-b
Stainless steel	Air – indoor uncontrolled	Cracking/ stress corrosion cracking	Chapter XI.S1, “ASME Section XI, Subsection IWE” and Chapter XI.S4, “10 CFR Part 50, Appendix J”	II	19	C-24	B3.1.1-b B3.2.2-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.S1, “ASME Section XI, Subsection IWE “ and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: Stress corrosion cracking (SCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Code 1995 edition, with addenda through 1996, ASME Section XI, Subsection IWE covers inspection of these items under Examination Categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B and E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.	II	11	C-22	B1.1.1-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		None	None	III	57	TP-5	B1.1. B1.2. B1.3. B2. B3. B4. B5.
	Air – indoor uncontrolled (External)	None	None	IV	86	RP-04	E.
				V	53	EP-18	F.
				VII	94	AP-17	J.
				VIII	41	SP-12	I.
	Air with borated water leakage	None	None	IV	86	RP-05	E.
				V	57	EP-19	F.
				VII	99	AP-18	J.
			None	III	57	TP-4	B1.1. B1.2. B1.3. B2. B3. B4. B5.
	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Chapter XI.M18, “Bolting Integrity”	IV	52	R-78	A2.2-e
		Loss of material/ wear	Chapter XI.M18, “Bolting Integrity”	IV	52	R-79	A2.2-f
		Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, “Bolting Integrity”	IV	52	R-80	A2.2-g
	Air with reactor coolant leakage (Internal) or Reactor Coolant	Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	IV	23	R-74	A2.1-f

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Closed cycle cooling water	Loss of material/ pitting and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	V	28	E-19	A.6-c D1.5-a D1.6-a D2.4-c
						EP-33	A. C. D1. D2.
				VII	50	A-52	C2.2-a
				VIII	25	S-25	E.4-e F.4-e G.5-c
						SP-39	E. F. G.
		Reduction of heat transfer/ fouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	V	30	EP-35	A. D1. D2.
				VII	52	AP-63	C2. E3. E4.
				VIII	27	SP-41	E. F. G.
	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M21, "Closed-Cycle Cooling Water System"	V	25	EP-44	A. C. D1. D2.
				VII	46	AP-60	C2. E3. E4.
				VIII	23	SP-54	E. F. G.
	Concrete	None	None	IV	86	RP-06	E.
				V	55	EP-20	F.
				VII	96	AP-19	J.
				VIII	43	SP-13	I.
	Condensation	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	VII	27	A-09	F1.4-a F2.4-a F3.4-a
	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	V	8	E-14	D2.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
						EP-53	A. D1.
			Chapter XI.M24, “Compressed Air Monitoring”	VII	54	AP-81	D.
	Diesel exhaust	Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated.	VII	6	AP-33	H2.
	Dried Air	None	None	VII	98	AP-20	J.
	Fuel oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	32	AP-54	G. H1. H2.
	Gas	None	None	IV	86	RP-07	E.
				V	56	EP-22	F.
				VII	97	AP-22	J.
				VIII	44	SP-15	I.
	Lubricating oil	Loss of material/ pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	6	EP-51	D1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	33	AP-59	C1. C2. E1. E4. H2. G.
				VIII	18	S-20	G.5-d
						SP-38	A. D1. D2. E. G.
		Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	III	9	SP-62	G.
				V	9	EP-50	A. D1. D2.
	Raw water	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	V	7	E-01	D1.8-c
			Chapter XI.M20, "Open-Cycle Cooling Water System"	VII	78	A-53	C3.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Loss of material/ pitting and crevice corrosion, and fouling	Chapter XI.M27, “Fire Water System”	VII	69	A-55	G.6-a G.6-b
			Chapter XI.M20, “Open-Cycle Cooling Water System”	VII	79	A-54	C1.1-a C1.2-a C1.4-a C1.6-a
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M20, “Open-Cycle Cooling Water System”	V	37	EP-55	D1.
				VII	80	AP-55	H2.
				VIII	32	SP-36	E. F. G.
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	V	38	E-34	C.1-b
					39	E-20	A.6-a D1.6-b D2.4-a
				VIII	33	S-26	E.4-b F.4-b G.5-a
		Reduction of heat transfer/ fouling	Chapter XI.M20, “Open-Cycle Cooling Water System”	V	40	E-21	A.6-b D1.6-c D2.4-b
				VII	83	AP-61	C1. C3. G. H2.
				VIII	34	S-28	E.4-c F.4-c G.5-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Reactor coolant	Changes in dimensions/ void swelling	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	33	R-107	B2.1-b
						R-110	B2.1-f
						R-117	B2.2-b
						R-121	B2.3-b
						R-124	B2.4-b
						R-126	B2.4-d
						R-139	B2.5-l
						R-144	B2.6-b
						R-147	B3.1-b
						R-158	B3.3-b
						R-174	B4.1-c
						R-177	B4.2-c
						R-182	B4.3-c
						R-199	B4.5-h
						R-215	B4.8-b
		Cracking/ cyclic loading	A plant-specific aging management program is to be evaluated.	IV	25	R-102	B1.4-d
		Cracking/ flow-induced vibration	A plant-specific aging management program is to be evaluated.	IV	29	RP-18	B1.
		Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated.	IV	23	RP-13	A2.
			Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	82	RP-17	D1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	68	R-217	C2.5-r
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	41	R-20	C1.1-f C1.2-b C1.3-c
			Chapter XI.M9, “BWR Vessel Internals,” for lower plenum and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	43	R-104	B1.5-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water. The AMP in Chapter XI.M1 is to be augmented to detect cracking due to stress corrosion cracking 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 is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	IV	20	R-15	C1.4-a
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M9, “BWR Vessel Internals,” for core plate and Chapter XI.M2, “Water Chemistry” for BWR water	IV	44	R-93	B1.1-b
			Chapter XI.M9, “BWR Vessel Internals,” for core shroud and Chapter XI.M2, “Water Chemistry” for BWR water	IV	44	R-92	B1.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M9, “BWR Vessel Internals,” for core spray internals and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	44	R-99	B1.3-a
			Chapter XI.M9, “BWR Vessel Internals,” for lower plenum and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	44	R-105	B1.6-a
			Chapter XI.M9, “BWR Vessel Internals,” for the LPCI coupling and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	44	R-97	B1.1-g
			Chapter XI.M9, “BWR Vessel Internals,” for top guide and Chapter XI.M2, “Water Chemistry,” for BWR water. Additionally, for top guides with neutron fluence exceeding the IASCC threshold (5E20, E>lMeV) prior to the period of extended operation, inspect five percent (5%) of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation. An additional 5% of the top guide locations will be inspected within twelve years after entering the period of extended operation.	IV	44	R-98	B1.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5% of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5% of the top guide locations will be inspected within twelve years after the date projected for exceeding the threshold. The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold. The extent and frequency of examination of the top guide is similar to the examination of the control rod drive housing guide tube in BWRVIP-47.				

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M2, "Water Chemistry" for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	30	R-106	B2.1-a
						R-109	B2.1-e
						R-116	B2.2-a
						R-120	B2.3-a
						R-123	B2.4-a
						R-138	B2.5-k
						R-143	B2.6-a
						R-146	B3.1-a
						R-149	B3.2-a
						R-155	B3.3-a
						R-159	B3.4-a
						R-166	B3.5-a
						R-172	B4.1-a
						R-173	B4.1-b
						R-175	B4.2-a
						R-176	B4.2-b
						R-180	B4.3-a
						R-181	B4.3-b
						R-185	B4.4-a
						R-193	B4.5-a
						R-202	B4.6-a
						R-209	B4.7-a
						R-214	B4.8-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.M2, "Water Chemistry," for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	30	R-125	B2.4-c, B4.5-g
		Loss of material/ wear	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components	IV	63	R-142	B2.5-o
						R-148	B3.1-c
						R-152	B3.2-d
						R-156	B3.3-b
						R-179	B4.2-f
						R-190	B4.4-f
						R-208	B4.6-h

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Loss of preload/ stress relaxation	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	27	R-108	B2.1-d
						R-129	B2.4-h
						R-184	B4.3-e
						R-201	B4.5-j
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	22	R-122	B2.3-c
						R-127	B2.4-e
						R-128	B2.4-f B4.5-i
						R-132	B2.5-c
						R-141	B2.5-n
						R-157	B3.3-a
						R-161	B3.4-c
						R-178	B4.2-e
						R-216	B4.8-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Sodium pentaborate solution	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	30	AP-73	E2.
	Sodium pentaborate solution >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	4	A-59	E2.1-a E2.2-a E2.3-a E2.4-a
	Soil	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	V	4	EP-31	D1. D2.
				VII	29	AP-56	C1. C3. G. H1. H2.
			A plant-specific aging management program is to be evaluated.	VIII	16	SP-37	E. G.
	Steam	Cracking/ stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for PWR secondary water	VIII	39	SP-44	A. B1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	12	SP-45	A. B2.
		Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water	VIII	37	SP-46	A. B2.
			Chapter XI.M2, “Water Chemistry,” for PWR secondary water	VIII	37	SP-43	A. B1.
	Treated borated water	Cracking/ stress corrosion cracking, cyclic loading	Chapter XI.M2, “Water Chemistry,” for PWR primary water The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	VII	9	A-76	E1.5-a
		Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	V	1	E-13	D1.1-c D1.4-a
				VII	2	A-100	E1.8-a
						A-57	E1.1-a E1.3-a E1.7-a E1.8-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	V	12	E-24	D1.2-c
		Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for PWR primary water	V	49	EP-41	A. D1.
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water	V	48	E-12	A.1-a A.1-c A.3-a A.4-a D1.1-a D1.2-a D1.4-b D1.7-b D1.8-a
				VII	90	A-97	A2.1-c
						AP-82	E1.
		Cracking/ stress corrosion cracking, cyclic loading	Chapter XI.M2, “Water Chemistry,” for PWR primary water. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading, or loss of material due to pitting and crevice corrosion. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	VII	7	A-69	E1.8-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M2, "Water Chemistry," for PWR primary water The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	VII	8	A-84	E1.7-c
	Treated water	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	VII	2	A-62	E3.1-b E3.2-b E4.1-b
		Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	24	A-58	A4.1-a A4.6-a E4.1-a E3.
				VIII	15	S-21	E.4-a E.4-d
			Chapter XI.M2, "Water Chemistry," for PWR primary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VIII	15	S-22	E.4-a E.4-d F.4-a F.4-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	3	E-33	C.1-b
				VIII	15	SP-16	B1. C. D1. F. G. E. D2.
			Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	5	EP-32	D2.
		Reduction of heat transfer/ fouling	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	10	EP-34	A. D2.
				VII	3	AP-62	A4. E3.
				VIII	8	SP-40	E. F.
	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water	VII	38	A-61	E4.1-c E4.3-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			A plant-specific aging management program is to be evaluated.	VII	5	A-85	E3.3-d
			Chapter XI.M2, “Water Chemistry,” for BWR water	VII	39	A-96	A2.1-c
			Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	13	SP-19	E.
			Chapter XI.M2, “Water Chemistry,” for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	13	S-39	F.4-a
						SP-17	B1. C. E. D1. F. G.
			Chapter XI.M2, “Water Chemistry” The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	13	SP-42	E.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water	V	18	E-37	D2.1-c D2.3-c
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	Chapter XI.M25, "BWR Reactor Water Cleanup System"	VII	37	A-60	E3.1-a E3.2-a
	Treated water or treated borated water	Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" and, Monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	III	46	T-14	A5.2-b
	Water – standing	Cracking/ stress corrosion cracking Loss of material/pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	III	38	T-23	A7.2-b A8.2-b
Stainless steel with or without chrome plating	Reactor coolant	Loss of material/ wear	Chapter XI.M37, "Flux Thimble Tube Inspection"	IV	60	R-145	B2.6-c
Stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	Cracking/ stress corrosion cracking	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows:	II	10	C-15	A3.1-d B4.1-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			(4) Detection of Aging Effects: Transgranular Stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Section XI, Subsection IWE covers inspection of these items under examination categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B & E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.				

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Stainless steel; nickel alloy	Air with reactor coolant leakage (Internal) or Reactor Coolant	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	IV	19	R-61	A1.1-d
	Reactor coolant	Changes in dimensions/ void swelling	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	33	R-113	B2.1-j
						R-119	B2.2-e
						R-131	B2.5-b
						R-134	B2.5-f
						R-151	B3.2-c
						R-160	B3.4-b
						R-163	B3.4-f
						R-168	B3.5-c
						R-187	B4.4-c
						R-195	B4.5-c
						R-204	B4.6-c
						R-211	B4.7-c
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	41	R-68	A1.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M4, “BWR Vessel ID Attachment Welds,” and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	42	R-64	A1.2-e
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	Chapter XI.M8, “BWR Penetrations,” and Chapter XI.M2, “Water Chemistry,” for BWR water	IV	40	R-69	A1.5-a
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” and Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" and, For nickel ally, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines	IV	34	R-76	A2.2-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	Chapter XI.M2, "Water Chemistry" for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	37	R-112	B2.1-i
						R-118	B2.2-d
						R-130	B2.5-a
						R-133	B2.5-e
						R-162	B3.4-e
						R-167	B3.5-b
						R-186	B4.4-b
						R-194	B4.5-b
						R-203	B4.6-b
						R-210	B4.7-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.M2, "Water Chemistry" for PWR primary water. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	37	R-150	B3.2-b
		Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	5	R-53	B1.1-c B1.2-b B1.3-b B1.4-b B1.5-b B1.6-b B2.1-c B2.1-h B2.1-m B2.2-c B2.2-f B2.3-d B2.4-g B2.5-d B2.5-j B2.5-p B3.2-f B3.4-d B3.5-g B4.1-d B4.2-d B4.3-f B4.4-e B4.5-f B4.6-f
		Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	83	RP-24	B2. B3. B4.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry" for BWR water	IV	47	RP-26	B1.
		Loss of material/ wear	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components	IV	63	R-115	B2.1-l
						R-170	B3.5-e
		Loss of preload/ stress relaxation	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	27	R-114	B2.1-k
						R-136	B2.5-h
						R-137	B2.5-i
						R-154	B3.2-g
						R-165	B3.4-h
						R-192	B4.4-h
						R-197	B4.5-e
						R-207	B4.6-g
						R-213	B4.7-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	IV	22	R-135 R-164 R-169 R-188 R-196 R-205 R-212	B2.5-g B3.4-g B3.5-d B4.4-d B4.5-d B4.6-d B4.7-d
Stainless steel; nickel alloy welds and/or buttering	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	69	R-83	A2.4-b
Stainless steel; steel	Air – indoor uncontrolled	Cracking/ cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, “ASME Section XI, Subsection IWE ” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/ ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	II	13	C-20	B1.1.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	II	13	C-47	B2.2.2-c
		Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	II	8	C-21	B1.1.1-c
	Air – indoor uncontrolled or treated water (as applicable)	Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	II	8	C-48	B2.2.2-d
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J"	II	20	C-49	B2.2.2-b B1.2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air with metal temperature up to 288°C (550°F)	Cracking/ cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components	IV	61	R-19	C2.5-v
	Diesel exhaust	Loss of material/ general (steel only), pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	VII	18	A-27	H2.4-a
	Reactor coolant	Cracking/ cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components The AMP in Chapter 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 is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	IV	26	R-225	C1.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for BWR water and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	IV	48	R-03	C1.1-i
		Loss of material/ general (steel only), pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	IV	13	R-16	C1.4-b
	System temperature up to 288°C (550°F)	Loss of material/ wear	Chapter XI.M18, “Bolting Integrity”	IV	52	R-29	C1.2-d C1.3-e
	System temperature up to 340°C (644°F)	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	7	R-18	C2.3-d C2.4-d C2.5-t C2.5-w

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Treated Water < 60C (<140 F)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water, and Chapter XI.S3, “ASME Section XI, Subsection IWF”	III	49	TP-10	B1.1
Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for PWR primary water	IV	83	RP-28	A2.
			Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	IV	14	RP-25	A1.
Stainless steel; steel with stainless steel cladding	Closed cycle cooling water	Loss of material/ microbiologically influenced corrosion	Chapter XI.M21, “Closed-Cycle Cooling Water System”	VII	49	A-67	E3.4-b E4.4-a
	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M21, “Closed-Cycle Cooling Water System”	VII	46	A-68	E3.4-a
	Reactor coolant	Cracking/ cyclic loading	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components	IV	62	R-56	C2.1-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Cracking/ stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	68	R-07	C2.2-f C2.5-h D1.1-i C2.5-m
						R-09	C2.3-b C2.4-b
						R-30	C2.1-c
		Cracking/ stress corrosion cracking, thermal and mechanical loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR water and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	IV	70	R-02	C2.1-g C2.2-h
	Treated borated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	VII	91	AP-79	E1. A2. A3.
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	68	R-14	C2.6-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Treated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	23	A-70	A4.4-b
	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	A plant-specific aging management program is to be evaluated.	VII	5	A-71	E3.4-a
Steel	Air – indoor controlled (External)	None	None	V	54	EP-4	F.
				VII	95	AP-2	J.
				VIII	42	SP-1	I.
	Air – indoor uncontrolled	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	1	R-70	A1.7-a A2.8-a
				VII	2	A-34	E1.1-a E1.3-a E1.7-a E1.8-a E3.2-c
		Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	III	42	T-26	B1.1.1-c B1.2.1-c B1.3.1-b
		Fretting or lockup/ mechanical wear	Chapter XI.S1, "ASME Section XI, Subsection IWE"	II	21	C-23	B1.1.1-e B2.2.2-e B2.1.1-d B1.2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" 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 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. 3. 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. 4. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for	II	6	C-09	A1.2-a A2.1-a B3.2.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			corrosion is necessary. Chapter XI.S4, “10 CFR Part 50, Appendix J”				
		Loss of material/ wear	Chapter XI.M26, “Fire Protection”	VII	63	A-21	G.1-d G.2-d G.3-d G.4-d G.5-c
	Air – indoor uncontrolled or air outdoor	Loss of leak tightness/ mechanical wear of locks, hinges and closure mechanisms	Chapter XI.S4, “10 CFR Part 50, Appendix J” and Plant Technical Specifications	II	17	C-17	A3.2-b B4.2-b
	Air – indoor uncontrolled (External)	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for structural girders of cranes that fall within the scope of 10 CFR 54. See the Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analyses,” for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	VII	1	A-06	B.1-a
		Loss of material/ general corrosion	Chapter XI.M36, "External Surfaces Monitoring"	V	31	E-26	A.2-a A.5-a B.1-a B.2-a D2.1-e D2.5-a
						E-35	C.1-a
						E-40	B.1-a
						E-44	E.
				VII	55	A-105	F1.1-a F2.1-a F3.1-a F4.1-a I.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
					56	A-10	F1.1-a F1.4-a F2.1-a F2.4-a F3.1-a F3.4-a F4.1-a
					57	A-80	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a
					58	A-77	I.1-b
				VIII	28	S-29	H.1-b
			Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	VII	73	A-07	B.1-b
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M18, “Bolting Integrity”	V	23	EP-25	E.
				VII	43	AP-27	I.
				VIII	22	S-34	H.
			Chapter XI.M36, "External Surfaces Monitoring"	VII	59	AP-41	F1. F2. F3. F4. G. H2.
			Chapter XI.S6, “Structures Monitoring Program”	VII	86	A-94	A1.1-a
		Loss of material/ wear	Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	VII	74	A-05	B.2-a
		Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, “Bolting Integrity”	V	24	EP-24	E.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
				VII	45	AP-26	I.
				VIII	22	S-33	H.
	Air – indoor uncontrolled (Internal)	Loss of material/ general corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	V	32	E-25	B.2-a
						E-29	A.2-a A.5-a D2.5-a
		Loss of material/ general corrosion and fouling	A plant-specific aging management program is to be evaluated.	V	13	E-04	D2.5-b
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	V	33	EP-42	A.
	Air – indoor uncontrolled or air – outdoor	Loss of material/ corrosion	Chapter XI.S6, "Structures Monitoring Program" If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	III	25	T-11	A1.2-a A2.2-a A3.2-a A4.2-a A5.2-a A7.2-a A8.2-a
			Chapter XI.S2, "ASME Section XI, Subsection IWL"	II	22	C-10	A1.3-a B2.2.3-a
		Loss of material/ general and pitting corrosion	Chapter XI.S6, "Structures Monitoring Program"	III	39	T-30	B2.1-a B3.1-a B4.1-a B5.1-a
			Chapter XI.S3, "ASME Section XI, Subsection IWF"	III	53	T-24	B1.1.1-a B1.2.1-a B1.3.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE," Chapter XI.S4, "10 CFR Part 50, Appendix J"	II	18	C-16	A3.2-a B4.2-a
		Loss of prestress/ relaxation; shrinkage; creep; elevated temperature	Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, 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.	II	7	C-11	A1.3-b B2.2.3-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air – indoor uncontrolled or treated water (as applicable)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.S1, "ASME Section XI, Subsection IWE" For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary. Chapter XI.S4, "10 CFR Part 50, Appendix J"	II	5	C-46	B2.1.1-a B2.2.2-a B1.2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.S1, "ASME Section XI, Subsection IWE" For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary. Chapter XI.S4, "10 CFR Part 50, Appendix J"	II	5	C-19	B1.1.1-a B3.1.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air – outdoor	Loss of material/ wear	Chapter XI.M26, “Fire Protection”	VII	63	A-22	G.1-d G.2-d G.3-d G.4-d
	Air – outdoor (External)	Loss of material/ general corrosion	Chapter XI.M36, "External Surfaces Monitoring"	V	31	E-45	E.
				VII	58	A-78	I.1-b
				VIII	28	S-41	H.1-b
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M29, “Aboveground Steel Tanks”	VII	40	A-95	H1.4-b
				VIII	20	S-31	E.5-c G.4-c
			Chapter XI.M18, “Bolting Integrity”	V	23	EP-1	E.
				VII	43	AP-28	I.
				VIII	22	S-32	H.
			Chapter XI.M36, "External Surfaces Monitoring"	VII	59	AP-40	G. H2.
					60	A-24	H1.1-a H1.2-a H1.3-a
	Air – outdoor (Internal)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	VIII	30	SP-59	B1.
	Air with borated water leakage	Loss of material/ boric acid corrosion	Chapter XI.M10, “Boric Acid Corrosion”	III	55	T-25	B1.1.1-b B1.2.1-b B2.1-b B3.1-b B4.1-b B5.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
				IV	58	R-17	A2.1-a A2.5-e A2.8-b C2.1-d C2.2-d C2.3-f C2.4-f C2.5-b C2.5-o C2.5-u C2.6-b D1.1-g D1.1-k D2.1-b D2.1-j
				V	45	E-28	A.1-b A.3-b A.4-b A.5-b A.6-d D1.1-d D1.2-b D1.3-a D1.4-c D1.5-b D1.6-d D1.7-a D1.8-b E.1-a
						E-41	E.
				VII	89	A-102	I.
						A-79	A3.1-a A3.2-b A3.2-c A3.3-c A3.4-b A3.5-b A3.6-a E1.1-b E1.2-a E1.3-b E1.4-a E1.5-b E1.6-a E1.7-b E1.8-d E1.9-a E1.10-a I.1-a
				VIII	38	S-30	H.1-a
						S-40	H.
	Air with borated water leakage (Internal)	Loss of material/ general, pitting, crevice and boric acid corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	V	46	EP-43	A.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Air with leaking secondary-side water and/or steam	Loss of material/ erosion	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 2 components	IV	66	R-31	D2.1-l
	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Chapter XI.M18, "Bolting Integrity"	IV	52	R-10	D1.1-l
	Air with steam or water leakage	Loss of material/ general corrosion	Chapter XI.M18, "Bolting Integrity"	V	22	E-02	E.2-a
					42	A-03	I.2-a
				VIII	22	S-02	H.2-a
	Closed cycle cooling water	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	IV	53	RP-10	C2.
				V	26	EP-48	C.
				VII	47	A-25	C2.1-a C2.2-a C2.3-a C2.4-a C2.5-a F1.3-a F2.3-a F3.3-a F4.3-a H2.1-a
		Loss of material/ general, pitting, crevice, and galvanic corrosion	Chapter XI.M21, "Closed-Cycle Cooling Water System"	V	27	E-17	A.6-c D1.5-a D1.6-a D2.4-c
				VII	48	A-63	A3.4-a A4.4-a E1.8-c E4.4-a C2. E3. F1. F2. F3. F4.
				VIII	24	S-23	A. E.4-e F.4-e G.5-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Reduction of heat transfer/ fouling	Chapter XI.M21, "Closed-Cycle Cooling Water System"	VII	52	AP-77	F1. F2. F3. F4.
				VIII	27	SP-64	A. E.4-e F.4-e G.5-c
	Concrete	None	None	IV	87	RP-01	E.
				V	55	EP-5	F.
				VII	96	AP-3	J.
				VIII	43	SP-2	I.
	Condensation	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M18, "Bolting Integrity"	VII	44	A-103	D.2-a
	Condensation (External)	Loss of material/ general corrosion	Chapter XI.M36, "External Surfaces Monitoring"	V	31	E-30	C.1-a
						E-46	E.
				VII	58	A-81	I.1-b
				VIII	28	S-42	H.1-b
	Condensation (Internal)	Loss of material/ general and pitting corrosion	Chapter XI.M24, "Compressed Air Monitoring"	VII	53	A-26	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	V	34	E-27	D2.1-e
				VIII	30	SP-60	B1. G.
		Loss of material/ general, pitting, crevice, and (for drip pans and drain lines) microbiologically influenced corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	VII	72	A-08	F1.1-a F2.1-a F3.1-a F4.1-a F1.4-a F2.4-a F3.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Dried Air	None	None	VII	98	AP-4	J.
	Fuel oil	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M26, “Fire Protection,” and Chapter XI.M30, “Fuel Oil Chemistry”	VII	64	A-28	G.8-a
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	20	A-30	H1.4-a H2.5-a
	Gas	None	None	V	56	EP-7	F.
				VII	97	AP-6	J.
				VIII	44	SP-4	I.
	Lubricating oil	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	16	EP-46	A. D1. D2.
				VII	14	AP-30	C1. C2. E1. E4. F1. F2. F3. F4. G. H2.
					15	A-83	G.7-b
				VIII	6	SP-25	A. D1. D2. E. G.
			Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented to evaluate the thickness of the lower portion of the tank. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VII	16	A-82	G.7-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VIII	11	S-17	G.5-d
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	21	AP-39	H2.
		Reduction of heat transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	V	9	EP-40	A. D1. D2.
				VIII	9	SP-63	G.
	Moist air or condensation (Internal)	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	VII	71	A-23	H2.2-a H2.3-a G.
	Raw water	Loss of material/	Chapter XI.M27, "Fire Water System"	VII	68	A-33	G.6-a G.6-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	V	35	E-22	C.1-a
			A plant-specific aging management program is to be evaluated.	VIII	7	S-12	G.1-d
		Loss of material/ general, pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	V	36	E-18	A.6-a D1.6-b D2.4-a
				VII	77	A-64	C1.3-a
				VIII	31	S-24	E.4-b F.4-b G.5-a
		Reduction of heat transfer/ fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	V	40	E-23	D2.4-b
				VIII	34	S-27	G.5-b
	Reactor coolant	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	11	R-59	A1.1-a
		Loss of material/ wear	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components	IV	63	R-87	A2.5-f
		Wall thinning/ flow-accelerated corrosion	Chapter XI.M17, "Flow-Accelerated Corrosion"	IV	45	R-23	C1.1-a C1.1-c C1.3-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	IV	17	R-67	A1.3-e
	Secondary feedwater	Loss of material/ erosion	A plant-specific aging management program is to be evaluated.	IV	28	R-39	D1.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Secondary feedwater/ steam	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	7	R-33	D1.1-a D1.1-b D2.1-d D2.1-g
		Ligament cracking/ corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	IV	76	R-42	D1.2-k D2.
		Loss of material/ erosion, general, pitting, and crevice corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	IV	76	RP-16	D1.
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	12	R-224	D2.1-e

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 2 components and Chapter XI.M2, “Water Chemistry,” for PWR secondary water. As noted in NRC IN 90-04, if general and pitting corrosion of the shell is known to exist, the AMP guidelines in Chapter XI.M1 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.	IV	16	R-34	D1.1-c
		Wall thinning/ flow-accelerated corrosion	A plant-specific aging management program is to be evaluated. Reference NRC IN 91-19, "Steam Generator Feedwater Distribution Piping Damage."	IV	32	R-51	D1.3-a
			Chapter XI.M17, “Flow-Accelerated Corrosion”	IV	59	R-37	D1.1-d
						R-38	D2.1-f
			Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	IV	78	R-41	D1.2-h

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
	Steam	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	2	S-04	A.1-b A.2-b C.1-b C.2-b
			Chapter XI.M2, “Water Chemistry,” for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	2	S-06	A.1-b A.2-b C.1-b C.2-b
		Loss of material/ pitting and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water	VIII	37	S-05	B2.1-a B2.2-b
			Chapter XI.M2, “Water Chemistry,” for PWR secondary water	VIII	37	S-07	B1.1-a B1.2-a
		Wall thinning/ flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	V	19	E-07	D2.1-f
				VIII	29	S-15	A.1-a A.2-a B1.1-c B1.2-b B2.1-b B2.2-a C.1-a C.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
	Steam or treated water	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	VIII	1	S-08	B1.1-b B2.1-c
	System temperature up to 288°C (550°F)	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation; check ASME Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	4	R-28	C1.2-f C1.3-g
		Loss of material/ wear	Chapter XI.M18, “Bolting Integrity”	IV	52	R-26	C1.2-d C1.3-e
	System temperature up to 340°C (644°F)	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, “Bolting Integrity”	IV	52	R-32	D1.1-f D2.1-k
	Treated water	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	V	1	E-10	D2.1-b
				VIII	1	S-11	D1.1-b D2.1-c G.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Loss of material/ general, pitting, and crevice corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	14	E-08	D2.1-a D2.2-a D2.3-b
				VII	17	A-35	E3. E4.1-a E4.2-a
				VIII	4	S-09	B2. C. D2.1-b D2.2-b D2.3-b E.1-b E.2-b E.3-a E.5-a E.6-a
			Chapter XI.M2, “Water Chemistry,” for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	3	S-19	E.4-a E.4-d F.4-a F.4-d
					4	S-10	B1. C. D1.1-c D1.2-b D1.3-a E.1-b E.2-b E.3-a E.5-a E.6-a F.1-b F.2-b F.3-a G.1-c G.2-a G.3-a G.4-a
			Chapter XI.M2, “Water Chemistry” The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	V	15	E-31	C.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
		Loss of material/ general, pitting, crevice, and galvanic corrosion	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	VIII	19	S-18	E.4-a E.4-d
		Wall thinning/ flow-accelerated corrosion	Chapter XI.M17, “Flow-Accelerated Corrosion”	V	19	E-09	D2.3-a
				VIII	29	S-16	D1.1-a D1.2-a D1.3-b D2.1-a D2.2-a D2.3-a E.1-a E.2-a F.1-a F.2-a G.1-a
Steel (with or without coating or wrapping)	Soil	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Chapter XI.M28, “Buried Piping and Tanks Surveillance,” or Chapter XI.M34, “Buried Piping and Tanks Inspection”	V	17	E-42	B.
				VII	19	A-01	H1.1-b C1.1-b C3. G.
				VIII	10	S-01	E.5-d G.1-e G.4-d
Steel (with or without lining/coating or with degraded lining/coating)	Raw water	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation	Chapter XI.M20, “Open-Cycle Cooling Water System”	VII	76	A-38	C1.1-a C1.2-a C1.5-a C1.6-a H2.1-b C3.1-a C3.2-a C3.3-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Steel (with or without stainless steel cladding)	Reactor coolant	Cracking/ cyclic loading	Chapter XI.M5, “BWR Feedwater Nozzle”	IV	39	R-65	A1.3-b
			Chapter XI.M6, “BWR Control Rod Drive Return Line Nozzle”	IV	38	R-66	A1.3-c
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	IV	18	R-63	A1.2-d
			Neutron irradiation embrittlement is a time dependent aging mechanism to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1017 n/cm2 (E >1 MeV) at the end of the license renewal term. Aspects of this evaluation may involve a TLAA. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant’s pressure-temperature limits, (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. Additionally, the applicant is to monitor axial beltline weld embrittlement. One acceptable method is to determine that the	IV	17	R-62	A1.2-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			mean RTNDT of the axial beltline welds at the end of the extended period of operation is less than the value specified by the Staff in its March 7, 2000 letter (ADAMS ML031430372). See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).				
Steel and non-steel materials (e.g., Lubrite® plates, vibration isolators, etc.)	Air – indoor uncontrolled or air – outdoor	Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; elastomer hardening	Chapter XI.S3, "ASME Section XI, Subsection IWF"	III	54	T-28	B1.1.3-a B1.2.2-a B1.3.2-a
Steel with elastomer lining	Treated borated water	Loss of material/ pitting and crevice corrosion (only for steel after lining degradation)	Chapter XI.M2, "Water Chemistry," for PWR primary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	22	A-39	A3.2-a A3.3-a A3.5-a
Steel with elastomer lining or stainless steel cladding	Treated water	Loss of material/ pitting and crevice corrosion (only for steel after lining/cladding degradation)	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	22	A-40	A4.2-a A4.3-a A4.5-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Steel with stainless steel cladding	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	Chapter XI.M31, “Reactor Vessel Surveillance”	IV	18	R-82	A2.3-b
						R-86	A2.5-c
			Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant’s pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. See the Standard Review Plan, Section 4.2 “Reactor Vessel Neutron Embrittlement” for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	IV	17	R-84	A2.5-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. The applicant may choose to demonstrate that the materials in the inlet, outlet, and safety injection nozzles are not controlling for the TLAA evaluations.	IV	17	R-81	A2.3-a
	Treated borated water	Loss of material/cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, "Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	V	2	EP-49	D1.
				VII	35	AP-85	E1.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
		Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	7	R-13	C2.6-a
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Chapter XI.M2, “Water Chemistry,” for PWR primary water	V	48	E-38	D1.7-b
				VII	90	A-56	A3.3-b
Steel with stainless steel or nickel alloy cladding	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and For nickel alloy, provide a commitment in the FSAR supplement to implement applicable (1) NRC Orders, Bulletins, and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	35	R-35	D2.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	Cracking/ cyclic loading	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water 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 periodically inspected as part of the ISI program, the existing AMP is adequate for managing the effect of pressurizer clad cracking.	IV	67	R-58	C2.5-c C2.5-g
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	64	R-25	C2.5-c C2.5-g
Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	Reactor coolant	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	IV	83	RP-23	C2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	IV	15	RP-27	C1.
Steel, Stainless steel	Treated water	Loss of material/ general (steel only), pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VIII	5	S-13	E.5-a E.5-b G.4-a G.4-b
Steel; copper alloys	Air – indoor uncontrolled or air - outdoor; Water – flowing or water – standing	Loss of material/ general (steel only), pitting and crevice corrosion	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. If protective coatings are relied upon to manage the effects of aging, this AMP is to include provisions to address protective coating monitoring and maintenance.	III	47	T-21	A6.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Steel; dissimilar metal welds	Air – indoor uncontrolled or air outdoor	Loss of material/ general, pitting, and crevice corrosion	Chapter XI.S1, “ASME Section XI, Subsection IWE,” (Note: IWE examination category E-F, surface examination of dissimilar metal welds, is recommended) Chapter XI.S4, “10 CFR Part 50, Appendix J”	II	18	C-12	A3.1-a B4.1-a
Steel; galvanized steel	Air – indoor and outdoor	Loss of material/ general corrosion	Chapter XI.S6, “Structures Monitoring Program”	VI	9	LP-06	A.
Steel; stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	Cracking/ cyclic loading (CLB fatigue analysis does not exist)	Chapter XI.S1, “ASME Section XI, Subsection IWE ” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is to be supplemented to consider the following: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	II	12	C-14	A3.1-c B4.1-c
						C-44	B2.1.1-b
		Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, “Containment Liner Plate and Penetration Fatigue Analysis” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	II	9	C-13	A3.1-b B4.1-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
			Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, “Containment Liner Plate and Penetration Fatigue Analysis” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	II	9	C-45	B2.1.1-c
Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	Cumulative fatigue damage/ fatigue	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	IV	2	R-04	A1.1-b A1.2-a A1.2-a A1.2-b A1.2-b A1.2-b A1.2-b A1.3-a A1.3-d A1.3-d A1.4-b A1.5-b A1.5-b A1.5-b A1.5-b A1.5-b A1.5-b A1.6-a
					3	R-220	C1.1-b C1.1-d C1.1-e C1.1-e C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.2-a C1.2-a C1.2-a C1.3-d C1.3-d C1.3-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
					8	R-223	C2.1-a C2.1-a C2.1-b C2.1-b C2.2-a C2.2-a C2.2-a C2.2-a C2.2-b C2.2-b C2.2-c C2.3-a C2.3-a C2.4-a C2.4-a C2.5-a C2.5-d C2.5-d C2.5-e C2.5-f C2.5-f C2.5-f C2.5-q
					9	R-219	A2.1-b A2.2-c A2.2-c A2.3-c A2.3-c A2.3-c A2.4-a A2.4-a A2.4-a A2.5-d A2.5-d A2.5-d A2.5-d
					10	R-221	D1.1-h
						R-222	D2.1-c
Various	Water – flowing Water – standing	Loss of material, loss of form/ erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs.	III	48	T-22	A6.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL Rev.1 Chapters**	**SRP-LR ID**	**Related Item**	**Location in AMR Chapters**
Various metals used for electrical contacts	Air – indoor and outdoor	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	Chapter XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	13	LP-12	A.
	Air with borated water leakage	Corrosion of connector contact surfaces/ intrusion of borated water	Chapter XI.M10, “Boric Acid Corrosion”	VI	5	L-04	A.2-a
Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by exposure to moisture and voltage	Localized damage and breakdown of insulation leading to electrical failure/ moisture intrusion, water trees	Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	4	L-03	A.1-c
	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation of organics (Thermal/ thermoxidative), radiolysis and photolysis (UV sensitive material	Chapter XI.E1, “Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements”	VI	2	L-01	A.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL Rev.1 Chapters	SRP-LR ID	Related Item	Location in AMR Chapters
			Chapter XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	VI	3	L-02	A.1-b
Various polymeric and metallic materials	Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	Various degradation/ various mechanisms	EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.E1, “Environmental Qualification (EQ) of Electric Components,” of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	VI	1	L-05	B.1-a

A.7. References:

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APPENDIX B
SRP-LR Development Tools

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Introduction

Certain tables in GALL Volume 1 (GV1) and the SRP-LR summarize the GALL Volume 2 (GV2) AMR table information. The SRP-LR development tools were prepared to support this summarization, or rollup process. These summary tables preserve some of the detailed AMR information; however, they do not preserve the material or environment information, both of which are often useful when organizing an LRA to align it with GV1. The SRP development tools presented in this appendix also facilitate that alignment. Figure 2 on pg. 10 in the introduction to this NUREG-1833 schematically clarifies the relationship between these documents.

To understand the organization of the SRP development tools, it is helpful to understand how the rollup presented in these tools was prepared. The objective for the rollup of the AMR items in the mechanical chapters of GV2 (RCS, ESF, AUX, and SPC) was to group sets of components together that were subject to the same aging management activities and the same further evaluation needs. (The items in the Components, Structures and Electrical chapters in GV2 (Chapters II, III and VI) were already grouped as commodities, and therefore, such SRP development tools were not considered necessary.) Therefore, components within a GV2 mechanical chapter with the same aging effect/mechanism, further evaluation requirements, and aging management program are rolled up and grouped together in the SRP development tool.

A common ID number for each grouping was also used as the identifier for the corresponding row in the SRP-LR and GV1 tables. For each ID number, summary descriptions of the aging management expectations were then developed for use in the SRP-LR and GV1 tables. These groupings were also used to develop the SRP-LR reference statements in the text sections of the SRP-LR. Additionally, the SRP-LR development tools also assisted the Staff in ensuring that the GV2 AMR tables were consistent, complete, and accurate.

The SRP development tools for the Reactor Coolant Systems, Engineered Safety Features Systems, Auxiliary Systems, and Steam and Power Conversion Systems are provided in Tables B1.1 through B1.4, respectively. These tables are organized as follows. The AMR item groupings for which further evaluation is required are presented first, in the order in which they are addressed in the SRP-LR text. These are followed by items for which commitments are to be verified, if any. Next are the items for which no further evaluation is required. Finally, the items for which there are no aging effects that require management are presented. Other than the listing of items requiring further evaluation, the items within each grouping are presented in alphabetical order, based on the first character in the aging effect/mechanism field, then the next field to the right, and so forth.

It should be noted that the process used to develop these tables leaves the cell in a column blank if the entry would duplicate the entry in the row above. Therefore, to determine the value that applies when a cell is blank, the reader must look up the column to the previous non-blank cell.

B.1 Reactor Coolant System SRP-LR Development Tool

Table B.1 presents the reactor coolant system SRP-LR development tool.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Cumulative fatigue damage/ fatigue	3.1.2.2.1	BWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel	Air – indoor uncontrolled	R-70	Pressure vessel support skirt and attachment welds	A1.7-a A2.8-a
2	Cumulative fatigue damage/ fatigue	3.1.2.2.1	BWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	R-04	Reactor vessel components: Flanges; Nozzles; Penetrations; Safe ends; Thermal sleeves; Vessel shells, heads and welds	A1.1-b A1.2-a A1.2-a A1.2-b A1.2-b A1.2-b A1.2-b A1.3-a A1.3-d A1.3-d A1.4-b A1.5-b A1.5-b A1.5-b A1.5-b A1.5-b A1.5-b A1.6-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
3	Cumulative fatigue damage/ fatigue	3.1.2.2.1	BWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirem ents of 10 CFR 54.21(c)(1).	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	R-220	Reactor coolant pressure boundary components: Piping, piping components, and piping elements	C1.1-b C1.1-d C1.1-e C1.1-e C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.1-h C1.2-a C1.2-a C1.2-a C1.3-d C1.3-d C1.3-d
4	Cumulative fatigue damage/ fatigue	3.1.2.2.1	BWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation; check ASME Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel	System temperature up to 288°C (550°F)	R-28	Pump and valve closure bolting	C1.2-f C1.3-g

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
5	Cumulative fatigue damage/ fatigue	3.1.2.2.1	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Stainless steel; nickel alloy	Reactor coolant	R-53	Reactor vessel internals components	B1.1-c B1.2-b B1.3-b B1.4-b B1.5-b B1.6-b B2.1-c B2.1-h B2.1-m B2.2-c B2.2-f B2.3-d B2.4-g B2.5-d B2.5-j B2.5-p B3.2-f B3.4-d B3.5-g B4.1-d B4.2-d B4.3-f B4.4-e B4.5-f B4.6-f
6	Cumulative fatigue damage/ fatigue	3.1.2.2.1	PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Nickel alloy	Reactor coolant and secondary feedwater/steam	R-46	Tubes and sleeves	D1.2-d D2.2-e

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
7	Cumulative fatigue damage/ fatigue	3.1.2.2.1	PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Low alloy steel	Air with reactor coolant leakage	R-73	Closure head Stud assembly	A2.1-e
						Stainless steel; steel	System temperature up to 340°C (644°F)	R-18	Piping and components external surfaces and bolting	C2.3-d C2.4-d C2.5-t C2.5-w
						Steel	Secondary feedwater/ steam	R-33	Steam generator components Top head; Steam nozzle and safe end; Upper and lower shell; FW and AFW nozzle and safe end; FW impingement plate and support	D1.1-a D1.1-b D2.1-d D2.1-g
						Steel with stainless steel cladding	Treated borated water	R-13	Pressurizer relief tank Tank shell and heads Flanges and nozzles	C2.6-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
8	Cumulative fatigue damage/ fatigue	3.1.2.2.1	PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	R-223	Reactor coolant pressure boundary components: Piping, piping components, and piping elements; Flanges; Nozzles and safe ends; Pressurizer vessel shell heads and welds; Heater sheaths and sleeves; Penetrations; and Thermal sleeves	C2.1-a C2.1-a C2.1-b C2.1-b C2.2-a C2.2-a C2.2-a C2.2-a C2.2-b C2.2-b C2.2-c C2.3-a C2.3-a C2.4-a C2.4-a C2.5-a C2.5-d C2.5-d C2.5-e C2.5-f C2.5-f C2.5-f C2.5-q
9	Cumulative fatigue damage/ fatigue	3.1.2.2.1	PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	R-219	Reactor vessel components: Flanges; Nozzles; Penetrations; Pressure housings; Safe ends; Thermal sleeves; Vessel shells, heads and welds	A2.1-b A2.2-c A2.2-c A2.3-c A2.3-c A2.3-c A2.4-a A2.4-a A2.4-a A2.5-d A2.5-d A2.5-d A2.5-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
10	Cumulative fatigue damage/ fatigue	3.1.2.2.1	PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation, and, for Class 1 components, environmental effects on fatigue are to be addressed. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	R-221	Recirculating steam generator components: Flanges; Penetrations; Nozzles; Safe ends, lower heads and welds	D1.1-h
								R-222	Once-through steam generator components: Primary side nozzles Safe ends and welds	D2.1-c
11	Loss of material/ general, pitting, and crevice corrosion	3.1.2.2.2.1	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Reactor coolant	R-59	Top head enclosure (without cladding) Top head Nozzles (vent, top head spray or RCIC, and spare)	A1.1-a

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
12	Loss of material/ general, pitting, and crevice corrosion	3.1.2.2.2.1	PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Secondary feedwater/ steam	R-224	Steam generator components Shell assembly	D2.1-e
13	Loss of material/ general (steel only), pitting and crevice corrosion	3.1.2.2.2.2	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel; steel	Reactor coolant	R-16	Isolation condenser components	C1.4-b
14	Loss of material/ pitting and crevice corrosion	3.1.2.2.2.3	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	RP-25	Reactor Vessel: Flanges, nozzles; penetrations; safe ends; vessel shells, heads and welds	A1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
15	Loss of material/ pitting and crevice corrosion	3.1.2.2.2.3	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	Reactor coolant	RP-27	Reactor coolant pressure boundary components	C1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
16	Loss of material/ general, pitting, and crevice corrosion	3.1.2.2.2.4	PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 2 components and Chapter XI.M2, "Water Chemistry," for PWR secondary water. As noted in NRC IN 90-04, if general and pitting corrosion of the shell is known to exist, the AMP guidelines in Chapter XI.M1 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.	Steel	Secondary feedwater/ steam	R-34	Steam generator components Upper and lower shell, and transition cone	D1.1-c
17	Loss of fracture toughness/ neutron irradiation embrittlement	3.1.2.2.3.1	BWR/ PWR	Yes, TLAA	Neutron irradiation embrittlement is a time dependent aging mechanism to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1017 n/cm2 (E >1 MeV) at the end of the	Steel (with or without stainless steel cladding)	Reactor coolant and neutron flux	R-62	Vessel shell Intermediate beltline shell Beltline welds	A1.2-c

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					license renewal term. Aspects of this evaluation may involve a TLAA. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. Additionally, the applicant is to monitor axial beltline weld embrittlement. One acceptable method is to determine that the mean RTNDT of the axial beltline welds at the end of the extended period of operation is less than the value specified by the Staff in its March 7, 2000 letter (ADAMS ML031430372). See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for					

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
					meeting the requirements of 10 CFR 54.21(c).					
					Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Steel with stainless steel cladding	Reactor coolant and neutron flux	R-84	Vessel shell Upper shell Intermediate and lower shell (including beltline welds)	A2.5-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. In accordance with approved BWRVIP-74, the TLAA is to evaluate the impact of neutron embrittlement on: (a) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (b) the need for inservice inspection of circumferential welds, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations. See the Standard Review Plan, Section 4.2 "Reactor Vessel Neutron Embrittlement" for acceptable methods for meeting the requirements of 10 CFR 54.21(c).	Steel	Reactor coolant and neutron flux	R-67	Nozzles Low pressure coolant injection or RHR injection mode	A1.3-e

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all ferritic materials that have a neutron fluence greater than 1E17 n/cm2 (E >1 MeV) at the end of the license renewal term. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RT_{PTS} value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature values used for calculation of the plant's pressure-temperature limits, and (c) the Charpy upper shelf energy or the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G requirements. The applicant may choose to demonstrate that the materials in the inlet, outlet, and safety injection nozzles are not controlling for the TLAA evaluations.	Steel with stainless steel cladding	Reactor coolant and neutron flux	R-81	Nozzles Inlet Outlet Safety injection	A2.3-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
18	Loss of fracture toughness/ neutron irradiation embrittlement	3.1.2.2.3.2	BWR/ PWR	No	Chapter XI.M31, "Reactor Vessel Surveillance"	Steel (with or without stainless steel cladding)	Reactor coolant and neutron flux	R-63	Vessel shell Intermediate beltline shell Beltline welds	A1.2-d
						Steel with stainless steel cladding	Reactor coolant and neutron flux	R-82	Nozzles Inlet Outlet Safety injection	A2.3-b
								R-86	Vessel shell Upper shell Intermediate and lower shell (including beltline welds)	A2.5-c
19	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	3.1.2.2.4.1	BWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	Stainless steel; nickel alloy	Air with reactor coolant leakage (Internal) or Reactor Coolant	R-61	Top head enclosure Vessel flange leak detection line	A1.1-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
20	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	3.1.2.2.4.2	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for BWR water. The AMP in Chapter XI.M1 is to be augmented to detect cracking due to stress corrosion cracking and verification of the program's effectiveness is necessary to ensure that significant degradation is not occurring and the component intended function will be m aintained during the extended period of operation. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Stainless steel	Reactor coolant	R-15	Isolation condenser components	C1.4-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
21	Crack growth/ cyclic loading	3.1.2.2.5	PWR	Yes, TLAA	Growth of intergranular separations (underclad cracks) in low-alloy steel forging heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process. The methodology for evaluating an underclad flaw is in accordance with the current well-established flaw evaluation procedure and criterion in the ASME Section XI Code. See the Standard Review Plan, Section 4.7, “Other Plant-Specific Time-Limited Aging Analysis,” for generic guidance for meeting the requirements of 10 CFR 54.21(c).	SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	Reactor coolant	R-85	Vessel shell Upper shell Intermediate and lower shell (including beltline welds)	A2.5-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
22	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	3.1.2.2.6	PWR	No, but licensee commitment needs to be confirmed	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel	Reactor coolant and neutron flux	R-122	Core barrel Core barrel (CB) CB flange (upper) CB outlet nozzles Thermal shield	B2.3-c
								R-127	Baffle/former assembly Baffle and former plates	B2.4-e
								R-128	Baffle/former assembly Baffle/former bolts and screws	B2.4-f B4.5-i
								R-132	Lower internal assembly Lower core plate	B2.5-c

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-141	Lower internal assembly Lower support forging Lower support plate columns	B2.5-n
								R-157	Core support barrel Core support barrel upper flange	B3.3-a
								R-161	Core shroud assembly Core shroud tie rods (core support plate attached by welds in later plants)	B3.4-c
								R-178	Upper grid assembly Upper grid rib section Upper grid ring forging Fuel assembly support pads Plenum rib pads Rib-to-ring screws	B4.2-e
								R-216	Thermal shield	B4.8-c
						Stainless steel; nickel alloy	Reactor coolant and neutron flux	R-135	Lower internal assembly Fuel alignment pins Lower support plate column bolts Clevis insert bolts	B2.5-g

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-164	Core shroud assembly Core shroud assembly bolts (later plants are welded)	B3.4-g
								R-169	Lower internal assembly Core support plate Fuel alignment pins Lower support structure beam assemblies Core support column bolts Core support barrel snubber assemblies	B3.5-d
								R-188	Core support shield assembly Core support shield cylinder (top and bottom flange) Core support shield-to-core barrel bolts Outlet and vent valve (VV) nozzles VV assembly locking device	B4.4-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-196	Core barrel assembly Core barrel cylinder (top and bottom flange) Lower internals assembly-to- core barrel bolts Core barrel-to-thermal shield bolts Baffle plates and formers	B4.5-d
								R-205	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid rib-to-shell forging screws Lower grid flow dist. plate Orifice plugs Lower grid and shell forgings Lower internals assembly-to-thermal shield bolts Guide blocks and bolts Shock pads and bolts Support post pipes	B4.6-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-212	Flow distributor assembly Flow distributor head and flange Shell forging-to-flow distributor bolts Incore guide support plate Clamping ring	B4.7-d
23	Cracking/ stress corrosion cracking	3.1.2.2.7.1	PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated because existing programs may not be capable of mitigating or detecting crack initiation and growth due to SCC in the vessel flange leak detection line.	Stainless steel	Air with reactor coolant leakage (Internal) or Reactor Coolant	R-74	Closure head Vessel flange leak detection line	A2.1-f
					A plant-specific aging management program is to be evaluated.	Stainless steel	Reactor coolant	RP-13	Bottom-mounted guide tube	A2.

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
24	Cracking/ stress corrosion cracking	3.1.2.2.7.2	PWR	Yes, plant-specific	Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later) minimize the potential of SCC, and material selection according to NUREG-0313, Rev. 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 guidelines, a plant-specific aging management program is to be 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.	Cast austenitic stainless steel	Reactor coolant	R-05	Class 1 piping, piping components, and piping elements	C2.1-e C2.2-g C2.5-i
25	Cracking/ cyclic loading	3.1.2.2.8.1	BWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Reactor coolant	R-102	Jet pump assemblies Jet pump sensing line	B1.4-d

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
26	Cracking/ cyclic loading	3.1.2.2.8.2	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components The AMP in Chapter 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 is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Stainless steel; steel	Reactor coolant	R-225	Isolation condenser components	C1.4-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
27	Loss of preload/ stress relaxation	3.1.2.2.9	PWR	No, but licensee commitment needs to be confirmed	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel	Reactor coolant	R-108	Upper internals assembly Hold-down spring	B2.1-d
								R-129	Baffle/former assembly Baffle/former bolts	B2.4-h
								R-184	Control rod guide tube (CRGT) assembly Flange-to-upper grid screws	B4.3-e

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-201	Core barrel assembly Baffle/former bolts and screws	B4.5-j
						Stainless steel; nickel alloy	Reactor coolant	R-114	Upper internals assembly Upper support column bolts	B2.1-k
								R-136	Lower internal assembly Lower support plate column bolts	B2.5-h
								R-137	Lower internal assembly Clevis insert bolts	B2.5-i
								R-154	CEA shroud assemblies CEA shrouds bolts	B3.2-g
								R-165	Core shroud assembly Core shroud assembly bolts Core shroud tie rods	B3.4-h
								R-192	Core support shield assembly Core support shield-to-core barrel bolts	B4.4-h

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-197	Core barrel assembly Lower internals assembly-to-core barrel bolts Core barrel-to-thermal shield bolts	B4.5-e
								R-207	Lower grid assembly Lower grid rib-to-shell forging screws Lower internals assembly-to-thermal shield bolts	B4.6-g
								R-213	Flow distributor assembly Shell forging-to-flow distributor bolts	B4.7-e
28	Loss of material/ erosion	3.1.2.2.10	PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Secondary feedwater	R-39	Steam generator feedwater impingement plate and support	D1.1-e
29	Cracking/ flow-induced vibration	3.1.2.2.11	BWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Reactor coolant	RP-18	Steam Dryers	B1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
30	Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	3.1.2.2.12	PWR	No, but licensee commitment needs to be confirmed	Chapter XI.M2, "Water Chemistry" for PWR primary water No further aging managem ent review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel	Reactor coolant	R-106	Upper internals assembly Upper support plate Upper core plate Hold-down spring	B2.1-a
								R-109	Upper internals assembly Upper support column	B2.1-e
								R-116	RCCA guide tube assemblies RCCA guide tubes	B2.2-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-120	Core barrel Core barrel (CB) CB flange (upper) CB outlet nozzles Thermal shield	B2.3-a
								R-123	Baffle/former assembly Baffle and former plates	B2.4-a
								R-138	Lower internal assembly Lower support forging or casting Lower support plate columns	B2.5-k
								R-143	Instrumentation support structures Flux thimble guide tubes	B2.6-a
								R-146	Upper internals assembly Upper guide structure support plate Fuel alignment plate Fuel alignment plate guide lugs and guide lug inserts	B3.1-a
								R-149	CEA shroud assemblies	B3.2-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-155	Core support barrel Core support barrel upper flange	B3.3-a
								R-159	Core shroud assembly Core shroud tie rods (core support plate attached by welds in later plants)	B3.4-a
								R-166	Lower internal assembly Core support plate Lower support structure beam assemblies Core support column Core support barrel snubber assemblies	B3.5-a
								R-172	Plenum cover and plenum cylinder Plenum cover assembly Plenum cylinder Reinforcing plates	B4.1-a
								R-173	Plenum cover and plenum cylinder Top flange-to-cover bolts Bottom flange-to-upper grid screws	B4.1-b

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
								R-175	Upper grid assembly Upper grid rib section Upper grid ring forging Fuel assembly support pads Plenum rib pads	B4.2-a
								R-176	Upper grid assembly Rib-to-ring screws	B4.2-b
								R-180	Control rod guide tube (CRGT) assembly CRGT pipe and flange CRGT spacer casting CRGT rod guide tubes CRGT rod guide sectors	B4.3-a
								R-181	Control rod guide tube (CRGT) assembly CRGT spacer screws Flange-to-upper grid screws	B4.3-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-185	Core support shield assembly Core support shield cylinder (top and bottom flange) Outlet and vent valve (VV) nozzles VV body and retaining ring	B4.4-a
								R-193	Core barrel assembly Core barrel cylinder (top and bottom flange) Baffle plates and formers	B4.5-a
								R-202	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid flow dist. plate Orifice plugs Lower grid and shell forgings Guide blocks Shock pads Support post pipes Incore guide tube spider castings	B4.6-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-209	Flow distributor assembly Flow distributor head and flange Incore guide support plate Clamping ring	B4.7-a
								R-214	Thermal shield	B4.8-a
					Chapter XI.M2, "Water Chemistry," for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel	Reactor coolant	R-125	Core barrel assembly Baffle/former assembly Baffle/former bolts and screws	B2.4-c, B4.5-g

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
31	Cracking/ primary water stress corrosion cracking	3.1.2.2.13	PWR	No, but licensee commitment needs to be confirmed	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines	Nickel alloy; steel with nickel-alloy cladding	Reactor coolant	R-01	Instrument penetrations and primary side nozzles, safe ends, and welds	D1.1-i D1.1-j D2.1-h
					Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Nickel alloy or nickel alloy cladding	Reactor coolant	R-06	Pressurizer instrumentation penetrations, heater sheaths and sleeves, heater bundle diaphragm plate, and manways and flanges	C2.5-k C2.5-s C2.5-m

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water and comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Nickel alloy	Reactor coolant	R-89	Penetrations Instrument tubes (bottom head)	A2.7-a
							Reactor coolant/ steam	RP-22	Pressurizer surge and steam space nozzles, and welds	C2.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" for Class 1 components, and Chapter XI.M2, "Water Chemistry" for PWR primary water and comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Nickel alloy	Reactor coolant/ steam	RP-31	Piping, piping components, and piping elements	C2.
					Chapter XI.M2, "Water Chemistry," and Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" and, for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to submit a plant-specific AMP to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Nickel alloy	Reactor coolant	R-88	Core support pads/ core guide lugs	A2.6-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
32	Wall thinning/ flow-accelerated corrosion	3.1.2.2.14.1	PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated. Reference NRC IN 91-19, "Steam Generator Feedwater Distribution Piping Damage."	Steel	Secondary feedwater/ steam	R-51	Upper assembly and separators Feedwater inlet ring and support	D1.3-a
33	Changes in dimensions/ void swelling	3.1.2.2.15	PWR	No, but licensee commitment needs to be confirmed	No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel	Reactor coolant	R-107	Upper internals assembly Upper support plate Upper core plate Hold-down spring	B2.1-b
								R-110	Upper internals assembly Upper support column	B2.1-f

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-117	RCCA guide tube assemblies RCCA guide tubes	B2.2-b
								R-121	Core barrel Core barrel (CB) CB flange (upper) CB outlet nozzles Thermal shield	B2.3-b
								R-124	Baffle/former assembly Baffle and former plates	B2.4-b
								R-126	Baffle/former assembly Baffle/former bolts	B2.4-d
								R-139	Lower internal assembly Lower support forging or casting Lower support plate columns	B2.5-l
								R-144	Instrumentation support structures Flux thimble guide tubes	B2.6-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-147	Upper internals assembly Upper guide structure support plate Fuel alignment plate Fuel alignment plate guide lugs and guide lug inserts	B3.1-b
								R-158	Core support barrel Core support barrel upper flange	B3.3-b
								R-174	Plenum cover and plenum cylinder Plenum cover assembly Plenum cylinder Reinforcing plates Top flange-to-cover bolts Bottom flange-to-upper grid screws	B4.1-c
								R-177	Upper grid assembly Upper grid rib section Upper grid ring forging Fuel assembly support pads Plenum rib pads Rib-to-ring screws	B4.2-c

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-182	Control rod guide tube (CRGT) assembly CRGT pipe and flange CRGT spacer casting CRGT spacer screws Flange-to-upper grid screws CRGT rod guide tubes CRGT rod guide sectors	B4.3-c
								R-199	Core barrel assembly Baffle/former bolts and screws	B4.5-h
								R-215	Thermal shield	B4.8-b
						Stainless steel; nickel alloy	Reactor coolant	R-113	Upper internals assembly Upper support column bolts Upper core plate alignment pins Fuel alignment pins	B2.1-j
								R-119	RCCA guide tube assemblies RCCA guide tube bolts RCCA guide tube support pins	B2.2-e

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-131	Lower internal assembly Lower core plate Radial keys and clevis inserts	B2.5-b
								R-134	Lower internal assembly Fuel alignment pins Lower support plate column bolts Clevis insert bolts	B2.5-f
								R-151	CEA shroud assemblies CEA shrouds bolts	B3.2-c
								R-160	Core shroud assembly Core shroud tie rods (core support plate attached by welds in later plants)	B3.4-b
								R-163	Core shroud assembly Core shroud assembly bolts (later plants are welded)	B3.4-f

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-168	Lower internal assembly Core support plate Fuel alignment pins Lower support structure beam assemblies Core support column bolts Core support barrel snubber assemblies	B3.5-c
								R-187	Core support shield assembly Core support shield cylinder (top and bottom flange) Core support shield-to-core barrel bolts VV retaining ring VV assembly locking device	B4.4-c
								R-195	Core barrel assembly Core barrel cylinder (top and bottom flange) Lower internals assembly-to- core barrel bolts Core barrel-to-thermal shield bolts Baffle plates and formers	B4.5-c

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
								R-204	Lower grid assembly Lower grid rib section Fuel assembly support pads Lower grid rib-to-shell forging screws Lower grid flow dist. plate Orifice plugs Lower grid and shell forgings Lower internals assembly-to- thermal shield bolts Guide blocks and bolts Shock pads and bolts Support post pipes Incore guide tube spider castings	B4.6-c
								R-211	Flow distributor assembly Flow distributor head and flange Shell forging-to-flow distributor bolts Incore guide support plate Clamping ring	B4.7-c

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
34	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	3.1.2.2.16.1	PWR	No, but licensee commitment needs to be confirmed	Chapter XI.M2, "Water Chemistry," and Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD" and, for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Stainless steel; nickel alloy	Reactor coolant	R-76	Control rod drive head penetration Pressure housing	A2.2-b
35	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	3.1.2.2.16.1	PWR	No, but licensee commitment needs to be confirmed	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR primary water and for nickel alloy, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Steel with stainless steel or nickel alloy cladding	Reactor coolant	R-35	Primary side components Upper and lower heads Tube sheets and tube-to-tube sheet welds	D2.1-a

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
36	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	3.1.2.2.16.2	PWR	No, unless licensee commitment needs to be confirmed	Chapter XI.M2, "Water Chemistry," and Chapter XI.M32 "One-Time Inspection" and for nickel alloy welded spray heads, comply with applicable NRC Orders and provide a commitment in the FSAR supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines.	Nickel alloy; stainless steel	Reactor coolant	R-24	Pressurizer Spray head	C2.5-j

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
37	Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	3.1.2.2.17	PWR	No, but licensee commitment needs to be confirmed	Chapter XI.M2, "Water Chemistry" for PWR primary water No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel; nickel alloy	Reactor coolant	R-112	Upper internals assembly Upper support column bolts Upper core plate alignment pins Fuel alignment pins	B2.1-i
								R-118	RCCA guide tube assemblies RCCA guide tube bolts RCCA guide tube support pins	B2.2-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-130	Lower internal assembly Lower core plate Radial keys and clevis inserts	B2.5-a
								R-133	Lower internal assembly Fuel alignment pins Lower support plate column bolts Clevis insert bolts	B2.5-e
								R-162	Core shroud assembly Core shroud assembly bolts (later plants are welded)	B3.4-e
								R-167	Lower internal Assembly Fuel alignment pins Core support column bolts	B3.5-b
								R-186	Core support shield assembly Core support shield-to-core barrel bolts VV assembly locking device	B4.4-b

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
								R-194	Core barrel assembly Lower internals assembly-to-core barrel bolts Core barrel-to-thermal shield bolts	B4.5-b
								R-203	Lower grid assembly Lower grid rib-to-shell forging screws Lower internals assembly-to- thermal shield bolts Guide blocks bolts Shock pads bolts	B4.6-b
								R-210	Flow distributor assembly Shell forging-to-flow distributor bolts	B4.7-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M2, "Water Chemistry" for PWR primary water. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) participate in the industry programs for investigating and managing aging effects on reactor internals; (2) evaluate and implement the results of the industry programs as applicable to the reactor internals; and (3) upon completion of these programs, but not less than 24 months before entering the period of extended operation, submit an inspection plan for reactor internals to the NRC for review and approval.	Stainless steel; nickel alloy	Reactor coolant	R-150	CEA shroud assemblies CEA shrouds bolts	B3.2-b
38	Cracking/ cyclic loading	NA	BWR	No	Chapter XI.M6, “BWR Control Rod Drive Return Line Nozzle”	Steel (with or without stainless steel cladding)	Reactor coolant	R-66	Nozzles Control rod drive return line	A1.3-c
39	Cracking/ cyclic loading	NA	BWR	No	Chapter XI.M5, “BWR Feedwater Nozzle”	Steel (with or without stainless steel cladding)	Reactor coolant	R-65	Nozzles Feedwater	A1.3-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
40	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	NA	BWR	No	Chapter XI.M8, “BWR Penetrations,” and Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel; nickel alloy	Reactor coolant	R-69	Penetrations Control rod drive stub tubes Instrumentation Jet pump instrument Standby liquid control Flux monitor Drain line	A1.5-a
41	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water	Nickel alloy	Reactor coolant	R-21	Piping, piping components, and piping elements greater than or equal to 4 NPS	C1.1-f
						Stainless steel	Reactor coolant	R-20	Piping, piping components, and piping elements greater than or equal to 4 NPS	C1.1-f C1.2-b C1.3-c
						Stainless steel; nickel alloy	Reactor coolant	R-68	Nozzle safe ends (and associated welds) High pressure core spray Low pressure core spray Control rod drive return line Recirculating water Low pressure coolant injection or RHR injection mode	A1.4-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
42	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M4, "BWR Vessel ID Attachment Welds," and Chapter XI.M2, "Water Chemistry," for BWR water	Stainless steel; nickel alloy	Reactor coolant	R-64	Vessel shell Attachment welds	A1.2-e
43	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M9, "BWR Vessel Internals," for lower plenum and Chapter XI.M2, "Water Chemistry," for BWR water	Stainless steel	Reactor coolant	R-104	Fuel supports and control rod drive assemblies Control rod drive housing	B1.5-c
44	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	NA	BWR	No	Chapter XI.M9, "BWR Vessel Internals," for core plate and Chapter XI.M2, "Water Chemistry" for BWR water	Stainless steel	Reactor coolant	R-93	Core shroud and core plate Core plate Core plate bolts (used in early BWRs)	B1.1-b
					Chapter XI.M9, "BWR Vessel Internals," for core shroud and Chapter XI.M2, "Water Chemistry" for BWR water	Stainless steel	Reactor coolant	R-92	Core shroud (including repairs) and core plate Core shroud (upper, central, lower)	B1.1-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M9, “BWR Vessel Internals,” for core spray internals and Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel	Reactor coolant	R-99	Core spray lines and spargers Core spray lines (headers) Spray rings Spray nozzles Thermal sleeves	B1.3-a
					Chapter XI.M9, “BWR Vessel Internals,” for jet pump assembly and Chapter XI.M2, “Water Chemistry,” for BWR water	Nickel alloy; stainless steel	Reactor coolant	R-100	Jet pump assemblies Thermal sleeve Inlet header Riser brace arm Holddown beams Inlet elbow Mixing assembly Diffuser Castings	B1.4-a
					Chapter XI.M9, “BWR Vessel Internals,” for lower plenum and Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel	Reactor coolant	R-105	Instrumentation Intermediate range monitor (IRM) dry tubes Source range monitor (SRM) dry tubes Incore neutron flux monitor guide tubes	B1.6-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M9, “BWR Vessel Internals,” for shroud support and Chapter XI.M2, “Water Chemistry,” for BWR water	Nickel alloy	Reactor coolant	R-96	Core shroud (including repairs) and core plate Shroud support structure (shroud support cylinder, shroud support plate, shroud support legs)	B1.1-f
					Chapter XI.M9, “BWR Vessel Internals,” for the LPCI coupling and Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel	Reactor coolant	R-97	Core shroud and core plate LPCI coupling	B1.1-g
					Chapter XI.M9, “BWR Vessel Internals,” for top guide and Chapter XI.M2, “Water Chemistry,” for BWR water. Additionally, for top guides with neutron fluence exceeding the IASCC threshold (5E20, E>lMeV) prior to the period of extended operation, inspect five percent (5%) of the top guide locations using enhanced visual inspection technique, EVT-1 within six years after entering the period of extended operation.	Stainless steel	Reactor coolant	R-98	Top guide	B1.2-a

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					An additional 5% of the top guide locations will be inspected within twelve years after entering the period of extended operation. Alternatively, if the neutron fluence for the limiting top guide location is projected to exceed the threshold for IASCC after entering the period of extended operation, inspect 5% of the top guide locations (EVT-1) within six years after the date projected for exceeding the threshold. An additional 5% of the top guide locations will be inspected within twelve years after the date projected for exceeding the threshold. The top guide inspection locations are those that have high neutron fluences exceeding the IASCC threshold.					

Table B.1 Reactor Coolant Systems											
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
					The extent and frequency of examination of the top guide is similar to the examination of the control rod drive housing guide tube in BWRVIP-47.					
45	Wall thinning/ flow-accelerated corrosion	NA	BWR	No	Chapter XI.M17, "Flow-Accelerated Corrosion"	Steel	Reactor coolant	R-23	Piping, piping components, and piping elements	C1.1-a C1.1-c C1.3-a
46	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	NA	BWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for BWR water	Nickel alloy	Reactor coolant	R-95	Core shroud and core plate Access hole cover (mechanical covers)	B1.1-e
47	Loss of material/ pitting and crevice corrosion	NA	BWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry" for BWR water	Stainless steel; nickel alloy	Reactor coolant	RP-26	Reactor vessel internals components	B1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
48	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking (for stainless steel only), and thermal and mechanical loading	NA	BWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for BWR water and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	Stainless steel; steel	Reactor coolant	R-03	Class 1 piping, fittings and branch connections < NPS 4	C1.1-i
49	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	NA	BWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for BWR water Because cracking initiated in crevice regions is not amenable to visual inspection, for BWRs with a crevice in the access hole covers, an augmented inspection is to include ultrasonic testing (UT) or other demonstrated acceptable inspection of the access hole cover welds.	Nickel alloy	Reactor coolant	R-94	Core shroud and core plate Access hole cover (welded covers)	B1.1-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
50	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M3, “Reactor Head Closure Studs”	High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 ksi)	Air with reactor coolant leakage	R-60	Top head enclosure Closure studs and nuts	A1.1-c
51	Loss of fracture toughness/ thermal aging and neutron irradiation embrittlement	NA	BWR	No	Chapter XI.M13, “Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)”	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F) and neutron flux	R-101	Jet pump assemblies Castings	B1.4-c
								R-103	Fuel supports and control rod drive assemblies Orificed fuel support	B1.5-a
52	Cracking/ stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	High-strength low-alloy steel, stainless steel	Air with reactor coolant leakage	R-11	Closure bolting	C2.3-e C2.4-e C2.5-n
						Stainless steel	Air with reactor coolant leakage	R-78	Control rod drive head penetration Flange bolting	A2.2-e
						Steel	Air with reactor coolant leakage	R-10	Closure bolting	D1.1-l
	Loss of material/ wear	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Stainless steel	Air with reactor coolant leakage	R-79	Control rod drive head penetration Flange bolting	A2.2-f

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Stainless steel; steel	System temperature up to 288°C (550°F)	R-29	Pump and valve seal flange closure bolting	C1.2-d C1.3-e
						Steel	System temperature up to 288°C (550°F)	R-26	Pump and valve closure bolting	C1.2-d C1.3-e
	Loss of preload/ thermal effects, gasket creep, and self-loosening	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Stainless steel	Air with reactor coolant leakage	R-80	Control rod drive head penetration Flange bolting	A2.2-g
	Loss of preload/ thermal effects, gasket creep, and self-loosening	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Low-alloy steel SA 193 Gr. B7	System temperature up to 288°C (550°F)	R-27	Pump and valve closure bolting	C1.2-e C1.3-f
						Low-alloy steel, stainless steel	Air with reactor coolant leakage	R-12	Closure bolting	C2.3-g C2.4-g C2.5-p
						Steel	System temperature up to 340°C (644°F)	R-32	Steam generator closure bolting	D1.1-f D2.1-k
53	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Steel	Closed cycle cooling water	RP-10	Piping, piping components, and piping elements	C2.

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
54	Loss of material/ pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Copper alloy	Closed cycle cooling water	RP-11	Piping, piping components, and piping elements	C2.
55	Loss of fracture toughness/ thermal aging embrittlement	NA	BWR/ PWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies. Alternatively, the requirements of ASME Code Case N-481 for pump casings are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings.	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	R-08	Class 1 pump casings, and valve bodies and bonnets	C1.2-c C1.3-b C2.3-c C2.4-c
56	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, "Selective Leaching of Materials"	Copper alloy >15% Zn	Closed cycle cooling water	RP-12	Piping, piping components, and piping elements	C2.

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
57	Loss of fracture toughness/ thermal aging embrittlement	NA	BWR/ PWR	No	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	R-52	Class 1 piping, piping components, and piping elements	C1.1-g C2.1-f C2.2-e C2.5-l
								R	Control rod drive head penetration Pressure housing	A2.2-d
58	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, "Boric Acid Corrosion"	Steel	Air with borated water leakage	R-17	External surfaces	A2.1-a A2.5-e A2.8-b C2.1-d C2.2-d C2.3-f C2.4-f C2.5-b C2.5-o C2.5-u C2.6-b D1.1-g D1.1-k D2.1-b D2.1-j
59	Wall thinning/ flow-accelerated corrosion	NA	PWR	No	Chapter XI.M17, "Flow-Accelerated Corrosion"	Steel	Secondary feedwater/ steam	R-37	Pressure boundary and structural Steam nozzle and safe end FW nozzle and safe end	D1.1-d

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-38	Steam generator components FW and AFW nozzles and safe ends Steam nozzles and safe ends	D2.1-f
60	Loss of material/ wear	NA	PWR	No	Chapter XI.M37, “Flux Thimble Tube Inspection"	Stainless steel with or without chrome plating	Reactor coolant	R-145	Instrumentation support structures Flux thimble tubes	B2.6-c
61	Cracking/ cyclic loading	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components	Stainless steel; steel	Air with metal temperature up to 288°C (550°F)	R-19	Pressurizer Integral support	C2.5-v
62	Cracking/ cyclic loading	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components	Stainless steel; steel with stainless steel cladding	Reactor coolant	R-56	Reactor coolant system piping and fittings Cold leg Hot leg Surge line Spray line	C2.1-c
63	Loss of material/ wear	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components	Stainless steel	Reactor coolant	R-142	Lower internal assembly Radial keys and clevis Inserts	B2.5-o

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-148	Upper internals assembly Fuel alignment plate Fuel alignment plate guide lugs and their lugs Hold-down ring	B3.1-c
								R-152	CEA shroud assemblies CEA shroud extension shaft guides	B3.2-d
								R-156	Core support barrel Core support barrel upper flange Core support barrel alignment keys	B3.3-b
								R-179	Upper grid assembly Fuel assembly support pads Plenum rib pads	B4.2-f
								R-190	Core support shield assembly Core support shield cylinder (top flange) VV assembly locking device	B4.4-f

Table B.1 Reactor Coolant Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
								R-208	Lower grid assembly Fuel assembly support pads Guide blocks	B4.6-h
						Stainless steel; nickel alloy	Reactor coolant	R-115	Upper internals assembly Upper core plate alignment pins	B2.1-l
								R-170	Lower internal assembly Fuel alignment pins Core support barrel snubber assemblies	B3.5-e
						Steel	Reactor coolant	R-87	Vessel shell Vessel flange	A2.5-f
64	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD” for Class 1 components, and Chapter XI.M2, “Water Chemistry,” for PWR primary water	Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	R-25	Pressurizer components	C2.5-c C2.5-g

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
65	Cracking/ primary water stress corrosion cracking	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water and Chapter XI.M11-A, "Nickel-Alloy Penetration Nozzles Welded to the Upper Reactor Vessel Closure Heads of Pressurized Water Reactors (PWRs Only)"	Nickel alloy	Reactor coolant	R-75	Control rod drive head penetration Nozzle and welds	A2.2-a
								R-90	Penetrations Head vent pipe (top head) Instrument tubes (top head)	A2.7-b
66	Loss of material/ erosion	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 2 components	Steel	Air with leaking secondary-side water and/or steam	R-31	Secondary manways and handholes (cover only)	D2.1-l

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
67	Cracking/ cyclic loading	NA	PWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water 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 periodically inspected as part of the ISI program, the existing AMP is adequate for managing the effect of pressurizer clad cracking.	Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	R-58	Pressurizer components	C2.5-c C2.5-g
68	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water	Stainless steel	Reactor coolant	R-217	Pressurizer heater sheaths and sleeves, and heater bundle diaphragm plate	C2.5-r

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Stainless steel; steel with stainless steel cladding	Reactor coolant	R-07	Class 1 piping, fittings, primary nozzles, safe ends, manways, and flanges	C2.2-f C2.5-h D1.1-i C2.5-m
								R-09	Class 1 pump casings and valve bodies	C2.3-b C2.4-b
								R-30	Reactor coolant system piping and fittings Cold leg Hot leg Surge line Spray line	C2.1-c
							Treated borated water >60°C (>140°F)	R-14	Pressurizer relief tank Tank shell and heads Flanges and nozzles	C2.6-c
69	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel; nickel alloy welds and/or buttering	Reactor coolant	R-83	Nozzle safe ends and welds: Inlet Outlet Safety injection	A2.4-b

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
70	Cracking/ stress corrosion cracking, thermal and mechanical loading	NA	PWR	No	Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components, and Chapter XI.M2, "Water Chemistry," for PWR water and XI.M35, "One-Time Inspection of ASME Code Class 1 Small-bore Piping"	Stainless steel; steel with stainless steel cladding	Reactor coolant	R-02	Class 1 piping, fittings and branch connections < NPS 4	C2.1-g C2.2-h
71	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M3, "Reactor Head Closure Studs"	High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 ksi)	Air with reactor coolant leakage	R-71	Closure head Stud assembly	A2.1-c
	Loss of material/ wear	NA	PWR	No	Chapter XI.M3, "Reactor Head Closure Studs"	High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 ksi)	Air with reactor coolant leakage	R-72	Closure head Stud assembly	A2.1-d
72	Cracking/ intergranular attack	NA	PWR	No	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	Nickel alloy	Secondary feedwater/ steam	R-48	Tubes and sleeves	D1.2-c D2.2-c

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
	Cracking/ outer diameter stress corrosion cracking	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Nickel alloy	Secondary feedwater/ steam	R-47	Tubes and sleeves	D1.2-b D2.2-b
	Loss of material/ fretting and wear	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Nickel alloy	Secondary feedwater/ steam	R-49	Tubes and sleeves	D1.2-e D2.2-d
73	Cracking/ primary water stress corrosion cracking	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR primary water	Nickel alloy	Reactor coolant	R-40	Tube plugs	D1.2-i D1.2-j D2.2-f D2.2-g
								R-44	Tubes and sleeves	D1.2-a D2.2-a
74	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Chrome plated steel; stainless steel; Nickel alloy	Secondary feedwater/ steam	RP-14	Steam generator structural Anti-vibration bars	D1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
	Loss of material/ crevice corrosion and fretting	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Chrome plated steel; stainless steel; Nickel alloy	Secondary feedwater/ steam	RP-15	Steam generator structural Anti-vibration bars	D1.
75	Denting/ corrosion of carbon steel tube support plate	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water.	Nickel alloy	Secondary feedwater/ steam	R-226	Tubes	D2.
76	Ligament cracking/ corrosion	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Steel	Secondary feedwater/ steam	R-42	Steam generator structural Tube support plates	D1.2-k D2.
	Loss of material/ erosion, general, pitting, and crevice corrosion	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Steel	Secondary feedwater/ steam	RP-16	Steam generator Tube bundle wrapper	D1.
77	Loss of material/ wastage and pitting corrosion	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water	Nickel alloy	Secondary feedwater/ steam	R-50	Tubes and sleeves (exposed to phosphate chemistry)	D1.2-f

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
78	Wall thinning/ flow-accelerated corrosion	NA	PWR	No	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water	Steel	Secondary feedwater/ steam	R-41	Steam generator structural Tube support lattice bars	D1.2-h
79	Denting/ corrosion of carbon steel tube support plate	NA	PWR	No	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water. For plants that could experience denting at the upper support plates, the applicant should evaluate potential for rapidly propagating cracks and then develop and take corrective actions consistent with Bulletin 88-02, "Rapidly Propagating Cracks in SG Tubes."	Nickel alloy	Secondary feedwater/ steam	R-43	Tubes	D1.2-g
80	Loss of fracture toughness/ thermal aging and neutron irradiation embrittlement	NA	PWR	No	Chapter XI.M13, "Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS)"	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F) and neutron flux	R-111	Upper internals assembly Upper support column (only cast austenitic stainless steel portions)	B2.1-g

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								R-140	Lower internal assembly Lower support casting Lower support plate columns	B2.5-m
								R-153	CEA shroud assemblies	B3.2-e
								R-171	Lower internal assembly Core support column	B3.5-f
								R-183	Control rod guide tube (CRGT) assembly CRGT spacer casting	B4.3-d
								R-191	Core support shield assembly Outlet and vent valve nozzles VV body and retaining ring	B4.4-g
								R-206	Lower grid assembly Incore guide tube spider castings	B4.6-e
81	Cracking/ primary water stress corrosion cracking	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Nickel alloy; steel with nickel-alloy cladding	Reactor coolant	RP-21	Primary side Divider Plate	D1.

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
82	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel	Reactor coolant	RP-17	Primary side Divider Plate	D1.
83	Loss of material/ pitting and crevice corrosion	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel; nickel alloy	Reactor coolant	RP-24	Reactor vessel internals components	B2. B3. B4.
						Stainless steel; steel with nickel-alloy or stainless steel cladding; nickel-alloy	Reactor coolant	RP-28	Flanges ; nozzles; penetrations; pressure housings; safe ends; vessel shells, heads and welds	A2.
						Steel with stainless steel or nickel alloy cladding; stainless steel; nickel alloy	Reactor coolant	RP-23	Piping, piping components, and piping elements; flanges; heater sheaths and sleeves; penetrations; thermal sleeves; vessel shell heads and welds	C2.
84	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M2, "Water Chemistry" and Chapter XI.M32 "One-Time Inspection" or Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD.”	Nickel alloy	Secondary feedwater/ steam	R-36	Steam generator components Such as secondary side nozzles (vent, drain, and instrumentation)	D2.1-i

Table B.1 Reactor Coolant Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
85	None	NA	BWR/ PWR	No	None	Nickel alloy	Air – indoor uncontrolled (External)	RP-03	Piping, piping components, and piping elements	E.
86	None	NA	BWR/ PWR	No	None	Stainless steel	Air – indoor uncontrolled (External)	RP-04	Piping, piping components, and piping elements	E.
							Air with borated water leakage	RP-05	Piping, piping components, and piping elements	E.
							Concrete	RP-06	Piping, piping components, and piping elements	E.
							Gas	RP-07	Piping, piping components, and piping elements	E.
87	None	NA	BWR/ PWR	No	None	Steel	Concrete	RP-01	Piping, piping components, and piping elements	E.

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B.2 Engineered Safety Features SRP-LR Development Tool

Table B.2 presents the engineered safety features SRP-LR development tool.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Cumulative fatigue damage/ fatigue	3.2.2.2.1	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Stainless steel	Treated borated water	E-13	Piping, piping components, and piping elements	D1.1-c D1.4-a
						Steel	Treated water	E-10	Piping, piping components, and piping elements	D2.1-b
2	Loss of material/cladding breach	3.2.2.2.2	PWR	Yes, verify that plant-specific program addresses cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Steel with stainless steel cladding	Treated borated water	EP-49	Pump Casings	D1.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
3	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry” The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Treated water	E-33	Containment isolation piping and components internal surfaces	C.1-b
4	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Soil	EP-31	Piping, piping components, and piping elements	D1. D2.
5	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.3	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Aluminum	Treated water	EP-26	Piping, piping components, and piping elements	D2.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.M2, “Water Chemistry” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Treated water	EP-32	Piping, piping components, and piping elements	D2.
6	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.4	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Copper alloy	Lubricating oil	EP-45	Piping, piping components, and piping elements	A. D1. D2.
						Stainless steel	Lubricating oil	EP-51	Piping, piping components, and piping elements	D1.
7	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.5	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated for pitting and crevice corrosion of tank bottom because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	Stainless steel	Raw water	E-01	Partially encased tanks with breached moisture barrier	D1.8-c

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
8	Loss of material/ pitting and crevice corrosion	3.2.2.2.3.6	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Condensation (Internal)	E-14	Piping, piping components, and piping elements internal surfaces	D2.1-e
								EP-53	Piping, piping components, piping elements internal surfaces, and tanks	A. D1.
9	Reduction of heat transfer/ fouling	3.2.2.2.4.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Copper alloy	Lubricating oil	EP-47	Heat exchanger tubes	A. D1. D2.
						Stainless steel	Lubricating oil	EP-50	Heat exchanger tubes	A. D1. D2.
						Steel	Lubricating oil	EP-40	Heat exchanger tubes	A. D1. D2.
10	Reduction of heat transfer/ fouling	3.2.2.2.4.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water	EP-34	Heat exchanger tubes	A. D2.

Table B.2 Engineered Safety Features										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
11	Hardening and loss of strength/ elastomer degradation	3.2.2.2.5	BWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Elastomers	Air – indoor uncontrolled	E-06	Elastomer seals and components	B.1-b B.2-b
12	Loss of material/ erosion	3.2.2.2.6	PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Stainless steel	Treated borated water	E-24	Orifice (miniflow recirculation)	D1.2-c
13	Loss of material/ general corrosion and fouling	3.2.2.2.7	BWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Air – indoor uncontrolled (Internal)	E-04	Drywell and suppression chamber spray system (internal surfaces): Flow orifice Spray nozzles	D2.5-b
14	Loss of material/ general, pitting, and crevice corrosion	3.2.2.2.8.1	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Treated water	E-08	Piping, piping components, and piping elements	D2.1-a D2.2-a D2.3-b

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
15	Loss of material/ general, pitting, and crevice corrosion	3.2.2.2.8.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	E-31	Containment isolation piping and components internal surfaces	C.1-a
16	Loss of material/ general, pitting, and crevice corrosion	3.2.2.2.8.3	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Lubricating oil	EP-46	Piping, piping components, and piping elements	A. D1. D2.
17	Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion	3.2.2.2.9	BWR/ PWR	No Yes, detection of aging effects and operating experience are to be further evaluated	Chapter XI.M28, "Buried Piping and Tanks Surveillance," or Chapter XI.M34, "Buried Piping and Tanks Inspection"	Steel (with or without coating or wrapping)	Soil	E-42	Piping, piping components, and piping elements	B.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
18	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M7, "BWR Stress Corrosion Cracking," and Chapter XI.M2, "Water Chemistry," for BWR water	Stainless steel	Treated water >60°C (>140°F)	E-37	Piping, piping components, and piping elements	D2.1-c D2.3-c
19	Wall thinning/ flow-accelerated corrosion	NA	BWR	No	Chapter XI.M17, "Flow-Accelerated Corrosion"	Steel	Steam	E-07	Piping, piping components, and piping elements	D2.1-f
							Treated water	E-09	Piping, piping components, and piping elements	D2.3-a
20	Loss of fracture toughness/ thermal aging embrittlement	NA	BWR	No	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	Cast austenitic stainless steel	Treated water >250°C (>482°F)	E-11	Piping, piping components, and piping elements	D2.1-d
21	Cracking/ cyclic loading, stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	High-strength steel	Air with steam or water leakage	E-03	Closure bolting	E.2-b
22	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air with steam or water leakage	E-02	Closure bolting	E.2-a
23	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	EP-25	Closure bolting	E.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
							Air – outdoor (External)	EP-1	Bolting	E.
24	Loss of preload/ thermal effects, gasket creep, and self-loosening	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	EP-24	Closure bolting	E.
25	Cracking/ stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water >60°C (>140°F)	EP-44	Piping, piping components, and piping elements	A. C. D1. D2.
26	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	EP-48	Piping, piping components, and piping elements	C.
27	Loss of material/ general, pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	E-17	Heat exchanger components	A.6-c D1.5-a D1.6-a D2.4-c
28	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water	E-19	Heat exchanger components	A.6-c D1.5-a D1.6-a D2.4-c
								EP-33	Piping, piping components, and piping elements	A. C. D1. D2.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
29	Loss of material/ pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Copper alloy	Closed cycle cooling water	EP-13	Heat exchanger components	A. D1. D2.
								EP-36	Piping, piping components, and piping elements	A. B. D1. D2.
30	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Copper alloy	Closed cycle cooling water	EP-39	Heat exchanger tubes	A.
						Stainless steel	Closed cycle cooling water	EP-35	Heat exchanger tubes	A. D1. D2.
31	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	E-26	Ducting, piping and components external surfaces	A.2-a A.5-a B.1-a B.2-a D2.1-e D2.5-a
								E-35	Containment isolation piping and components external surfaces	C.1-a
								E-40	Ducting closure bolting	B.1-a
								E-44	External surfaces	E.
							Air – outdoor (External)	E-45	External surfaces	E.
							Condensation (External)	E-30	Containment isolation piping and components external surfaces	C.1-a
								E-46	External surfaces	E.

Table B.2 Engineered Safety Features										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
32	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Air – indoor uncontrolled (Internal)	E-25	Ducting and components internal surfaces	B.2-a
								E-29	Piping and components internal surfaces	A.2-a A.5-a D2.5-a
33	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Air – indoor uncontrolled (Internal)	EP-42	Encapsulation Components	A.
34	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Condensation (Internal)	E-27	Piping and components internal surfaces	D2.1-e
35	Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Steel	Raw water	E-22	Containment isolation piping and components internal surfaces	C.1-a

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
36	Loss of material/ general, pitting, crevice, galvanic, and micro-biologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Steel	Raw water	E-18	Heat exchanger components	A.6-a D1.6-b D2.4-a
37	Loss of material/ pitting, crevice, and micro-biologically influenced corrosion	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Stainless steel	Raw water	EP-55	Piping, piping components, and piping elements	D1.
38	Loss of material/ pitting, crevice, and micro-biologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Stainless steel	Raw water	E-34	Containment isolation piping and components internal surfaces	C.1-b
39	Loss of material/ pitting, crevice, and micro-biologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Stainless steel	Raw water	E-20	Heat exchanger components	A.6-a D1.6-b D2.4-a

Table B.2 Engineered Safety Features										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
40	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Stainless steel	Raw water	E-21	Heat exchanger tubes	A.6-b D1.6-c D2.4-b
						Steel	Raw water	E-23	Heat exchanger tubes	D2.4-b
41	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials”	Copper alloy >15% Zn	Closed cycle cooling water	EP-27	Piping, piping components, and piping elements	A. B. D1. D2.
								EP-37	Heat exchanger components	A. B. D1. D2.
42	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials”	Gray cast iron	Closed cycle cooling water	EP-52	Piping, piping components, and piping elements	D1.
43	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials"	Gray cast iron	Soil	EP-54	Piping, piping components, and piping elements	B. D1. D2.
44	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials”	Gray cast iron	Treated water	E-43	Motor Cooler	A. D1.
45	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, “Boric Acid Corrosion”	Aluminum	Air with borated water leakage	EP-2	Piping, piping components , and piping elements	D2.
						Copper alloy >15% Zn	Air with borated water leakage	EP-38	Piping, piping components, and piping elements	E.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Steel	Air with borated water leakage	E-28	External surfaces	A.1-b A.3-b A.4-b A.5-b A.6-d D1.1-d D1.2-b D1.3-a D1.4-c D1.5-b D1.6-d D1.7-a D1.8-b E.1-a
								E-41	Bolting	E.
46	Loss of material/ general, pitting, crevice and boric acid corrosion	NA	PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Air with borated water leakage (Internal)	EP-43	Encapsulation Components	A.
47	Loss of fracture toughness/ thermal aging embrittlement	NA	PWR	No	Chapter XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	Cast austenitic stainless steel	Treated borated water >250°C (>482°F)	E-47	Piping, piping components, and piping elements	D1.1-b
48	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M2, "Water Chemistry," for PWR primary water	Stainless steel	Treated borated water >60°C (>140°F)	E-12	Piping, piping components, piping elements, and tanks	A.1-a A.1-c A.3-a A.4-a D1.1-a D1.2-a D1.4-b D1.7-b D1.8-a

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Steel with stainless steel cladding	Treated borated water >60°C (>140°F)	E-38	Safety injection tank (accumulator)	D1.7-b
49	Loss of material/ pitting and crevice corrosion	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel	Treated borated water	EP-41	Piping, piping components, piping elements, and tanks	A. D1.
50	None	NA	BWR/ PWR	No	None	Aluminum	Air – indoor uncontrolled (Internal/External)	EP-3	Piping, piping components, and piping elements	F.
51	None	NA	BWR/ PWR	No	None	Galvanized steel	Air – indoor controlled (External)	EP-14	Ducting	F.
52	None	NA	BWR/ PWR	No	None	Glass	Air – indoor uncontrolled (External)	EP-15	Piping elements	F.
							Lubricating oil	EP-16	Piping elements	F.
							Raw water	EP-28	Piping elements	F.
							Treated borated water	EP-30	Piping elements	F.
							Treated water	EP-29	Piping elements	F.
53	None	NA	BWR/ PWR	No	None	Copper alloy	Air – indoor uncontrolled (External)	EP-10	Piping, piping components, and piping elements	F.
						Nickel alloy	Air – indoor uncontrolled (External)	EP-17	Piping, piping components, and piping elements	F.
						Stainless steel	Air – indoor uncontrolled (External)	EP-18	Piping, piping components, and piping elements	F.

Table B.2 Engineered Safety Features

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
54	None	NA	BWR/ PWR	No	None	Steel	Air – indoor controlled (External)	EP-4	Piping, piping components, and piping elements	F.
55	None	NA	BWR/ PWR	No	None	Stainless steel	Concrete	EP-20	Piping, piping components, and piping elements	F.
						Steel	Concrete	EP-5	Piping, piping components, and piping elements	F.
56	None	NA	BWR/ PWR	No	None	Copper alloy	Gas	EP-9	Piping, piping components, and piping elements	F.
						Stainless steel	Gas	EP-22	Piping, piping components, and piping elements	F.
						Steel	Gas	EP-7	Piping, piping components, and piping elements	F.
57	None	NA	PWR	No	None	Copper alloy <15% Zn	Air with borated water leakage	EP-12	Piping, piping components, and piping elements	F.
						Stainless steel	Air with borated water leakage	EP-19	Piping, piping components, and piping elements	F.

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B.3 Auxiliary Systems SRP-LR Development Tool

Table B.3 presents the auxiliary systems SRP-LR development tool.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Cumulative fatigue damage/ fatigue	3.3.2.2.1	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for structural girders of cranes that fall within the scope of 10 CFR 54. See the Standard Review Plan, Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses," for generic guidance for meeting the requirements of 10 CFR 54.21(c)(1).	Steel	Air – indoor uncontrolled (External)	A-06	Cranes - Structural girders	B.1-a
2	Cumulative fatigue damage/ fatigue	3.3.2.2.1	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Stainless steel	Treated borated water	A-100	Heat exchanger components	E1.8-a
								A-57	Piping, piping components, and piping elements	E1.1-a E1.3-a E1.7-a E1.8-a
							Treated water	A-62	Piping, piping components, and piping elements	E3.1-b E3.2-b E4.1-b

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Steel	Air – indoor uncontrolled	A-34	Piping, piping components, and piping elements	E1.1-a E1.3-a E1.7-a E1.8-a E3.2-c
3	Reduction of heat transfer/ fouling	3.3.2.2.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water	AP-62	Heat exchanger tubes	A4. E3.
4	Cracking/ stress corrosion cracking	3.3.2.2.3.1	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Sodium pentaborate solution >60°C (>140°F)	A-59	Piping, piping components, and piping elements	E2.1-a E2.2-a E2.3-a E2.4-a
5	Cracking/ stress corrosion cracking	3.3.2.2.3.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Treated water >60°C (>140°F)	A-85	Regenerative heat exchanger components	E3.3-d
						Stainless steel; steel with stainless steel cladding	Treated water >60°C (>140°F)	A-71	Heat exchanger components	E3.4-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
6	Cracking/ stress corrosion cracking	3.3.2.2.3.3	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Diesel exhaust	AP-33	Diesel engine exhaust Piping, piping components, and piping elements	H2.
7	Cracking/ stress corrosion cracking, cyclic loading	3.3.2.2.4.1	PWR	Yes, plant-specific	Chapter XI.M2, “Water Chemistry,” for PWR primary water. The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading, or loss of material due to pitting and crevice corrosion. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	Stainless steel	Treated borated water >60°C (>140°F)	A-69	Non-regenerative heat exchanger components	E1.8-b
8	Cracking/ stress corrosion cracking, cyclic loading	3.3.2.2.4.2	PWR	Yes, plant-specific	Chapter XI.M2, “Water Chemistry,” for PWR primary water The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Stainless steel	Treated borated water >60°C (>140°F)	A-84	Heat exchanger components	E1.7-c

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
9	Cracking/ stress corrosion cracking, cyclic loading	3.3.2.2.4.3	PWR	Yes, plant-specific	Chapter XI.M2, “Water Chemistry,” for PWR primary water The AMP is to be augmented by verifying the absence of cracking due to stress corrosion cracking and cyclic loading. A plant specific aging management program is to be evaluated.	Stainless steel	Treated borated water	A-76	High-pressure pump Casing	E1.5-a
10	Cracking/ cyclic loading, stress corrosion cracking	3.3.2.2.4.4	BWR/ PWR	Yes, if the bolts are not replaced during maintenance	Chapter XI.M18, “Bolting Integrity.” The AMP is to be augmented by appropriate inspection to detect cracking if the bolts are not otherwise replaced during maintenance.	High-strength steel	Air with steam or water leakage	A-104	High-pressure pump Closure bolting	E1.5-a
11	Hardening and loss of strength/ elastomer degradation	3.3.2.2.5.1	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Elastomers	Air – indoor uncontrolled (Internal/ External)	A-17	Elastomer seals and components	F1.1-b F1.4-b F2.1-b F2.4-b F3.1-b F3.4-b F4.1-b
12	Hardening and loss of strength/ elastomer degradation	3.3.2.2.5.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program that determines and assesses the qualified life of the linings in the environment is to be evaluated.	Elastomers	Treated borated water	A-15	Elastomer lining	A3.2-a A3.2-d A3.3-a A3.3-d A3.5-a A3.5-c

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
							Treated water	A-16	Elastomer lining	A4.2-a A4.2-b A4.3-a A4.3-b A4.5-a A4.5-b
13	Reduction of neutron-absorbing capacity and loss of material/ general corrosion	3.3.2.2.6	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Boral, boron steel	Treated borated water	A-88	Spent fuel storage racks Neutron-absorbing sheets - PWR	A2.1-b
							Treated water	A-89	Spent fuel storage racks Neutron-absorbing sheets - BWR	A2.1-b
14	Loss of material/ general, pitting, and crevice corrosion	3.3.2.2.7.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Lubricating oil	AP-30	Piping, piping components, and piping elements	C1. C2. E1. E4. F1. F2. F3. F4. G. H2.

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
15	Loss of material/ general, pitting, and crevice corrosion	3.3.2.2.7.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Lubricating oil	A-83	Reactor coolant pump oil collection system Piping, tubing, valve bodies	G.7-b
16	Loss of material/ general, pitting, and crevice corrosion	3.3.2.2.7.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented to evaluate the thickness of the lower portion of the tank. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Lubricating oil	A-82	Reactor coolant pump oil collection system Tank	G.7-a
17	Loss of material/ general, pitting, and crevice corrosion	3.3.2.2.7.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	A-35	Piping, piping components, and piping elements	E3. E4.1-a E4.2-a

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
18	Loss of material/ general (steel only), pitting and crevice corrosion	3.3.2.2.7.3	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel; steel	Diesel exhaust	A-27	Diesel engine exhaust Piping, piping components, and piping elements	H2.4-a
19	Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion	3.3.2.2.8	BWR/ PWR	No Yes, detection of aging effects and operating experience are to be further evaluated	Chapter XI.M28, “Buried Piping and Tanks Surveillance,” or Chapter XI.M34, “Buried Piping and Tanks Inspection”	Steel (with or without coating or wrapping)	Soil	A-01	Piping, piping components, and piping elements	H1.1-b C1.1-b C3. G.
20	Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion, and fouling	3.3.2.2.9.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Fuel oil	A-30	Piping, piping components, piping elements, and tanks	H1.4-a H2.5-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
21	Loss of material/ general, pitting, crevice, and micro-biologically influenced corrosion, and fouling	3.3.2.2.9.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Lubricating oil	AP-39	Heat exchanger components	H2.
22	Loss of material/ pitting and crevice corrosion (only for steel after lining degradation)	3.3.2.2.10.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for PWR primary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel with elastomer lining	Treated borated water	A-39	Piping, piping components, and piping elements	A3.2-a A3.3-a A3.5-a
					Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel with elastomer lining or stainless steel cladding	Treated water	A-40	Piping, piping components, and piping elements	A4.2-a A4.3-a A4.5-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
23	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel; steel with stainless steel cladding	Treated water	A-70	Heat exchanger components	A4.4-b
24	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Aluminum	Treated water	AP-38	Piping, piping components, and piping elements	A4. E3. E4.
					Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Treated water	A-58	Piping, piping components, and piping elements	A4.1-a A4.6-a E4.1-a E3.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
25	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.3	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Copper alloy	Condensation (External)	A-46	Piping, piping components, and piping elements	F1.2-a F2.2-a F3.2-a F4.2-a
26	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.4	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Copper alloy	Lubricating oil	AP-47	Piping, piping components, and piping elements	C1. C2. E1. E4. G. H2.
27	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.5	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Aluminum	Condensation	AP-74	Piping, piping components, and piping elements	F1. F2. F3. F4.
						Stainless steel	Condensation	A-09	Ducting and components	F1.4-a F2.4-a F3.4-a
28	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.6	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Copper alloy	Condensation (Internal)	AP-78	Piping, piping components, and piping elements	G.
29	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.7	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Soil	AP-56	Piping, piping components, and piping elements	C1. C3. G. H1. H2.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
30	Loss of material/ pitting and crevice corrosion	3.3.2.2.10.8	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Sodium pentaborate solution	AP-73	Piping, piping components, and piping elements	E2.
31	Loss of material/ pitting, crevice, and galvanic corrosion	3.3.2.2.11	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemis try,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Copper alloy	Treated water	AP-64	Piping, piping components, and piping elements	A4. E3. E4.
32	Loss of material/ pitting, crevice, and micro-biologically influenced corrosion	3.3.2.2.12.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M30, “Fuel Oil Chemistry” The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Aluminum	Fuel oil	AP-35	Piping, piping components, and piping elements	H1. H2.
						Copper alloy	Fuel oil	AP-44	Piping, piping components, and piping elements	H1. H2. G.
						Stainless steel	Fuel oil	AP-54	Piping, piping components, and piping elements	G. H1. H2.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
33	Loss of material/ pitting, crevice, and micro-biologically influenced corrosion	3.3.2.2.12.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Lubricating oil	AP-59	Piping, piping components, and piping elements	C1. C2. E1. E4. H2. G.
34	Loss of material/ wear	3.3.2.2.13	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Elastomers	Air – indoor uncontrolled (External)	A-73	Elastomer seals and components	F1.1-c F2.1-c F3.1-c F4.1-c
							Air – indoor uncontrolled (Internal)	A-18	Elastomer seals and components	F1.1-c F2.1-c F3.1-c F4.1-c
35	Loss of material/ cladding breach	3.3.2.2.14	PWR	Yes, verify plant-specific program addresses cladding breach	A plant-specific aging management program is to be evaluated. Reference NRC Information Notice 94-63, “Boric Acid Corrosion of Charging Pump Casings Caused by Cladding Cracks."	Steel with stainless steel cladding	Treated borated water	AP-85	Pump Casings	E1.
36	Reduction of neutron-absorbing capacity/ boraflex degradation	NA	BWR	No	Chapter XI.M22, “Boraflex Monitoring”	Boraflex	Treated water	A-87	Spent fuel storage racks Neutron-absorbing sheets - BWR	A2.1-a

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
37	Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M25, “BWR Reactor Water Cleanup System”	Stainless steel	Treated water >60°C (>140°F)	A-60	Piping, piping components, and piping elements	E3.1-a E3.2-a
38	Cracking/ stress corrosion cracking	NA	BWR	No	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel	Treated water >60°C (>140°F)	A-61	Piping, piping components, and piping elements	E4.1-c E4.3-a
39	Cracking/ stress corrosion cracking	NA	BWR	No	Chapter XI.M2, “Water Chemistry,” for BWR water	Stainless steel	Treated water >60°C (>140°F)	A-96	Spent fuel storage racks Storage racks - BWR	A2.1-c
40	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M29, “Aboveground Steel Tanks”	Steel	Air – outdoor (External)	A-95	Tanks	H1.4-b
41	Cracking/ cyclic loading, stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	High-strength steel	Air with steam or water leakage	A-04	Closure bolting	I.2-b
42	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Steel	Air with steam or water leakage	A-03	Closure bolting	I.2-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
43	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Steel	Air – indoor uncontrolled (External)	AP-27	Closure bolting	I.
							Air – outdoor (External)	AP-28	Bolting	I.
44	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Steel	Condensation	A-103	Closure bolting	D.2-a
45	Loss of preload/ thermal effects, gasket creep, and self-loosening	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Steel	Air – indoor uncontrolled (External)	AP-26	Closure bolting	I.
46	Cracking/ stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Stainless steel	Closed cycle cooling water >60°C (>140°F)	AP-60	Piping, piping components, and piping elements	C2. E3. E4.
						Stainless steel; steel with stainless steel cladding	Closed cycle cooling water >60°C (>140°F)	A-68	Heat exchanger components	E3.4-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
47	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	A-25	Piping, piping components, piping elements, and tanks	C2.1-a C2.2-a C2.3-a C2.4-a C2.5-a F1.3-a F2.3-a F3.3-a F4.3-a H2.1-a
48	Loss of material/ general, pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	A-63	Heat exchanger components	A3.4-a A4.4-a E1.8-c E4.4-a C2. E3. F1. F2. F3. F4.
49	Loss of material/ microbiologically influenced corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel; steel with stainless steel cladding	Closed cycle cooling water	A-67	Heat exchanger components	E3.4-b E4.4-a
50	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water	A-52	Piping, piping components, and piping elements	C2.2-a
51	Loss of material/ pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Copper alloy	Closed cycle cooling water	AP-12	Piping, piping components, and piping elements	A3. A4. C2. E1. E3. E4. F1. F2. F3. F4. H1. H2.
								AP-34	Heat exchanger components	E1. F1. F3.

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
52	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Copper alloy	Closed cycle cooling water	AP-80	Heat exchanger tubes	C2. F1. F2. F3.
						Stainless steel	Closed cycle cooling water	AP-63	Heat exchanger tubes	C2. E3. E4.
						Steel	Closed cycle cooling water	AP-77	Heat exchanger tubes	F1. F2. F3. F4.
53	Loss of material/ general and pitting corrosion	NA	BWR/ PWR	No	Chapter XI.M24, “Compressed Air Monitoring”	Steel	Condensation (Internal)	A-26	Compressed air system Piping, piping components, and piping elements	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a
54	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M24, “Compressed Air Monitoring”	Stainless steel	Condensation (Internal)	AP-81	Piping, piping components, and piping elements	D.
55	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	A-105	Ducting closure bolting	F1.1-a F2.1-a F3.1-a F4.1-a I.
56	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	A-10	Ducting and components external surfaces	F1.1-a F1.4-a F2.1-a F2.4-a F3.1-a F3.4-a F4.1-a
57	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	A-80	Piping and components external surfaces	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
58	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	A-77	External surfaces	I.1-b
							Air – outdoor (External)	A-78	External surfaces	I.1-b
							Condensation (External)	A-81	External surfaces	I.1-b
59	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	AP-41	Heat exchanger components	F1. F2. F3. F4. G. H2.
							Air – outdoor (External)	AP-40	Heat exchanger components	G. H2.
60	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – outdoor (External)	A-24	Piping, piping components, and piping elements	H1.1-a H1.2-a H1.3-a
61	Increased hardness, shrinkage and loss of strength/ weathering	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection”	Elastomers	Air – indoor uncontrolled	A-19	Fire barrier penetration seals	G.1-a G.2-a G.3-a G.4-a
							Air – outdoor	A-20	Fire barrier penetration seals	G.1-a G.2-a G.3-a G.4-a

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
62	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection”	Aluminum	Raw water	AP-83	Piping, piping components, and piping elements	G.
63	Loss of material/ wear	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection”	Steel	Air – indoor uncontrolled	A-21	Fire rated doors	G.1-d G.2-d G.3-d G.4-d G.5-c
							Air – outdoor	A-22	Fire rated doors	G.1-d G.2-d G.3-d G.4-d
64	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection,” and Chapter XI.M30, “Fuel Oil Chemistry”	Steel	Fuel oil	A-28	Piping, piping components, and piping elements	G.8-a
65	Concrete cracking and spalling/ aggressive chemical attack, and reaction with aggregates	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	Reinforced concrete	Air – indoor uncontrolled	A-90	Structural fire barriers: Walls, ceilings and floors	G.1-b G.2-b G.3-b G.4-b G.5-a
66	Concrete cracking and spalling/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	NA	BWR/ PWR	No	Chapter XI.M26, “Fire Protection” and Chapter XI.S6, “Structures Monitoring Program”	Reinforced concrete	Air – outdoor	A-92	Structural fire barriers: Walls, ceilings and floors	G.1-b G.2-b G.3-b G.4-b

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
67	Loss of material/ corrosion of embedded steel	NA	BWR/ PWR	No	Chapter XI.M26, "Fire Protection" and Chapter XI.S6, "Structures Monitoring Program"	Reinforced concrete	Air – indoor uncontrolled	A-91	Structural fire barriers: Walls, ceilings and floors	G.1-c G.2-c G.3-c G.4-c G.5-b
							Air – outdoor	A-93	Structural fire barriers: Walls, ceilings and floors	G.1-c G.2-c G.3-c G.4-c
68	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M27, "Fire Water System"	Steel	Raw water	A-33	Piping, piping components, and piping elements	G.6-a G.6-b
69	Loss of material/ pitting and crevice corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M27, "Fire Water System"	Stainless steel	Raw water	A-55	Piping, piping components, and piping elements	G.6-a G.6-b
70	Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M27, "Fire Water System"	Copper alloy	Raw water	A-45	Piping, piping components, and piping elements	G.6-b

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
71	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Moist air or condensation (Internal)	A-23	Piping, piping components, and piping elements	H2.2-a H2.3-a G.
72	Loss of material/ general, pitting, crevice, and (for drip pans and drain lines) microbiologic ally influenced corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Condensation (Internal)	A-08	Ducting and components internal surfaces	F1.1-a F2.1-a F3.1-a F4.1-a F1.4-a F2.4-a F3.4-a
73	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	Steel	Air – indoor uncontrolled (External)	A-07	Cranes - Structural girders	B.1-b
74	Loss of material/ wear	NA	BWR/ PWR	No	Chapter XI.M23, “Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems”	Steel	Air – indoor uncontrolled (External)	A-05	Cranes - rails	B.2-a
75	Hardening and loss of strength/ elastomer degradation	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Elastomers	Raw water	AP-75	Elastomer seals and components	C1.
	Loss of material/ erosion	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Elastomers	Raw water	AP-76	Elastomer seals and components	C1.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
76	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, fouling, and lining/coating degradation	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Steel (with or without lining/coating or with degraded lining/coating)	Raw water	A-38	Piping, piping components, and piping elements	C1.1-a C1.2-a C1.5-a C1.6-a H2.1-b C3.1-a C3.2-a C3.3-a
77	Loss of material/ general, pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Steel	Raw water	A-64	Heat exchanger components	C1.3-a
78	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	A-43	Piping, piping components, and piping elements	C3.1-a C3.2-a
						Nickel alloy	Raw water	AP-53	Piping, piping components, and piping elements	C1. C3.
						Stainless steel	Raw water	A-53	Piping, piping components, and piping elements	C3.2-a

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
79	Loss of material/ pitting and crevice corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Stainless steel	Raw water	A-54	Piping, piping components, and piping elements	C1.1-a C1.2-a C1.4-a C1.6-a
80	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	AP-45	Piping, piping components, and piping elements	H2.
						Stainless steel	Raw water	AP-55	Piping, piping components, and piping elements	H2.
81	Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	A-44	Piping, piping components, and piping elements	C1.1-a C1.2-a
82	Loss of material/ pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	A-65	Heat exchanger components	C1.3-a
83	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	A-72	Heat exchanger tubes	C1.3-b

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Stainless steel	Raw water	AP-61	Heat exchanger tubes	C1. C3. G. H2.
84	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials”	Copper alloy >15% Zn	Closed cycle cooling water	AP-43	Piping, piping components, and piping elements	A3. A4. C2.E1. E3. E4. F1. F2. F3. F4. H1. H2.
							Raw water	A-47	Piping, piping components, and piping elements	C1.1-a C1.2-a C3.1-a C3.2-a G.6-b H2.
								A-66	Heat exchanger components	C1.3-a
							Treated water	AP-32	Piping, piping components, and piping elements	A4. C2. E3. E4.
								AP-65	Heat exchanger components	E1. F1. F3.
85	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, “Selective Leaching of Materials"	Gray cast iron	Soil	A-02	Piping, piping components, and piping elements	C1.1-c C3. G. H1. H2.
					Chapter XI.M33, “Selective Leaching of Materials”	Gray cast iron	Closed cycle cooling water	A-50	Piping, piping components, and piping elements	C2.3-a F3.
							Raw water	A-51	Piping, piping components, and piping elements	C1.5-a C3. G. H2.
							Treated water	AP-31	Piping, piping components, and piping elements	A3. A4. C2. E1. E3. E4. F1. F2. F4. G.

Table B.3 Auxiliary Systems										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
86	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.S6, "Structures Monitoring Program"	Steel	Air – indoor uncontrolled (External)	A-94	Structural Steel	A1.1-a
87	Reduction of neutron-absorbing capacity/ boraflex degradation	NA	PWR	No	Chapter XI.M22, "Boraflex Monitoring"	Boraflex	Treated borated water	A-86	Spent fuel storage racks Neutron-absorbing sheets - PWR	A2.1-a
88	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, "Boric Acid Corrosion"	Aluminum	Air with borated water leakage	AP-1	Piping, piping components, and piping elements	A3. E1.
						Copper alloy >15% Zn	Air with borated water leakage	AP-66	Piping, piping components, and piping elements	I.
89	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, "Boric Acid Corrosion"	Steel	Air with borated water leakage	A-102	Bolting	I.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
								A-79	External surfaces	A3.1-a A3.2-b A3.2-c A3.3-c A3.4-b A3.5-b A3.6-a E1.1-b E1.2-a E1.3-b E1.4-a E1.5-b E1.6-a E1.7-b E1.8-d E1.9-a E1.10-a I.1-a
90	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel	Treated borated water >60°C (>140°F)	A-97	Spent fuel storage racks Storage racks - PWR	A2.1-c
								AP-82	Piping, piping components, piping elements, and tanks	E1.
						Steel with stainless steel cladding	Treated borated water >60°C (>140°F)	A-56	Piping, piping components, and piping elements	A3.3-b
91	Loss of material/ pitting and crevice corrosion	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water	Stainless steel; steel with stainless steel cladding	Treated borated water	AP-79	Piping, piping components, and piping elements	E1. A2. A3.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
92	None	NA	BWR/ PWR	No	None	Galvanized steel	Air – indoor uncontrolled	AP-13	Piping, piping components, and piping elements	J.
93	None	NA	BWR/ PWR	No	None	Glass	Air	AP-48	Piping elements	J.
							Air – indoor uncontrolled (External)	AP-14	Piping elements	J.
							Fuel oil	AP-49	Piping elements	J.
							Lubricating oil	AP-15	Piping elements	J.
							Raw water	AP-50	Piping elements	J.
							Treated borated water	AP-52	Piping elements	J.
							Treated water	AP-51	Piping elements	J.
94	None	NA	BWR/ PWR	No	None	Nickel alloy	Air – indoor uncontrolled (External)	AP-16	Piping, piping components, and piping elements	J.
						Stainless steel	Air – indoor uncontrolled (External)	AP-17	Piping, piping components, and piping elements	J.
95	None	NA	BWR/ PWR	No	None	Aluminum	Air – indoor controlled (External)	AP-36	Piping, piping components, and piping elements	J.
						Steel	Air – indoor controlled (External)	AP-2	Piping, piping components, and piping elements	J.
96	None	NA	BWR/ PWR	No	None	Stainless steel	Concrete	AP-19	Piping, piping components, and piping elements	J.
						Steel	Concrete	AP-3	Piping, piping components, and piping elements	J.

Table B.3 Auxiliary Systems

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
97	None	NA	BWR/ PWR	No	None	Aluminum	Gas	AP-37	Piping, piping components, and piping elements	J.
						Copper alloy	Gas	AP-9	Piping, piping components, and piping elements	J.
						Stainless steel	Gas	AP-22	Piping, piping components, and piping elements	J.
						Steel	Gas	AP-6	Piping, piping components, and piping elements	J.
98	None	NA	BWR/ PWR	No	None	Copper alloy	Dried Air	AP-8	Piping, piping components, and piping elements	J.
						Stainless steel	Dried Air	AP-20	Piping, piping components, and piping elements	J.
						Steel	Dried Air	AP-4	Piping, piping components, and piping elements	J.
99	None	NA	PWR	No	None	Copper alloy <15% Zn	Air with borated water leakage	AP-11	Piping, piping components, and piping elements	J.
						Stainless steel	Air with borated water leakage	AP-18	Piping, piping components, and piping elements	J.

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B.4 Steam and Power Conversion SRP-LR Development Tool

Table B.4 presents the steam and power conversion SRP-LR development tool.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Cumulative fatigue damage/ fatigue	3.4.2.2.1	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel	Steam or treated water	S-08	Piping, piping components, and piping elements	B1.1-b B2.1-c
							Treated water	S-11	Piping, piping components, and piping elements	D1.1-b D2.1-c G.1-b
2	Loss of material/ general, pitting, and crevice corrosion	3.4.2.2.2.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Steam	S-04	Piping, piping components, and piping elements	A.1-b A.2-b C.1-b C.2-b

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
					Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Steam	S-06	Piping, piping components, and piping elements	A.1-b A.2-b C.1-b C.2-b
3	Loss of material/ general, pitting, and crevice corrosion	3.4.2.2.2.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	S-19	PWR heat exchanger components	E.4-a E.4-d F.4-a F.4-d
4	Loss of material/ general, pitting, and crevice corrosion	3.4.2.2.2.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	S-09	Piping, piping components, and piping elements	B2. C. D2.1-b D2.2-b D2.3-b E.1-b E.2-b E.3-a E.5-a E.6-a

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
					Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	S-10	Piping, piping components, and piping elements	B1. C. D1.1-c D1.2-b D1.3-a E.1-b E.2-b E.3-a E.5-a E.6-a F.1-b F.2-b F.3-a G.1-c G.2-a G.3-a G.4-a
5	Loss of material/ general (steel only), pitting and crevice corrosion	3.4.2.2.7.1 for stainless steel componen ts; 3.4.2.2.2.1 for steel tanks	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel, Stainless steel	Treated water	S-13	Tanks	E.5-a E.5-b G.4-a G.4-b
6	Loss of material/ general, pitting, and crevice corrosion	3.4.2.2.2.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Lubricating oil	SP-25	Piping, piping components, and piping elements	A. D1. D2. E. G.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
7	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	3.4.2.2.3	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Raw water	S-12	Piping, piping components, and piping elements	G.1-d
8	Reduction of heat transfer/ fouling	3.4.2.2.4.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry” The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Copper alloy	Treated water	SP-58	Heat exchanger tubes	E. F. G.
						Stainless steel	Treated water	SP-40	Heat exchanger tubes	E. F.
9	Reduction of heat transfer/ fouling	3.4.2.2.4.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Copper alloy	Lubricating oil	SP-53	Heat exchanger tubes	G.
						Stainless steel	Lubricating oil	SP-62	Heat exchanger tubes	G.
						Steel	Lubricating oil	SP-63	Heat exchanger tubes	G.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
10	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.5.1	BWR/ PWR	No Yes, detection of aging effects and operating experience are to be further evaluated	Chapter XI.M28, “Buried Piping and Tanks Surveillance,” or Chapter XI.M34, “Buried Piping and Tanks Inspection”	Steel (with or without coating or wrapping)	Soil	S-01	Buried piping, piping components, piping elements, and tanks	E.5-d G.1-e G.4-d
11	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.5.2	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Steel	Lubricating oil	S-17	Heat exchanger components	G.5-d
12	Cracking/ stress corrosion cracking	3.4.2.2.6	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, “One-Time Inspection,” for an acceptable verification program.	Stainless steel	Steam	SP-45	Piping, piping components, and piping elements	A. B2.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
13	Cracking/ stress corrosion cracking	3.4.2.2.6	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water >60°C (>140°F)	SP-19	Piping, piping components, and piping elements	E.
					Chapter XI.M2, "Water Chemistry," for PWR secondary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water >60°C (>140°F)	S-39	Heat exchanger components	F.4-a
								SP-17	Piping, piping components, and piping elements	B1. C. E. D1. F. G.
					Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water >60°C (>140°F)	SP-42	Tanks	E.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
14	Loss of material/ pitting and crevice corrosion	3.4.2.2.7.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Aluminum	Treated water	SP-24	Piping, piping components, and piping elements	D1. D2. E. F. G.
						Copper alloy	Treated water	SP-61	Piping, piping components, and piping elements	A. F.
15	Loss of material/ pitting and crevice corrosion	3.4.2.2.7.1	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water	S-21	Heat exchanger components	E.4-a E.4-d
					Chapter XI.M2, "Water Chemistry," for PWR primary water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water	S-22	PWR heat exchanger components	E.4-a E.4-d F.4-a F.4-d

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
					Chapter XI.M2, "Water Chemistry" The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Treated water	SP-16	Piping, piping components, and piping elements	B1. C. D1. F. G. E. D2.
16	Loss of material/ pitting and crevice corrosion	3.4.2.2.7.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Soil	SP-37	Piping, piping components, and piping elements	E. G.
17	Loss of material/ pitting and crevice corrosion	3.4.2.2.7.3	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Copper alloy	Lubricating oil	SP-32	Piping, piping components, and piping elements	A. D1. D2. E. G.

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
18	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.8	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program . See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Stainless steel	Lubricating oil	S-20	Heat exchanger components	G.5-d
								SP-38	Piping, piping components, and piping elements	A. D1. D2. E. G.
19	Loss of material/ general, pitting, crevice, and galvanic corrosion	3.4.2.2.9	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water The AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Steel	Treated water	S-18	Heat exchanger components	E.4-a E.4-d
20	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M29, "Aboveground Steel Tanks"	Steel	Air – outdoor (External)	S-31	Tanks	E.5-c G.4-c
21	Cracking/ cyclic loading, stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	High-strength steel	Air with steam or water leakage	S-03	Closure bolting	H.2-b

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
22	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air with steam or water leakage	S-02	Closure bolting	H.2-a
	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	S-34	Closure bolting	H.
							Air – outdoor (External)	S-32	Bolting	H.
	Loss of preload/ thermal effects, gasket creep, and self-loosening	NA	BWR/ PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	S-33	Closure bolting	H.
23	Cracking/ stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water >60°C (>140°F)	SP-54	Piping, piping components, and piping elements	E. F. G.
24	Loss of material/ general, pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	S-23	Heat exchanger components	A. E.4-e F.4-e G.5-c
25	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water	S-25	Heat exchanger components	E.4-e F.4-e G.5-c

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
								SP-39	Piping, piping components, and piping elements	E. F. G.
26	Loss of material/ pitting, crevice, and galvanic corrosion	NA	BWR/ PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Copper alloy	Closed cycle cooling water	SP-8	Piping, piping components, and piping elements	E. F. G.
27	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Copper alloy	Closed cycle cooling water	SP-57	Heat exchanger tubes	E.
						Stainless steel	Closed cycle cooling water	SP-41	Heat exchanger tubes	E. F. G.
						Steel	Closed cycle cooling water	SP-64	Heat exchanger tubes	A. E.4-e F.4-e G.5-c
28	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M36, "External Surfaces Monitoring"	Steel	Air – indoor uncontrolled (External)	S-29	External surfaces	H.1-b
							Air – outdoor (External)	S-41	External surfaces	H.1-b
							Condensation (External)	S-42	External surfaces	H.1-b
29	Wall thinning/ flow-accelerated corrosion	NA	BWR/ PWR	No	Chapter XI.M17, “Flow-Accelerated Corrosion”	Steel	Steam	S-15	Piping, piping components, and piping elements	A.1-a A.2-a B1.1-c B1.2-b B2.1-b B2.2-a C.1-a C.2-a

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
							Treated water	S-16	Piping, piping components, and piping elements	D1.1-a D1.2-a D1.3-b D2.1-a D2.2-a D2.3-a E.1-a E.2-a F.1-a F.2-a G.1-a
30	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"	Steel	Air – outdoor (Internal)	SP-59	Piping, piping components, and piping elements	B1.
							Condensation (Internal)	SP-60	Piping, piping components, and piping elements	B1. G.
31	Loss of material/ general, pitting, crevice, galvanic, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Steel	Raw water	S-24	Heat exchanger components	E.4-b F.4-b G.5-a
32	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	NA	BWR/ PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Copper alloy	Raw water	SP-31	Piping, piping components, and piping elements	A. E. F. G.

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
						Stainless steel	Raw water	SP-36	Piping, piping components, and piping elements	E. F. G.
33	Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Stainless steel	Raw water	S-26	Heat exchanger components	E.4-b F.4-b G.5-a
34	Reduction of heat transfer/ fouling	NA	BWR/ PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Copper alloy	Raw water	SP-56	Heat exchanger tubes	E. F. G.
						Stainless steel	Raw water	S-28	Heat exchanger tubes	E.4-c F.4-c G.5-b
						Steel	Raw water	S-27	Heat exchanger tubes	G.5-b
35	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, "Selective Leaching of Materials"	Copper alloy >15% Zn	Closed cycle cooling water	SP-29	Piping, piping components, and piping elements	E. F. G.
							Raw water	SP-30	Piping, piping components, and piping elements	A. E. F. G.
							Treated water	SP-55	Piping, piping components, and piping elements	E. F. G.
36	Loss of material/ selective leaching	NA	BWR/ PWR	No	Chapter XI.M33, "Selective Leaching of Materials"	Gray cast iron	Soil	SP-26	Piping, piping components, and piping elements	E. G.
					Chapter XI.M33, "Selective Leaching of Materials"	Gray cast iron	Raw water	SP-28	Piping, piping components, and piping elements	A. G.

Table B.4 Steam and Power Conversion										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
							Treated water	SP-27	Piping, piping components, and piping elements	A. E. F. G.
37	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M2, "Water Chemistry," for BWR water	Stainless steel	Steam	SP-46	Piping, piping components, and piping elements	A. B2.
						Steel	Steam	S-05	Piping, piping components, and piping elements	B2.1-a B2.2-b
					Chapter XI.M2, "Water Chemistry," for PWR secondary water	Nickel-based alloys	Steam	SP-18	Piping, piping components, and piping elements	B1.
						Stainless steel	Steam	SP-43	Piping, piping components, and piping elements	A. B1.
						Steel	Steam	S-07	Piping, piping components, and piping elements	B1.1-a B1.2-a
38	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, "Boric Acid Corrosion"	Steel	Air with borated water leakage	S-30	External surfaces	H.1-a
								S-40	Bolting	H.
39	Cracking/ stress corrosion cracking	NA	PWR	No	Chapter XI.M2, "Water Chemistry," for PWR secondary water	Stainless steel	Steam	SP-44	Piping, piping components, and piping elements	A. B1.
40	None	NA	BWR/ PWR	No	None	Glass	Air	SP-33	Piping elements	I.
							Air – indoor uncontrolled (External)	SP-9	Piping elements	I.
							Lubricating oil	SP-10	Piping elements	I.

Table B.4 Steam and Power Conversion

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
							Raw water	SP-34	Piping elements	I.
							Treated water	SP-35	Piping elements	I.
41	None	NA	BWR/ PWR	No	None	Copper alloy	Air – indoor uncontrolled (External)	SP-6	Piping, piping components, and piping elements	I.
						Nickel alloy	Air – indoor uncontrolled (External)	SP-11	Piping, piping components, and piping elements	I.
						Stainless steel	Air – indoor uncontrolled (External)	SP-12	Piping, piping components, and piping elements	I.
42	None	NA	BWR/ PWR	No	None	Steel	Air – indoor controlled (External)	SP-1	Piping, piping components, and piping elements	I.
43	None	NA	BWR/ PWR	No	None	Stainless steel	Concrete	SP-13	Piping, piping components, and piping elements	I.
						Steel	Concrete	SP-2	Piping, piping components, and piping elements	I.
44	None	NA	BWR/ PWR	No	None	Aluminum	Gas	SP-23	Piping, piping components, and piping elements	I.
						Copper alloy	Gas	SP-5	Piping, piping components, and piping elements	I.
						Stainless steel	Gas	SP-15	Piping, piping components, and piping elements	I.
						Steel	Gas	SP-4	Piping, piping components, and piping elements	I.

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B.5 Structures SRP-LR Development Tool

Table B.5 presents the structures SRP-LR development tool.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	3.5.2.2.1.1	BWR/ PWR	Yes, plant-specific if environment is aggressive	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Concrete; steel	Air – indoor uncontrolled or air – outdoor	C-05	Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel	A1.1-e
								C-41	Concrete: Basemat; reinforcing steel	B2.2.1-d B1.2.
								C-42	Concrete: Dome; wall; basemat; reinforcing steel	B3.2.1-e

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Concrete; steel	Air – indoor uncontrolled or air – outdoor	C-43	Concrete: Basemat; reinforcing steel	A2.2-e B3.1.2-d

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	3.5.2.2.1.1	BWR/ PWR	Yes, plant-specific if environment is aggressive	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity and permeability, surface cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Concrete	Ground water/soil or air-indoor uncontrolled or air-outdoor	C-03	Concrete: Dome; wall; basemat; ring girders; buttresses	A1.1-c
								C-25	Concrete: Basemat	A2.2-c B.3.1.2-b
								C-26	Concrete: Containment; wall; basemat	B.2.2.1-b B.1.2.
								C-27	Concrete: Dome; wall; basemat	B3.2.1-c

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
2	Cracks and distortion due to increased stress levels from settlement	3.5.2.2.1.2	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon	Chapter XI.S6, "Structures Monitoring Program" 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 period of extended operation.	Concrete	Soil	C-06	Concrete elements; All	B2.2.1-e B3.2.1-f B1.2.
								C-36	Concrete: Basemat	A2.2-f B3.1.2-e
								C-37	Concrete: Dome; wall; basemat; ring girders; buttresses	A1.1-f
3	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	3.5.2.2.1.2	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. 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 period of extended operation.	Concrete; porous concrete	Water – flowing	C-07	Concrete: Foundation; subfoundation	A1.1-g A2.2-g B2.2.1-f B3.1.2-f B3.2.1-g B1.2.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
4	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	3.5.2.2.1.3	BWR/ PWR	Yes, if temperature limits are exceeded	Plant-specific aging management program 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 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 this reduction is applied to the design allowables.	Concrete	Air – indoor uncontrolled or air – outdoor	C-33	Concrete: Dome; wall; basemat	B3.2.1-h
								C-34	Concrete: Basemat	A2.2-h
								C-35	Concrete: Containment; wall; basemat	B2.2.1-g B1.2.
								C-50	Concrete: Basemat, concrete fill-in annulus	B3.1.2-g

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Plant-specific aging management program 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 this reduction is applied to the design allowables.	Concrete	Air – indoor uncontrolled or air – outdoor	C-08	Concrete: Dome; wall; basemat; ring girder; buttresses	A1.1-h

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
5	Loss of material/ general, pitting, and crevice corrosion	3.5.2.2.1.4	BWR	Yes, if corrosion is significant for inaccessible areas	Chapter XI.S1, "ASME Section XI, Subsection IWE" For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary.	Steel	Air – indoor uncontrolled or treated water (as applicable)	C-46	Steel elements: Suppression chamber; drywell liner; drywell head; embedded shell; sand pocket region; support skirt; downcomer pipes; region shielded by diaphragm floor NOTE: Inspection of containment supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)	B2.1.1-a B2.2.2-a B1.2.
				No	Chapter XI.S4, "10 CFR Part 50, Appendix J"					
				Yes, if corrosion is significant for inaccessible areas	Chapter XI.S1, "ASME Section XI, Subsection IWE" For inaccessible areas (embedded containment steel shell or liner), loss of material due to corrosion is not significant if the following conditions are satisfied: Concrete meeting the specifications of ACI 318 or 349 and the guidance of 201.2R was used for the containment concrete in contact with the embedded containment shell or liner. The concrete is monitored to ensure that it is free of penetrating cracks that provide a path for water	Steel	Air – indoor uncontrolled or treated water (as applicable)	C-19	Steel elements: Drywell; torus; drywell head; embedded shell and sand pocket regions; drywell support skirt; torus ring girder; downcomers; ECCS	B1.1.1-a B3.1.1-a

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
				     No	seepage to the surface of the containment shell or liner. The moisture barrier, at the junction where the shell or liner becomes embedded, is subject to aging management activities in accordance with ASME Section XI, Subsection IWE requirements. Water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary				suction header NOTE: Inspection of containment supports is addressed by ASME Section XI, Subsection IWF (see III.B1.3)	

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
6	Loss of material/ general, pitting, and crevice corrosion	3.5.2.2.1.4	BWR/ PWR	Yes, if corrosion is significant for inaccessible areas No	Chapter XI.S1, "ASME Section XI, Subsection IWE" 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 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. 3. 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. 4. Borated water spills and water ponding on the containment concrete floor are not common and when detected are cleaned up in a timely manner. If any of the above conditions cannot be satisfied, then a plant-specific aging management program for corrosion is necessary. Chapter XI.S4, "10 CFR Part 50, Appendix J"	Steel	Air – indoor uncontrolled	C-09	Steel elements: Liner; Liner anchors; Integral attachments	A1.2-a A2.1-a B3.2.2-a

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
7	Loss of prestress/ relaxation; shrinkage; creep; elevated temperature	3.5.2.2.1.5	BWR/ PWR	Yes, TLAA	Loss of tendon prestress is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, 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.	Steel	Air – indoor uncontrolled or air – outdoor	C-11	Prestressing system: Tendons	A1.3-b B2.2.3-b
8	Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	3.5.2.2.1.6	BWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Stainless steel; steel	Air – indoor uncontrolled	C-21	Steel elements: Torus; Vent line; Vent header; Vent line bellows; Downcomers	B1.1.1-c
							Air – indoor uncontrolled or treated water (as applicable)	C-48	Steel elements: Vent header; Downcomers	B2.2.2-d
9	Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	3.5.2.2.1.6	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	C-13	Penetration sleeves; Penetration bellows	A3.1-b B4.1-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.6, "Containment Liner Plate and Penetration Fatigue Analysis" for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel; stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	C-45	Suppression pool shell; unbraced downcomers	B2.1.1-c
10	Cracking/ stress corrosion cracking	3.5.2.2.1.7	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: Transgranular Stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Section XI, Subsection IWE covers inspection of these items under examination categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B & E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.	Stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	C-15	Penetration sleeves; Penetration bellows	A3.1-d B4.1-d

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
11	Cracking/ stress corrosion cracking	3.5.2.2.1.7	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: Stress corrosion cracking (SCC) is a concern for dissimilar metal welds. In the case of bellows assemblies, SCC may cause aging effects particularly if the material is not shielded from a corrosive environment. ASME Code 1995 edition, with addenda through 1996, ASME Section XI, Subsection IWE covers inspection of these items under Examination Categories E-B, E-F, and E-P (10 CFR Part 50, Appendix J pressure tests). 10 CFR 50.55a identifies examination categories E-B and E-F as optional during the current term of operation. For the extended period of operation, Examination Categories E-B and E-F, and additional appropriate examinations to detect SCC in bellows assemblies and dissimilar metal welds are warranted to address this issue. (10) Operating Experience: IN 92-20 describes an instance of containment bellows cracking, resulting in loss of leak tightness.	Stainless steel	Air – indoor uncontrolled	C-22	Steel elements: Vent line bellows	B1.1.1-d
12	Cracking/ cyclic loading (CLB fatigue analysis does not exist)	3.5.2.2.1.8	BWR/ PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is to be supplemented to consider the following: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	Steel; stainless steel; dissimilar metal welds	Air – indoor uncontrolled or air – outdoor	C-14	Penetration sleeves; Penetration bellows	A3.1-c B4.1-c
								C-44	Suppression pool shell; unbraced downcomers	B2.1.1-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
13	Cracking/ cyclic loading (CLB fatigue analysis does not exist)	3.5.2.2.1.8	BWR	Yes, detection of aging effects is to be evaluated	Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	Stainless steel; steel	Air – indoor uncontrolled	C-20	Steel elements: Torus; Vent line; Vent header; Vent line bellows ; Downcomers	B1.1.1-b
					Chapter XI.S1, "ASME Section XI, Subsection IWE " and Chapter XI.S4, "10 CFR Part 50, Appendix J" Evaluation of 10 CFR 50.55a/ASME Section XI, Subsection IWE is augmented as follows: (4) Detection of Aging Effects: VT-3 visual inspection may not detect fine cracks.	Stainless steel; steel	Air – indoor uncontrolled	C-47	Steel elements: Vent header; Downcomers	B2.2.2-c
14	Loss of material (spalling, scaling) and cracking/ freeze-thaw	3.5.2.2.1.9	BWR/ PWR	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions	Chapter XI.S2, "ASME Section XI, Subsection IWL" Accessible areas: Inspections performed in accordance with IWL will indicate the presence of loss of material (spalling, scaling) and surface cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index >100 day-inch/yr) (NUREG-1557). Documented evidence confirms that where the existing concrete had air content of 3% to 6%, subsequent inspections did not exhibit degradation related to freeze-thaw. Such inspections should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig. 1.	Concrete	Air – outdoor	C-01	Concrete: Dome; wall; basemat; ring girders; buttresses	A1.1-a
				Yes, for inaccessible areas of plants located in moderate to severe weathering conditions				C-28	Concrete: Basemat	A2.2-a
								C-29	Concrete: Dome; wall; basemat	B3.2.1-a

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
15	Cracking due to expansion/ reaction with aggregates	3.5.2.2.1.10	BWR/ PWR	Yes, if concrete was not constructed as stated for inaccessible areas	Chapter XI.S2, "ASME Section XI, Subsection IWL." Accessible Areas: Inspections performed in accordance with IWL will indicate the presence of surface cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R.Therefore, if these conditions are satisfied, aging management program is not necessary.	Concrete	Any	C-04	Concrete: Dome; wall; basemat; ring girders; buttresses	A1.1-d
								C-38	Concrete: Basemat	A2.2-d
								C-39	Concrete: Containment; wall; basemat	B2.2.1-c B1.2.
								C-40	Concrete: Dome; wall; basemat	B3.2.1-d
								C-51	Concrete: Basemat, concrete fill-in annulus	B3.1.2-c
	Increase in porosity, permeability/ leaching of calcium hydroxide	3.5.2.2.1.10	BWR/ PWR	Yes, if concrete was not constructed as stated for inaccessible areas	Chapter XI.S2, "ASME Section XI, Subsection IWL" Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	Concrete	Water – flowing	C-02	Concrete: Dome; wall; basemat; ring girders; buttresses	A1.1-b
								C-32	Concrete: Dome; wall; basemat	B3.2.1-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
					Chapter XI.S2, “ASME Section XI, Subsection IWL” Accessible areas: Inspections performed in accordance with IWL will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	Concrete	Water – flowing	C-30	Concrete: Basemat	A2.2-b B3.1.2-a
								C-31	Concrete: Containment; wall; basemat	B2.2.1-a B1.2.
16	Loss of sealing; Leakage through containment/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	NA	BWR/ PWR	No	Chapter XI.S1, “ASME Section XI, Subsection IWE” Leak tightness will be monitored by 10 CFR Part 50, Appendix J Leak Rate Tests for pressure boundary, seals and gaskets (including O-rings).	Elastomers, rubber and other similar materials	Air – indoor uncontrolled or air – outdoor	C-18	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	A3.3-a B4.3-a

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
17	Loss of leak tightness/ mechanical wear of locks, hinges and closure mechanisms	NA	BWR/ PWR	No	Chapter XI.S4, "10 CFR Part 50, Appendix J" and Plant Technical Specifications	Steel	Air – indoor uncontrolled or air outdoor	C-17	Personnel airlock, equipment hatch, CRD hatch: Locks, hinges, and closure mechanisms	A3.2-b B4.2-b
18	Loss of material/ general, pitting, and crevice corrosion	NA	BWR/ PWR	No No	Chapter XI.S1, "ASME Section XI, Subsection IWE," and (Note: IWE examination category E-F, surface examination of dissimilar metal welds, is recommended) Chapter XI.S4, "10 CFR Part 50, Appendix J"	Steel; dissimilar metal welds	Air – indoor uncontrolled or air outdoor	C-12	Penetration sleeves	A3.1-a B4.1-a
				No No	Chapter XI.S1, "ASME Section XI, Subsection IWE," and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Steel	Air – indoor uncontrolled or air – outdoor	C-16	Personnel airlock, equipment hatch, CRD hatch	A3.2-a B4.2-a
19	Cracking/ stress corrosion cracking	NA	BWR	No	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Stainless steel	Air – indoor uncontrolled	C-24	Steel elements: Suppression chamber shell (interior surface)	B3.1.1-b B3.2.2-b
20	Loss of material/ general, pitting, and crevice corrosion	NA	BWR	No	Chapter XI.S1, "ASME Section XI, Subsection IWE" and Chapter XI.S4, "10 CFR Part 50, Appendix J"	Stainless steel; steel	Air – indoor uncontrolled or treated water (as applicable)	C-49	Steel elements: Suppression chamber liner (interior surface)	B2.2.2-b B1.2.
21	Fretting or lockup/ mechanical wear	NA	BWR	No	Chapter XI.S1, "ASME Section XI, Subsection IWE"	Steel	Air – indoor uncontrolled	C-23	Steel elements: Drywell head; Downcomers	B1.1.1-e B2.2.2-e B2.1.1-d B1.2.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
22	Loss of material/ corrosion	NA	BWR/ PWR	No	Chapter XI.S2, "ASME Section XI, Subsection IWL"	Steel	Air – indoor uncontrolled or air – outdoor	C-10	Prestressing system: Tendons; anchorage components	A1.3-a B2.2.3-a
23	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	3.5.2.2.2.1	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel.	Reinforced concrete	Air – indoor uncontrolled or air – outdoor	T-04	Concrete: Interior and above-grade exterior	A1.1-d A2.1-d A3.1-d A4.1-d A5.1-d A7.1-d A9.1-d
24	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	3.5.2.2.2.1	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with Structures Monitoring Program will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack.	Reinforced concrete	Air-indoor uncontrolled or air-outdoor	T-06	Concrete: Interior and above-grade exterior	A1.1-f A2.1-f A3.1-f A4.1-a A5.1-f A7.1-f A9.1-f
25	Loss of material/ corrosion	3.5.2.2.2.1	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program" If protective coatings are relied upon to manage the effects of aging, the structures monitoring program is to include provisions to address protective coating monitoring and maintenance.	Steel	Air – indoor uncontrolled or air – outdoor	T-11	Steel components: All structural steel	A1.2-a A2.2-a A3.2-a A4.2-a A5.2-a A7.2-a A8.2-a

Table B.5 Structures										
ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
26	Loss of material (spalling, scaling) and cracking/ freeze-thaw	3.5.2.2.2.1 and 3.5.2.2.2.2.1	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or for inaccessible areas of plants located in moderate to severe weathering conditions	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: Evaluation is needed for plants that are located in moderate to severe weathering conditions (weathering index > 100 day-inch/yr) (NUREG-1557). Documented evidence to confirm that existing concrete has air content of 3% to 6% and water-to-cement ratio of 0.35-0.45, and subsequent inspections did not exhibit degradation related to freeze-thaw, should be considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig.1.	Reinforced concrete	Air – outdoor	T-01	Concrete: Exterior above- and below-grade; foundation	A1.1-a A2.1-a A3.1-a A5.1-a A7.1-a A8.1-a A9.1-a
27	Cracking due to expansion/ reaction with aggregates	3.5.2.2.2.1 and 3.5.2.2.2.2.2	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or concrete was not constructed as stated for inaccessible areas.	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections/evaluations performed in accordance with the Structures Monitoring Program will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible Areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, an aging management program is not necessary.	Reinforced concrete	Any	T-03	Concrete: All	A1.1-c A2.1-c A3.1-c A4.1-b A5.1-c A7.1-c A8.1-c A9.1-c

Table B.5 Structures										
ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
28	Cracks and distortion due to increased stress levels from settlement	3.5.2.2.2.1 and 3.5.2.2.2.2.3	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon	Chapter XI.S6, "Structures Monitoring Program" 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 period of extended operation.	Reinforced concrete	Soil	T-08	Concrete: All	A1.1-h A2.1-h A3.1-h A5.1-h A6.1-f A7.1-h A8.1-f A9.1-h
29	Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	3.5.2.2.2.1 and 3.5.2.2.2.2.3	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program or a de-watering system is relied upon	Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in NRC IN 97-11. NRC IN 98-26 proposes Maintenance Rule Structures Monitoring for managing this aging effect, if applicable. If a de-watering system is relied upon for control of erosion of cement from porous concrete subfoundations, the licensee is to ensure proper functioning of the de-watering system through the period of extended operation.	Reinforced concrete; porous concrete	Water – flowing under foundation	T-09	Concrete: Foundation; subfoundation	A1.1-I A2.1-I A3.1-I A5.1-I A6.1-g A7.1-I A8.1-g A9.1-i
30	Lock-up/ wear	3.5.2.2.2.1	BWR/ PWR	Yes, if not within the scope of Section XI, IWF or structures monitoring program	Chapter XI.S3, "ASME Section XI, Subsection IWF" or Chapter XI.S6, "Structures Monitoring Program"	Lubrite®	Air – indoor uncontrolled	T-13	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; Steam generator supports	A4.2-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
31	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	3.5.2.2.2.2.4	BWR/ PWR	Yes, plant-specific if environment is aggressive	Chapter XI.S6, "Structures Monitoring Program" Accessible Areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the cracking, loss of bond, or loss of material (spalling, scaling) due to corrosion of embedded steel. Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Reinforced concrete	Ground water/soil	T-05	Concrete: Below-grade exterior; foundation	A1.1-e A2.1-e A3.1-e A5.1-e A7.1-e A8.1-d A9.1-e

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	3.5.2.2.2.2.4	BWR/ PWR	Yes, plant-specific if environment is aggressive	Inaccessible Areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below-grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Reinforced concrete	Ground water/soil	T-07	Concrete: Below-grade exterior; foundation	A1.1-g A2.1-g A3.1-g A5.1-g A7.1-g A8.1-e A9.1-g
32	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	3.5.2.2.2.2.5	BWR/ PWR	Yes, if concrete was not constructed as stated for inaccessible areas	Chapter XI.S6, "Structures Monitoring Program" Accessible areas: Inspections performed in accordance with the Structures Monitoring Program will indicate the presence of increase in porosity, and permeability due to leaching of calcium hydroxide. Inaccessible Areas: An aging management program is not necessary, even if reinforced concrete is exposed to flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R.	Reinforced concrete	Water – flowing	T-02	Concrete: Exterior above- and below-grade; foundation	A1.1-b A2.1-b A3.1-b A5.1-b A7.1-b A8.1-b A9.1-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
33	Reduction of strength and modulus/ elevated temperature (>150°F general; >200°F local)	3.5.2.2.2.3	BWR/ PWR	Yes, if temperature limits are exceeded	Plant-specific aging management program For any concrete elements that exceed specified temperature limits, further evaluations are warranted. Appendix A of ACI 349-85 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 which are allowed to have increased temperatures not to exceed 200°F.	Reinforced concrete	Air – indoor uncontrolled	T-10	Concrete: All	A1.1-j A2.1-j A3.1-j A4.1-c A5.1-j

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
34	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	3.5.2.2.2.4.1	BWR/ PWR	Yes, plant-specific if environment is aggressive	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible areas: As described in NUREG-1557, corrosion of exterior above-grade and interior embedded steel is not significant if the steel is not exposed to an aggressive environment (concrete pH <11.5 or chlorides >500 ppm). If such steel is exposed to an aggressive environment, corrosion is not significant if the concrete in which the steel is embedded has a low water-to-cement ratio (0.35-0.45), adequate air entrainment (3-6%), low permeability, and is designed in accordance with ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e., pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider (1) Examination of the exposed portions of the below grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Reinforced concrete	Air – indoor uncontrolled or air – outdoor	T-18	Concrete: All	A6.1-d

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
	Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	3.5.2.2.2.4.1	BWR/ PWR	Yes, plant-specific if environment is aggressive	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance with “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, cracking, or loss of material (spalling, scaling) due to aggressive chemical attack. Inaccessible areas: For plants with non-aggressive ground water/soil; i.e. pH > 5.5, chlorides < 500 ppm, or sulfates <1500 ppm, as a minimum, consider: (1) Examination of the exposed portions of the below grade concrete, when excavated for any reason, and (2) Periodic monitoring of below-grade water chemistry, including consideration of potential seasonal variations. For plants with aggressive groundwater/soil, and/or where the concrete structural elements have experienced degradation, a plant specific AMP accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation.	Reinforced concrete	Ground water/soil	T-19	Concrete: All	A6.1-e

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
35	Loss of material (spalling, scaling) and cracking/ freeze-thaw	3.5.2.2.2.4.2	BWR/ PWR	Yes, for inaccessible areas of plants located in moderate to severe weathering conditions	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections performed in accordance with Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of loss of material (spalling, scaling) and cracking due to freeze-thaw. Inaccessible Areas: As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, or in above- and below-grade exterior concrete, for plants located in a geographic region of negligible weathering conditions (weathering index <100 day-inch/yr). Loss of material from such concrete is not significant at plants located in areas in which weathering conditions are severe (weathering index >500 day- inch/yr), provided that the concrete mix design meets the air content (entrained air 3-6%) and water-to-cement ratio (0.35-0.45) specified in ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary. #*# #*#The weathering index is defined in ASTM C33-90, Table 3, Footnote E. Fig. 1 of ASTM C33-90 illustrates the various weathering index regions throughout the U.S.	Reinforced concrete	Air – outdoor	T-15	Concrete: Exterior above- and below-grade; foundation	A6.1-a

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
36	Cracking due to expansion/ reaction with aggregates	3.5.2.2.2.4.3	BWR/ PWR	Yes, if concrete was not constructed as stated for inaccessible areas	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. Accessible Areas: Inspections/evaluations performed in accordance with “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of expansion and cracking due to reaction with aggregates. Inaccessible areas: As described in NUREG-1557, investigations, tests, and petrographic examinations of aggregates performed in accordance with ASTM C295-54 or ASTM C227-50 can demonstrate that those aggregates do not react within reinforced concrete. For potentially reactive aggregates, aggregate-reinforced concrete reaction is not significant if the concrete was constructed in accordance with ACI 201.2R. Therefore, if these conditions are satisfied, aging management is not necessary.	Reinforced concrete	Any	T-17	Concrete: All	A6.1-c

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
37	Increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide	3.5.2.2.2.4.3	BWR/ PWR	Yes, if concrete was not constructed as stated for inaccessible areas	Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs Accessible Areas: Inspections performed in accordance with Chapter XI.S7, “Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants” or the FERC / US Army Corp of Engineers dam inspections and maintenance programs will indicate the presence of increase in porosity and permeability, loss of strength/ leaching of calcium hydroxide Inaccessible Areas: As described in NUREG-1557, leaching of calcium hydroxide from reinforced concrete becomes significant only if the concrete is exposed to flowing water. Even if reinforced concrete is exposed to flowing water, such leaching is not significant if the concrete is constructed to ensure that it is dense, well-cured, has low permeability, and that cracking is well controlled. Cracking is controlled through proper arrangement and distribution of reinforcing bars. All of the above characteristics are assured if the concrete was constructed with the guidance of ACI 201.2R-77. Therefore, if these conditions are satisfied, aging management is not necessary.	Reinforced concrete	Water – flowing	T-16	Concrete: Exterior above- and below-grade; foundation; interior slab	A6.1-b

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
38	Cracking/ stress corrosion cracking Loss of material/ pitting and crevice corrosion	3.5.2.2.2.5	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be developed and evaluated.	Stainless steel	Water – standing	T-23	Steel components: Tank liner	A7.2-b A8.2-b
39	Loss of material/ general and pitting corrosion	3.5.2.2.2.6	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program"	Steel	Air – indoor uncontrolled or air – outdoor	T-30	Support members; welds; bolted connections; support anchorage to building structure	B2.1-a B3.1-a B4.1-a B5.1-a
40	Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	3.5.2.2.2.6	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program"	Reinforced concrete; grout	Air – indoor uncontrolled or air – outdoor	T-29	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	B1.1.4-a B1.2.3-a B1.3.3-a B2.2-a B3.2-a B4.3-a B5.2-a

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
41	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	3.5.2.2.2.6	BWR/ PWR	Yes, if not within the scope of the applicant's structures monitoring program	Chapter XI.S6, "Structures Monitoring Program"	Non-metallic (e.g., Rubber)	Air – indoor uncontrolled or air – outdoor	T-31	Vibration isolation elements	B4.2-a
42	Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	3.5.2.2.2.7	BWR/ PWR	Yes, TLAA	Fatigue is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.3 "Metal Fatigue," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1).	Steel	Air – indoor uncontrolled	T-26	Support members; welds; bolted connections; support anchorage to building structure	B1.1.1-c B1.2.1-c B1.3.1-b
43	Cracking due to restraint shrinkage, creep, and aggressive environment	NA	BWR/ PWR	No	Chapter XI.S5, "Masonry Wall Program"	Concrete block	Air – indoor uncontrolled or air – outdoor	T-12	Masonry walls: All	A1.3-a A2.3-a A3.3-a A5.3-a A6.3-a
44	Loss of sealing/ deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	NA	BWR/ PWR	No	Chapter XI.S6, "Structures Monitoring Program"	Elastomers such as EPDM rubber	Various	TP-7	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	A6.5.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
45	Loss of material/ abrasion; cavitation	NA	BWR/ PWR	No	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs.	Reinforced concrete	Water – flowing	T-20	Concrete: Exterior above- and below-grade; foundation; interior slab	A6.1-h
46	Cracking/ stress corrosion cracking Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.M2, "Water Chemistry" and, Monitoring of the spent fuel pool water level in accordance with technical specifications and leakage from the leak chase channels.	Stainless steel	Treated water or treated borated water	T-14	Steel components: Fuel pool liner	A5.2-b
47	Loss of material/ general (steel only), pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs. If protective coatings are relied upon to manage the effects of aging, this AMP is to include provisions to address protective coating monitoring and maintenance.	Steel; copper alloys	Air – indoor uncontrolled or air - outdoor; Water – flowing or water – standing	T-21	Metal components: All structural members	A6.2-a
48	Loss of material, loss of form/ erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	NA	BWR/ PWR	No	Chapter XI.S7, "Regulatory Guide 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" or the FERC / US Army Corp of Engineers dam inspections and maintenance programs.	Various	Water – flowing Water – standing	T-22	Earthen water-control structures: Dams, Embankments, Reservoirs, Channels, Canals and ponds	A6.4-a

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
49	Loss of material/ general, pitting, and crevice corrosion	NA	BWR	No	Chapter XI.M2, “Water Chemistry,” for BWR water, and Chapter XI.S3, “ASME Section XI, Subsection IWF”	Stainless steel; steel	Treated Water < 60C (<140 F)	TP-10	Support members; welds; bolted connections; support anchorage to building structure	B1.1
50	Loss of material/ pitting and crevice corrosion	NA	BWR/ PWR	No	Chapter XI.S6, “Structures Monitoring Program”	Galvanized steel, aluminum, stainless steel	Air – outdoor	TP-6	Support members; welds; bolted connections; support anchorage to building structure	B2. B4.
51	Cracking/ stress corrosion cracking	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Low alloy steel, yield strength >150 ksi	Air – indoor uncontrolled (External)	T-27	High strength bolting for NSSS component supports	B1.1.2-a
	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.M18, “Bolting Integrity”	Low alloy steel, yield strength >150 ksi	Air – indoor uncontrolled (External)	TP-9	High strength bolting for NSSS component supports	B1.1
52	Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	NA	BWR/ PWR	No	Chapter XI.S6, “Structures Monitoring Program”	Lubrite®	Air – indoor uncontrolled	TP-1	Sliding support bearings and sliding support surfaces	B2. B4.

Table B.5 Structures										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
							Air – outdoor	TP-2	Sliding support bearings and sliding support surfaces	B2. B4.
53	Loss of material/ general and pitting corrosion	NA	BWR/ PWR	No	Chapter XI.S3, “ASME Section XI, Subsection IWF”	Steel	Air – indoor uncontrolled or air – outdoor	T-24	Support members; welds; bolted connections; support anchorage to building structure	B1.1.1-a B1.2.1-a B1.3.1-a
54	Loss of mechanical function/ corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; elastomer hardening	NA	BWR/ PWR	No	Chapter XI.S3, “ASME Section XI, Subsection IWF”	Steel and non-steel materials (e.g., Lubrite® plates, vibration isolators, etc.)	Air – indoor uncontrolled or air – outdoor	T-28	Constant and variable load spring hangers; guides; stops; sliding surfaces; design clearances; vibration isolators	B1.1.3-a B1.2.2-a B1.3.2-a
55	Loss of material/ boric acid corrosion	NA	PWR	No	Chapter XI.M10, “Boric Acid Corrosion”	Galvanized steel, aluminum	Air with borated water leakage	TP-3	Support members; welds; bolted connections; support anchorage to building structure	B1.1. B1.2. B1.3. B2. B3. B4. B5.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Steel	Air with borated water leakage	T-25	Support members; welds; bolted connections; support anchorage to building structure	B1.1.1-b B1.2.1-b B2.1-b B3.1-b B4.1-b B5.1-b
56	Loss of mechanical function due to corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads	NA	BWR/ PWR	No	Chapter XI.S3, “ASME Section XI, Subsection IWF”	Lubrite®	Air–indoor uncontrolled or air–outdoor	T-32	Sliding surfaces	B1.1.3-a B1.2.2-a B1.3.2-a
57	Reduction or loss of isolation function/ radiation hardening, temperature, humidity, sustained vibratory loading	NA	BWR/ PWR	No	Chapter XI.S3, “ASME Section XI, Subsection IWF”	Non-metallic (e.g., Rubber)	Air–indoor uncontrolled or air–outdoor	T-33	Vibration isolation elements	III.B1.1.3 -a III.B1.2.2 -a III.B1.3.2 -a
58	None	NA	BWR/ PWR	No	None	Aluminum	Air – indoor uncontrolled	TP-8	Support members; welds; bolted connections; support anchorage to building structure	B1.1. B1.2. B1.3. B2. B3. B4. B5.

Table B.5 Structures

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
						Galvanized steel	Air – indoor uncontrolled	TP-11	Support members; welds; bolted connections; support anchorage to building structure	B1.1. B1.2. B1.3. B2. B3. B4. B5.
59	None	NA	BWR/ PWR	No	None	Stainless steel	Air – indoor uncontrolled	TP-5	Support members; welds; bolted connections; support anchorage to building structure	B1.1. B1.2. B1.3. B2. B3. B4. B5.
							Air with borated water leakage	TP-4	Support members; welds; bolted connections; support anchorage to building structure	B1.1. B1.2. B1.3. B2. B3. B4. B5.

B.6 Electrical SRP-LR Development Tool

Table B.6 presents the electrical SRP-LR development tool.

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
1	Various degradation/ various mechanisms	3.6.2.2.1	BWR/ PWR	Yes, TLAA	EQ is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation. See the Standard Review Plan, Section 4.4, "Environmental Qualification (EQ) of Electrical Equipment," for acceptable methods for meeting the requirements of 10 CFR 54.21(c)(1)(i) and (ii). See Chapter X.E1, “Environmental Qualification (EQ) of Electric Components,” of this report for meeting the requirements of 10 CFR 54.21(c)(1)(iii).	Various polymeric and metallic materials	Adverse localized environment caused by heat, radiation, oxygen, moisture, or voltage	L-05	Electrical equipment subject to 10 CFR 50.49 EQ requirements	B.1-a
11	Degradation of insulator quality/presence of any salt deposits or surface contamination	3.6.2.2.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated for plants located such that the potential exists for salt deposits or surface contamination (e.g., in the vicinity of salt water bodies or industrial pollution).	Porcelain, Malleable iron, aluminum, galvanized steel, cement	Air – outdoor	LP-07	High voltage insulators	A.

Table B.6 Electrical										
ID	**Aging Effect/ Mechanism**	**SRP-LR Ref**	**Type**	**Further Evaluation**	**Aging Management Program (AMP)**	**Material**	**Environment**	**Related Item**	**Structure and/or Component**	**Related**
11	Loss of material/ mechanical wear due to wind blowing on transmission conductors	3.6.2.2.2	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Porcelain, Malleable iron, aluminum, galvanized steel, cement	Air – outdoor	LP-11	High voltage insulators	A.
12	Loss of material/ wind induced abrasion and fatigue Loss of conductor strength/ corrosion Increased resistance of connection/ oxidation or loss of pre-load	3.6.2.2.3	BWR/ PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Aluminum, copper, bronze, stainless steel, galvanized steel	Air – outdoor	LP-09	Switchyard bus and connections	A.
						Aluminum, steel	Air – outdoor	LP-08	Transmission conductors and connections	A.

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
2	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation (Thermal/ thermoxidative) of organics/thermo plastics, radiation-induced oxidation, moisture intrusion and ohmic heating	NA	BWR/ PWR	No	Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	LP-03	Fuse Holders (Not Part of a Larger Assembly); Insulation	A.

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation of organics (Thermal/ thermoxidative), radiolysis and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation, and moisture intrusion	NA	BWR/ PWR	No	Chapter XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	L-01	Conductor insulation for electrical cables and connections	A.1-a

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
3	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ degradation of organics (Thermal/ thermoxidative), radiolysis and photolysis (UV sensitive materials only) of organics; radiation-induced oxidation, and moisture intrusion	NA	BWR/ PWR	No	Chapter XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits"	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen	L-02	Conductor insulation for electrical cables and connections used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR)	A.1-b
4	Localized damage and breakdown of insulation leading to electrical failure/ moisture intrusion, water trees	NA	BWR/ PWR	No	Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	Adverse localized environment caused by exposure to moisture and voltage	L-03	Conductor insulation for inaccessible medium-voltage (2kV to 35kV) cables (e.g., installed in conduit or direct buried)	A.1-c

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
5	Corrosion of connector contact surfaces/ intrusion of borated water	NA	PWR	No	Chapter XI.M10, "Boric Acid Corrosion"	Various metals used for electrical contacts	Air with borated water leakage	L-04	Connector contacts for electrical connectors exposed to borated water leakage	A.2-a
6	Fatigue/ohmic heating, thermal cycling, electrical transients, frequent manipulation, vibration, chemical contamination, corrosion, and oxidation	NA	BWR/ PWR	No	Chapter XI.E5, "Fuse Holders"	Copper alloy	Air – indoor	LP-01	Fuse Holders (Not Part of a Larger Assembly); Metallic Clamp	A.
7	Loosening of bolted connections/ thermal cycling and ohmic heating	NA	BWR/ PWR	No	Chapter XI.E4, "Metal Enclosed Bus"	Aluminum/ Silver Plated Aluminum Copper/ Silver Plated Copper; Stainless steel, steel	Air – indoor and outdoor	LP-04	Metal enclosed bus Bus/connections	A.

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
8	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure/ thermal/thermoxidative degradation of organics/thermoplastics, radiation-induced oxidation; moisture/debris intrusion, and ohmic heating	NA	BWR/ PWR	No	Chapter XI.E4, "Metal Enclosed Bus"	Porcelain, xenoy, thermo-plastic organic polymers	Air – indoor and outdoor	LP-05	Metal enclosed bus Insulation/insulators	A.
9	Loss of material/ general corrosion	NA	BWR/ PWR	No	Chapter XI.S6, “Structures Monitoring Program”	Steel; galvanized steel	Air – indoor and outdoor	LP-06	Metal enclosed bus Enclosure assemblies	A.
10	Hardening and loss of strength/ elastomer degradation	NA	BWR/ PWR	No	Chapter XI.S6, “Structures Monitoring Program”	Elastomers	Air – indoor and outdoor	LP-10	Metal enclosed bus Enclosure assemblies	A.

Table B.6 Electrical

ID	Aging Effect/ Mechanism	SRP-LR Ref	Type	Further Evaluation	Aging Management Program (AMP)	Material	Environment	Related Item	Structure and/or Component	Related
13	Loosening of bolted connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation	NA	BWR/ PWR	No	Chapter XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	Various metals used for electrical contacts	Air – indoor and outdoor	LP-12	Cable Connections (Metallic Parts)	A.
14	None	NA	BWR/ PWR	No	None	Insulation material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Air – indoor uncontrolled (Internal/External)	LP-02	Fuse Holders (Not Part of a Larger Assembly); Insulation	A.

APPENDIX C

GALL Rev. 0 to GALL Rev. 1 Relationship Tables

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Introduction

In GALL Rev. 1, Volume 2 contains item numbers (e.g., “R-59”) that have been assigned to each AMR line item. To assist in relating these line items to the AMR line items in GALL Rev 0, the tables in this appendix have been provided.

For each system chapter in GALL Volume 2 (Chapters II through VIII), these tables relate the item numbers in GALL Rev. 0 to the item numbers contained in GALL Rev. 1. For example, as shown in Table IVA, “Relationship of Reactor Vessel, Internals and Reactor Coolant (RCS) System IDs in GALL V 2,” item “A1.1-a” from GALL Rev. 0 (which is located in the reactor vessel subsystem in Chapter IV) relates to item “R-59” in GALL Rev 1.

All GALL Rev. 0 line items are related to one or more line items in GALL Rev. 1. However, not all GALL Rev. 1 items relate back to a GALL Rev. 0 line item (i.e., when a new item was added to GALL Rev. 1). In such cases, although there is no GALL Rev. 0 item number to relate to, the relationship table still contains a row for the new item. However, the GALL Rev. 0 column contains only a subsystem identifier, not a GALL Rev. 0 item number. For example, RP-25 is a new item in GALL Rev. 1. Table IVA, “Relationship of Reactor Vessel, Internals and Reactor Coolant (RCS) System IDs in GALL V 2” shows “RP-25” is related to “A1.” in GALL Rev. 0, indicating that RP-25 has been added in Rev. 1 of GALL and it can be found in subsystem A1, the reactor vessel subsystem in Chapter IV.

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C.1 GALL Rev. 0 to GALL Rev. 1 Relationship Tables

Table IIA. Relationship of Containment Structures IDs in GALL V 2	
GALL Rev.0	**GALL Rev. 1**
A1.1-a	C-01
A1.1-b	C-02
A1.1-c	C-03
A1.1-d	C-04
A1.1-e	C-05
A1.1-f	C-37
A1.1-g	C-07
A1.1-h	C-08
A1.2-a	C-09
A1.3-a	C-10
A1.3-b	C-11
A2.1-a	C-09
A2.2-a	C-28
A2.2-b	C-30
A2.2-c	C-25
A2.2-d	C-38
A2.2-e	C-43
A2.2-f	C-36
A2.2-g	C-07
A2.2-h	C-34
A3.1-a	C-12
A3.1-b	C-13
A3.1-c	C-14
A3.1-d	C-15
A3.2-a	C-16
A3.2-b	C-17
A3.3-a	C-18
B1.1.1-a	C-19
B1.1.1-b	C-20
B1.1.1-c	C-21
B1.1.1-d	C-22
B1.1.1-e	C-23
B1.2.	C-41
B1.2.	C-35
B1.2.	C-06
B1.2.	C-07
B1.2.	C-39
B1.2.	C-23
B1.2.	C-26

Table IIA. Relationship of Containment Structures IDs in GALL V 2	
GALL Rev.0	**GALL Rev. 1**
B1.2.	C-46
B1.2.	C-31
B1.2.	C-49
B2.1.1-a	C-46
B2.1.1-b	C-44
B2.1.1-c	C-45
B2.1.1-d	C-23
B2.2.1-a	C-31
B2.2.1-b	C-26
B2.2.1-c	C-39
B2.2.1-d	C-41
B2.2.1-e	C-06
B2.2.1-f	C-07
B2.2.1-g	C-35
B2.2.2-a	C-46
B2.2.2-b	C-49
B2.2.2-c	C-47
B2.2.2-d	C-48
B2.2.2-e	C-23
B2.2.3-a	C-10
B2.2.3-b	C-11
B3.1.1-a	C-19
B3.1.1-b	C-24
B3.1.2-a	C-30
B3.1.2-b	C-25
B3.1.2-c	C-51
B3.1.2-d	C-43
B3.1.2-e	C-36
B3.1.2-f	C-07
B3.1.2-g	C-50
B3.1.2-g	C-50
B3.2.1-a	C-29
B3.2.1-b	C-32
B3.2.1-c	C-27
B3.2.1-d	C-40
B3.2.1-e	C-42
B3.2.1-f	C-06
B3.2.1-g	C-07
B3.2.1-h	C-33

Table IIA. Relationship of Containment Structures IDs in GALL V 2	
GALL Rev.0	**GALL Rev. 1**
B3.2.2-a	C-09
B3.2.2-b	C-24
B4.1-a	C-12
B4.1-b	C-13
B4.1-c	C-14
B4.1-d	C-15
B4.2-a	C-16
B4.2-b	C-17
B4.3-a	C-18

Table IIIA. Relationship of Structures and Component Supports IDs in GALL V 2	
GALL Rev. 0	**GALL Rev. 1**
A1.1-a	T-01
A1.1-b	T-02
A1.1-c	T-03
A1.1-d	T-04
A1.1-e	T-05
A1.1-f	T-06
A1.1-g	T-07
A1.1-h	T-08
A1.1-i	T-09
A1.1-j	T-10
A1.2-a	T-11
A1.3-a	T-12
A2.1-a	T-01
A2.1-b	T-02
A2.1-c	T-03
A2.1-d	T-04
A2.1-e	T-05
A2.1-f	T-06
A2.1-g	T-07
A2.1-h	T-08
A2.1-i	T-09
A2.1-j	T-10
A2.2-a	T-11
A2.3-a	T-12
A3.1-a	T-01
A3.1-b	T-02
A3.1-c	T-03
A3.1-d	T-04
A3.1-e	T-05
A3.1-f	T-06
A3.1-g	T-07
A3.1-h	T-08
A3.1-i	T-09
A3.1-j	T-10
A3.2-a	T-11
A3.3-a	T-12
A4.1-a	T-06
A4.1-b	T-03
A4.1-c	T-10
A4.1-d	T-04
A4.2-a	T-11
A4.2-b	T-13

Table IIIA. Relationship of Structures and Component Supports IDs in GALL V 2	
GALL Rev. 0	**GALL Rev. 1**
A5.1-a	T-01
A5.1-b	T-02
A5.1-c	T-03
A5.1-d	T-04
A5.1-e	T-05
A5.1-f	T-06
A5.1-g	T-07
A5.1-h	T-08
A5.1-i	T-09
A5.1-j	T-10
A5.2-a	T-11
A5.2-b	T-14
A5.3-a	T-12
A6.1-a	T-15
A6.1-b	T-16
A6.1-c	T-17
A6.1-d	T-18
A6.1-e	T-19
A6.1-f	T-08
A6.1-g	T-09
A6.1-h	T-20
A6.2-a	T-21
A6.3-a	T-12
A6.4-a	T-22
A6.	TP-7
A7.1-a	T-01
A7.1-b	T-02
A7.1-c	T-03
A7.1-d	T-04
A7.1-e	T-05
A7.1-f	T-06
A7.1-g	T-07
A7.1-h	T-08
A7.1-i	T-09
A7.2-a	T-11
A7.2-b	T-23
A8.1-a	T-01
A8.1-b	T-02
A8.1-c	T-03
A8.1-d	T-05
A8.1-e	T-07
A8.1-f	T-08

Table IIIA. Relationship of Structures and Component Supports IDs in GALL V 2	
GALL Rev. 0	**GALL Rev. 1**
A8.1-g	T-09
A8.2-a	T-11
A8.2-b	T-23
A9.1-a	T-01
A9.1-b	T-02
A9.1-c	T-03
A9.1-d	T-04
A9.1-e	T-05
A9.1-f	T-06
A9.1-g	T-07
A9.1-h	T-08
A9.1-i	T-09
B1.1	TP-9
B1.1	TP-10
B1.1.	TP-11
B1.1.	TP-3
B1.1.	TP-8
B1.1.	TP-5
B1.1.	TP-4
B1.1.1-a	T-24
B1.1.1-b	T-25
B1.1.1-c	T-26
B1.1.2-a	T-27
B1.1.3-a	T-28
B1.1.4-a	T-29
B1.2.	TP-3
B1.2.	TP-5
B1.2.	TP-8
B1.2.	TP-4
B1.2.	TP-11
B1.2.1-a	T-24
B1.2.1-b	T-25
B1.2.1-c	T-26
B1.2.2-a	T-28
B1.2.3-a	T-29
B1.3.	TP-3
B1.3.	TP-4
B1.3.	TP-5
B1.3.	TP-11
B1.3.	TP-8
B1.3.1-a	T-24
B1.3.1-b	T-26

Table IIIA. Relationship of Structures and Component Supports IDs in GALL V 2	
GALL Rev. 0	GALL Rev. 1
B1.3.2-a	T-28
B1.3.3-a	T-29
B2.	TP-4
B2.	TP-11
B2.	TP-2
B2.	TP-8
B2.	TP-6
B2.	TP-1
B2.	TP-5
B2.	TP-3
B2.1-a	T-30
B2.1-b	T-25
B2.2-a	T-29
B3.	TP-8
B3.	TP-3
B3.	TP-4
B3.	TP-5
B3.	TP-11
B3.1-a	T-30
B3.1-b	T-25
B3.2-a	T-29
B4.	TP-1
B4.	TP-6
B4.	TP-2
B4.	TP-5
B4.	TP-3
B4.	TP-4
B4.	TP-11
B4.	TP-8
B4.1-a	T-30
B4.1-b	T-25
B4.2-a	T-31
B4.3-a	T-29
B5.	TP-3
B5.	TP-4
B5.	TP-8
B5.	TP-5
B5.	TP-11
B5.1-a	T-30
B5.1-b	T-25
B5.2-a	T-29

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A1.	RP-25
A1.1-a	R-59
A1.1-b	R-04
A1.1-c	R-60
A1.1-d	R-61
A1.2-a	R-04
A1.2-b	R-04
A1.2-c	R-62
A1.2-d	R-63
A1.2-e	R-64
A1.3-a	R-04
A1.3-b	R-65
A1.3-c	R-66
A1.3-d	R-04
A1.3-e	R-67
A1.4-a	R-68
A1.4-b	R-04
A1.5-a	R-69
A1.5-b	R-04
A1.6-a	R-04
A1.7-a	R-70
A2.	RP-28
A2.	RP-13
A2.1-a	R-17
A2.1-b	R-219
A2.1-c	R-71
A2.1-d	R-72
A2.1-e	R-73
A2.1-f	R-74
A2.2-a	R-75
A2.2-b	R-76
A2.2-c	R-219
A2.2-d	R-77
A2.2-e	R-78
A2.2-f	R-79
A2.2-g	R-80
A2.3-a	R-81
A2.3-b	R-82
A2.3-c	R-219
A2.4-a	R-219
A2.4-b	R-83
A2.5-a	R-84

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A2.5-b	R-85
A2.5-c	R-86
A2.5-d	R-219
A2.5-e	R-17
A2.5-f	R-87
A2.6-a	R-88
A2.7-a	R-89
A2.7-b	R-90
A2.8-a	R-70
A2.8-b	R-17
B1.	RP-26
B1.	RP-18
B1.1-a	R-92
B1.1-b	R-93
B1.1-c	R-53
B1.1-d	R-94
B1.1-e	R-95
B1.1-f	R-96
B1.1-g	R-97
B1.2-a	R-98
B1.2-b	R-53
B1.3-a	R-99
B1.3-b	R-53
B1.4-a	R-100
B1.4-b	R-53
B1.4-c	R-101
B1.4-d	R-102
B1.5-a	R-103
B1.5-b	R-53
B1.5-c	R-104
B1.6-a	R-105
B1.6-b	R-53
B2.	RP-24
B2.1-a	R-106
B2.1-b	R-107
B2.1-c	R-53
B2.1-d	R-108
B2.1-e	R-109
B2.1-f	R-110
B2.1-g	R-111
B2.1-h	R-53
B2.1-i	R-112

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
B2.1-j	R-113
B2.1-k	R-114
B2.1-l	R-115
B2.1-m	R-53
B2.2-a	R-116
B2.2-b	R-117
B2.2-c	R-53
B2.2-d	R-118
B2.2-e	R-119
B2.2-f	R-53
B2.3-a	R-120
B2.3-b	R-121
B2.3-c	R-122
B2.3-d	R-53
B2.4-a	R-123
B2.4-b	R-124
B2.4-c	R-125
B2.4-d	R-126
B2.4-e	R-127
B2.4-f	R-128
B2.4-g	R-53
B2.4-h	R-129
B2.5-a	R-130
B2.5-b	R-131
B2.5-c	R-132
B2.5-d	R-53
B2.5-e	R-133
B2.5-f	R-134
B2.5-g	R-135
B2.5-h	R-136
B2.5-i	R-137
B2.5-j	R-53
B2.5-k	R-138
B2.5-l	R-139
B2.5-m	R-140
B2.5-n	R-141
B2.5-o	R-142
B2.5-p	R-53
B2.6-a	R-143
B2.6-b	R-144
B2.6-c	R-145
B3.	RP-24

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
B3.1-a	R-146
B3.1-b	R-147
B3.1-c	R-148
B3.2-a	R-149
B3.2-b	R-150
B3.2-c	R-151
B3.2-d	R-152
B3.2-e	R-153
B3.2-f	R-53
B3.2-g	R-154
B3.3-a	R-157
B3.3-a	R-155
B3.3-b	R-158
B3.3-b	R-156
B3.4-a	R-159
B3.4-b	R-160
B3.4-c	R-161
B3.4-d	R-53
B3.4-e	R-162
B3.4-f	R-163
B3.4-g	R-164
B3.4-h	R-165
B3.5-a	R-166
B3.5-b	R-167
B3.5-c	R-168
B3.5-d	R-169
B3.5-e	R-170
B3.5-f	R-171
B3.5-g	R-53
B4.	RP-24
B4.1-a	R-172
B4.1-b	R-173
B4.1-c	R-174
B4.1-d	R-53
B4.2-a	R-175
B4.2-b	R-176
B4.2-c	R-177
B4.2-d	R-53
B4.2-e	R-178
B4.2-f	R-179
B4.3-a	R-180
B4.3-b	R-181

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
B4.3-c	R-182
B4.3-d	R-183
B4.3-e	R-184
B4.3-f	R-53
B4.4-a	R-185
B4.4-b	R-186
B4.4-c	R-187
B4.4-d	R-188
B4.4-e	R-53
B4.4-f	R-190
B4.4-g	R-191
B4.4-h	R-192
B4.5-a	R-193
B4.5-b	R-194
B4.5-c	R-195
B4.5-d	R-196
B4.5-e	R-197
B4.5-f	R-53
B4.5-g	R-125
B4.5-h	R-199
B4.5-i	R-128
B4.5-j	R-201
B4.6-a	R-202
B4.6-b	R-203
B4.6-c	R-204
B4.6-d	R-205
B4.6-e	R-206
B4.6-f	R-53
B4.6-g	R-207
B4.6-h	R-208
B4.7-a	R-209
B4.7-b	R-210
B4.7-c	R-211
B4.7-d	R-212
B4.7-e	R-213
B4.8-a	R-214
B4.8-b	R-215
B4.8-c	R-216
C1.	RP-27
C1.1-a	R-23
C1.1-b	R-220
C1.1-c	R-23

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
C1.1-d	R-220
C1.1-e	R-220
C1.1-e	R-220
C1.1-f	R-20
C1.1-f	R-21
C1.1-g	R-52
C1.1-h	R-220
C1.1-i	R-03
C1.2-a	R-220
C1.2-b	R-20
C1.2-c	R-08
C1.2-d	R-29
C1.2-d	R-26
C1.2-e	R-27
C1.2-f	R-28
C1.3-a	R-23
C1.3-b	R-08
C1.3-c	R-20
C1.3-d	R-220
C1.3-e	R-26
C1.3-e	R-29
C1.3-f	R-27
C1.3-g	R-28
C1.4-a	R-15
C1.4-a	R-225
C1.4-b	R-16
C2.	RP-12
C2.	RP-31
C2.	RP-23
C2.	RP-11
C2.	RP-10
C2.	RP-22
C2.1-a	R-223
C2.1-b	R-223
C2.1-c	R-56
C2.1-c	R-30
C2.1-d	R-17
C2.1-e	R-05
C2.1-f	R-52
C2.1-g	R-02
C2.2-a	R-223
C2.2-b	R-223

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
C2.2-c	R-223
C2.2-d	R-17
C2.2-e	R-52
C2.2-f	R-07
C2.2-g	R-05
C2.2-h	R-02
C2.3-a	R-223
C2.3-a	R-223
C2.3-b	R-09
C2.3-c	R-08
C2.3-d	R-18
C2.3-e	R-11
C2.3-f	R-17
C2.3-g	R-12
C2.4-a	R-223
C2.4-b	R-09
C2.4-c	R-08
C2.4-d	R-18
C2.4-e	R-11
C2.4-f	R-17
C2.4-g	R-12
C2.5-a	R-223
C2.5-b	R-17
C2.5-c	R-25
C2.5-c	R-58
C2.5-d	R-223
C2.5-e	R-223
C2.5-f	R-223
C2.5-g	R-25
C2.5-g	R-58
C2.5-h	R-07
C2.5-i	R-05
C2.5-j	R-24
C2.5-k	R-06
C2.5-l	R-52
C2.5-m	R-07
C2.5-m	R-06
C2.5-n	R-11
C2.5-o	R-17
C2.5-p	R-12
C2.5-q	R-223
C2.5-r	R-217

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
C2.5-s	R-06
C2.5-t	R-18
C2.5-u	R-17
C2.5-v	R-19
C2.5-w	R-18
C2.6-a	R-13
C2.6-b	R-17
C2.6-c	R-14
D1.	RP-21
D1.	RP-17
D1.	RP-14
D1.	RP-15
D1.	RP-16
D1.1-a	R-33
D1.1-b	R-33
D1.1-c	R-34
D1.1-d	R-37
D1.1-e	R-39
D1.1-f	R-32
D1.1-g	R-17
D1.1-h	R-221
D1.1-i	R-01
D1.1-i	R-07
D1.1-j	R-01
D1.1-k	R-17
D1.1-l	R-10
D1.2-a	R-44
D1.2-b	R-47
D1.2-c	R-48
D1.2-d	R-46
D1.2-e	R-49
D1.2-f	R-50
D1.2-g	R-43
D1.2-h	R-41
D1.2-i	R-40
D1.2-j	R-40
D1.2-k	R-42
D1.3-a	R-51
D2.	R-226
D2.	R-42
D2.1-a	R-35
D2.1-b	R-17

Table IVA. Relationship of Reactor Vessel, Internals, and Reactor Coolant (RCS) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
D2.1-c	R-222
D2.1-d	R-33
D2.1-e	R-224
D2.1-f	R-38
D2.1-g	R-33
D2.1-h	R-01
D2.1-i	R-36
D2.1-j	R-17
D2.1-k	R-32
D2.1-l	R-31
D2.2-a	R-44
D2.2-b	R-47
D2.2-c	R-48
D2.2-d	R-49
D2.2-e	R-46
D2.2-f	R-40
D2.2-g	R-40
E.	RP-04
E.	RP-06
E.	RP-07
E.	RP-05
E.	RP-01
E.	RP-03

Table VA. Relationship of Engineered Safety Features (ESF) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
A.	EP-39
A.	EP-47
A.	EP-43
A.	EP-34
A.	E-43
A.	EP-44
A.	EP-53
A.	EP-33
A.	EP-13
A.	EP-42
A.	EP-50
A.	EP-35
A.	EP-45
A.	EP-27
A.	EP-46
A.	EP-41
A.	EP-36
A.	EP-37
A.	EP-40
A.1-a	E-12
A.1-b	E-28
A.1-c	E-12
A.2-a	E-29
A.2-a	E-26
A.3-a	E-12
A.3-b	E-28
A.4-a	E-12
A.4-b	E-28
A.5-a	E-26
A.5-a	E-29
A.5-b	E-28
A.6-a	E-18
A.6-a	E-20
A.6-b	E-21
A.6-c	E-19
A.6-c	E-17
A.6-d	E-28
B.	EP-36
B.	EP-37
B.	EP-27
B.	E-42
B.	EP-54
B.1-a	E-26

Table VA. Relationship of Engineered Safety Features (ESF) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
B.1-a	E-40
B.1-b	E-06
B.2-a	E-25
B.2-a	E-26
B.2-b	E-06
C.	EP-33
C.	EP-48
C.	EP-44
C.1-a	E-35
C.1-a	E-22
C.1-a	E-30
C.1-a	E-31
C.1-b	E-34
C.1-b	E-33
D1.	E-43
D1.	EP-44
D1.	EP-31
D1.	EP-54
D1.	EP-50
D1.	EP-45
D1.	EP-52
D1.	EP-36
D1.	EP-40
D1.	EP-27
D1.	EP-33
D1.	EP-46
D1.	EP-37
D1.	EP-13
D1.	EP-35
D1.	EP-41
D1.	EP-53
D1.	EP-49
D1.	EP-55
D1.	EP-51
D1.	EP-47
D1.1-a	E-12
D1.1-b	E-47
D1.1-c	E-13
D1.1-d	E-28
D1.2-a	E-12
D1.2-b	E-28
D1.2-c	E-24
D1.3-a	E-28

Table VA. Relationship of Engineered Safety Features (ESF) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
D1.4-a	E-13
D1.4-b	E-12
D1.4-c	E-28
D1.5-a	E-17
D1.5-a	E-19
D1.5-b	E-28
D1.6-a	E-19
D1.6-a	E-17
D1.6-b	E-18
D1.6-b	E-20
D1.6-c	E-21
D1.6-d	E-28
D1.7-a	E-28
D1.7-b	E-38
D1.7-b	E-12
D1.8-a	E-12
D1.8-b	E-28
D1.8-c	E-01
D2.	EP-13
D2.	EP-2
D2.	EP-45
D2.	EP-36
D2.	EP-34
D2.	EP-47
D2.	EP-26
D2.	EP-37
D2.	EP-50
D2.	EP-27
D2.	EP-44
D2.	EP-32
D2.	EP-35
D2.	EP-54
D2.	EP-40
D2.	EP-31
D2.	EP-46
D2.	EP-33
D2.1-a	E-08
D2.1-b	E-10
D2.1-c	E-37
D2.1-d	E-11
D2.1-e	E-26
D2.1-e	E-14
D2.1-e	E-27

Table VA. Relationship of Engineered Safety Features (ESF) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
D2.1-f	E-07
D2.2-a	E-08
D2.3-a	E-09
D2.3-b	E-08
D2.3-c	E-37
D2.4-a	E-20
D2.4-a	E-18
D2.4-b	E-21
D2.4-b	E-23
D2.4-c	E-19
D2.4-c	E-17
D2.5-a	E-26
D2.5-a	E-29
D2.5-b	E-04
E.	E-41
E.	EP-38
E.	EP-24
E.	EP-1
E.	EP-25
E.	E-44
E.	E-45
E.1-a	E-28
E.1-b	E-46
E.2-a	E-02
E.2-b	E-03
F.	EP-4
F.	EP-3
F.	EP-14
F.	EP-12
F.	EP-5
F.	EP-29
F.	EP-30
F.	EP-20
F.	EP-9
F.	EP-18
F.	EP-7
F.	EP-10
F.	EP-16
F.	EP-15
F.	EP-28
F.	EP-17
F.	EP-19
F.	EP-22

Table VIA. Relationship of Electrical Components System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A.	LP-01
A.	LP-02
A.	LP-03
A.	LP-04
A.	LP-05
A.	LP-06
A.	LP-07
A.	LP-08
A.	LP-09
A.	LP-10
A.	LP-11
A.	LP-12
A.1-a	L-01
A.1-b	L-02
A.1-c	L-03
A.2-a	L-04
B.1-a	L-05

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A1.1-a	A-94
A2.	AP-79
A2.1-a	A-86
A2.1-a	A-87
A2.1-b	A-89
A2.1-b	A-88
A2.1-c	A-97
A2.1-c	A-96
A3.	AP-43
A3.	AP-79
A3.	AP-31
A3.	AP-1
A3.	AP-12
A3.1-a	A-79
A3.2-a	A-39
A3.2-a	A-15
A3.2-b	A-79
A3.2-c	A-79
A3.2-d	A-15
A3.3-a	A-15
A3.3-a	A-39
A3.3-b	A-56
A3.3-c	A-79
A3.3-d	A-15
A3.4-a	A-63
A3.4-b	A-79
A3.5-a	A-15
A3.5-a	A-39
A3.5-b	A-79
A3.5-c	A-15
A3.6-a	A-79
A4.	AP-31
A4.	AP-12
A4.	AP-38
A4.	AP-62
A4.	AP-32
A4.	AP-64
A4.	AP-43
A4.1-a	A-58
A4.2-a	A-16
A4.2-a	A-40
A4.2-b	A-16
A4.3-a	A-16
A4.3-a	A-40

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A4.3-b	A-16
A4.4-a	A-63
A4.4-b	A-70
A4.5-a	A-40
A4.5-a	A-16
A4.5-b	A-16
A4.6-a	A-58
B.1-a	A-06
B.1-b	A-07
B.2-a	A-05
C1.	AP-59
C1.	AP-61
C1.	AP-47
C1.	AP-56
C1.	AP-75
C1.	AP-76
C1.	AP-30
C1.	AP-53
C1.1-a	A-38
C1.1-a	A-44
C1.1-a	A-54
C1.1-a	A-47
C1.1-b	A-01
C1.1-c	A-02
C1.2-a	A-44
C1.2-a	A-38
C1.2-a	A-47
C1.2-a	A-54
C1.3-a	A-66
C1.3-a	A-65
C1.3-a	A-64
C1.3-b	A-72
C1.4-a	A-54
C1.5-a	A-51
C1.5-a	A-38
C1.6-a	A-38
C1.6-a	A-54
C2.	AP-59
C2.	AP-31
C2.	AP-30
C2.	AP-80
C2.	AP-12
C2.	AP-63
C2.	AP-60

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
C2.	AP-47
C2.	A-63
C2.	AP-32
C2.	AP-43
C2.1-a	A-25
C2.2-a	A-25
C2.2-a	A-52
C2.3-a	A-25
C2.3-a	A-50
C2.4-a	A-25
C2.5-a	A-25
C3.	A-01
C3.	AP-53
C3.	AP-56
C3.	A-02
C3.	A-51
C3.	AP-61
C3.1-a	A-47
C3.1-a	A-43
C3.1-a	A-38
C3.2-a	A-43
C3.2-a	A-47
C3.2-a	A-38
C3.2-a	A-53
C3.3-a	A-38
D.	AP-81
D.1-a	A-80
D.1-a	A-26
D.2-a	A-80
D.2-a	A-26
D.2-a	A-103
D.3-a	A-80
D.3-a	A-26
D.4-a	A-26
D.4-a	A-80
D.5-a	A-26
D.5-a	A-80
D.6-a	A-26
D.6-a	A-80
E1.	AP-43
E1.	AP-59
E1.	AP-65
E1.	AP-12
E1.	AP-82

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
E1.	AP-47
E1.	AP-31
E1.	AP-34
E1.	AP-30
E1.	AP-1
E1.	AP-85
E1.	AP-79
E1.10-a	A-79
E1.1-a	A-34
E1.1-a	A-57
E1.1-b	A-79
E1.2-a	A-79
E1.3-a	A-34
E1.3-a	A-57
E1.3-b	A-79
E1.4-a	A-79
E1.5-a	A-104
E1.5-a	A-76
E1.5-b	A-79
E1.6-a	A-79
E1.7-a	A-57
E1.7-a	A-34
E1.7-b	A-79
E1.7-c	A-84
E1.8-a	A-57
E1.8-a	A-34
E1.8-a	A-100
E1.8-b	A-69
E1.8-c	A-63
E1.8-d	A-79
E1.9-a	A-79
E1.10-a	A-79
E2.	AP-73
E2.1-a	A-59
E2.2-a	A-59
E2.3-a	A-59
E2.4-a	A-59
E3.	A-63
E3.	A-58
E3.	AP-43
E3.	AP-12
E3.	AP-32
E3.	AP-31
E3.	AP-38

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
E3.	AP-60
E3.	A-35
E3.	AP-63
E3.	AP-64
E3.	AP-62
E3.1-a	A-60
E3.1-b	A-62
E3.2-a	A-60
E3.2-b	A-62
E3.2-c	A-34
E3.3-d	A-85
E3.4-a	A-68
E3.4-a	A-71
E3.4-b	A-67
E4.	AP-59
E4.	AP-43
E4.	AP-38
E4.	AP-31
E4.	AP-64
E4.	AP-63
E4.	AP-47
E4.	AP-32
E4.	AP-30
E4.	AP-12
E4.	AP-60
E4.1-a	A-35
E4.1-a	A-58
E4.1-b	A-62
E4.1-c	A-61
E4.2-a	A-35
E4.3-a	A-61
E4.4-a	A-67
E4.4-a	A-63
F1.	AP-43
F1.	AP-12
F1.	AP-65
F1.	AP-34
F1.	AP-80
F1.	AP-77
F1.	AP-30
F1.	AP-74
F1.	A-63
F1.	AP-31
F1.	AP-41

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
F1.1-a	A-105
F1.1-a	A-08
F1.1-a	A-10
F1.1-b	A-17
F1.1-c	A-18
F1.1-c	A-73
F1.2-a	A-46
F1.3-a	A-25
F1.4-a	A-09
F1.4-a	A-08
F1.4-a	A-10
F1.4-b	A-17
F2.	AP-12
F2.	AP-77
F2.	AP-30
F2.	AP-43
F2.	AP-80
F2.	A-63
F2.	AP-74
F2.	AP-41
F2.	AP-31
F2.1-a	A-10
F2.1-a	A-08
F2.1-a	A-105
F2.1-b	A-17
F2.1-c	A-18
F2.1-c	A-73
F2.2-a	A-46
F2.3-a	A-25
F2.4-a	A-08
F2.4-a	A-09
F2.4-a	A-10
F2.4-b	A-17
F3.	AP-30
F3.	AP-41
F3.	AP-34
F3.	A-50
F3.	AP-80
F3.	AP-74
F3.	A-63
F3.	AP-12
F3.	AP-65
F3.	AP-77
F3.	AP-43

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
F3.1-a	A-08
F3.1-a	A-10
F3.1-a	A-105
F3.1-b	A-17
F3.1-c	A-18
F3.1-c	A-73
F3.2-a	A-46
F3.3-a	A-25
F3.4-a	A-08
F3.4-a	A-09
F3.4-a	A-10
F3.4-b	A-17
F4.	AP-41
F4.	A-63
F4.	AP-12
F4.	AP-31
F4.	AP-74
F4.	AP-77
F4.	AP-43
F4.	AP-30
F4.1-a	A-08
F4.1-a	A-10
F4.1-a	A-105
F4.1-b	A-17
F4.1-c	A-18
F4.1-c	A-73
F4.2-a	A-46
F4.3-a	A-25
G.	AP-83
G.	AP-44
G.	AP-56
G.	AP-78
G.	AP-40
G.	AP-54
G.	AP-41
G.	A-51
G.	A-23
G.	AP-31
G.	AP-30
G.	AP-61
G.	AP-59
G.	A-02
G.	A-01
G.	AP-47

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
G.1-a	A-19
G.1-a	A-20
G.1-b	A-92
G.1-b	A-90
G.1-c	A-93
G.1-c	A-91
G.1-d	A-22
G.1-d	A-21
G.2-a	A-19
G.2-a	A-20
G.2-b	A-90
G.2-b	A-92
G.2-c	A-93
G.2-c	A-91
G.2-d	A-21
G.2-d	A-22
G.3-a	A-20
G.3-a	A-19
G.3-b	A-92
G.3-b	A-90
G.3-c	A-91
G.3-c	A-93
G.3-d	A-22
G.3-d	A-21
G.4-a	A-20
G.4-a	A-19
G.4-b	A-90
G.4-b	A-92
G.4-c	A-91
G.4-c	A-93
G.4-d	A-22
G.4-d	A-21
G.5-a	A-90
G.5-b	A-91
G.5-c	A-21
G.6-a	A-55
G.6-a	A-33
G.6-b	A-45
G.6-b	A-33
G.6-b	A-55
G.6-b	A-47
G.7-a	A-82
G.7-b	A-83
G.8-a	A-28

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
H1.	AP-56
H1.	AP-54
H1.	AP-35
H1.	AP-44
H1.	AP-43
H1.	A-02
H1.	AP-12
H1.1-a	A-24
H1.1-b	A-01
H1.2-a	A-24
H1.3-a	A-24
H1.4-a	A-30
H1.4-b	A-95
H2.	AP-55
H2.	AP-59
H2.	AP-61
H2.	AP-39
H2.	AP-40
H2.	A-47
H2.	A-02
H2.	AP-47
H2.	AP-56
H2.	AP-12
H2.	AP-33
H2.	AP-54
H2.	AP-30
H2.	A-51
H2.	AP-35
H2.	AP-43
H2.	AP-44
H2.	AP-41
H2.	AP-45
H2.1-a	A-25
H2.1-b	A-38
H2.2-a	A-23
H2.3-a	A-23
H2.4-a	A-27
H2.5-a	A-30
I.	AP-66
I.	AP-26
I.	AP-27
I.	A-105
I.	AP-28
I.	A-102

Table VIIA. Relationship of Auxiliary System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
I.1-a	A-79
I.1-b	A-77
I.1-b	A-78
I.1-b	A-81
I.2-a	A-03
I.2-b	A-04
J.	AP-51
J.	AP-22
J.	AP-15
J.	AP-13
J.	AP-50
J.	AP-9
J.	AP-2
J.	AP-18
J.	AP-17
J.	AP-20
J.	AP-48
J.	AP-19
J.	AP-3
J.	AP-37
J.	AP-36
J.	AP-52
J.	AP-6
J.	AP-8
J.	AP-11
J.	AP-49
J.	AP-16
J.	AP-4
J.	AP-14

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
A.	SP-25
A.	SP-30
A.	SP-46
A.	S-23
A.	SP-45
A.	SP-44
A.	SP-32
A.	SP-38
A.	SP-64
A.	SP-27
A.	SP-31
A.	SP-28
A.	SP-43
A.	SP-61
A.1-a	S-15
A.1-b	S-04
A.1-b	S-06
A.2-a	S-15
A.2-b	S-04
A.2-b	S-06
B1.	SP-43
B1.	SP-59
B1.	SP-17
B1.	SP-44
B1.	SP-16
B1.	S-10
B1.	SP-18
B1.	SP-60
B1.1-a	S-07
B1.1-b	S-08
B1.1-c	S-15
B1.2-a	S-07
B1.2-b	S-15
B2.	SP-45
B2.	SP-46
B2.	S-09
B2.1-a	S-05
B2.1-b	S-15
B2.1-c	S-08
B2.2-a	S-15
B2.2-b	S-05
C.	S-10

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
C.	S-09
C.	SP-16
C.	SP-17
C.1-a	S-15
C.1-b	S-04
C.1-b	S-06
C.2-a	S-15
C.2-b	S-04
C.2-b	S-06
D1.	SP-16
D1.	SP-25
D1.	SP-24
D1.	SP-38
D1.	SP-17
D1.	SP-32
D1.1-a	S-16
D1.1-b	S-11
D1.1-c	S-10
D1.2-a	S-16
D1.2-b	S-10
D1.3-a	S-10
D1.3-b	S-16
D2.	SP-16
D2.	SP-38
D2.	SP-25
D2.	SP-32
D2.	SP-24
D2.1-a	S-16
D2.1-b	S-09
D2.1-c	S-11
D2.2-a	S-16
D2.2-b	S-09
D2.3-a	S-16
D2.3-b	S-09
E.	SP-29
E.	SP-38
E.	SP-56
E.	SP-39
E.	SP-17
E.	SP-40
E.	SP-55
E.	SP-19

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
E.	SP-36
E.	SP-30
E.	SP-25
E.	SP-27
E.	SP-24
E.	SP-54
E.	SP-26
E.	SP-32
E.	SP-31
E.	SP-41
E.	SP-37
E.	SP-57
E.	SP-8
E.	SP-16
E.	SP-58
E.	SP-42
E.1-a	S-16
E.1-b	S-10
E.1-b	S-09
E.2-a	S-16
E.2-b	S-09
E.2-b	S-10
E.3-a	S-10
E.3-a	S-09
E.4-a	S-22
E.4-a	S-21
E.4-a	S-19
E.4-a	S-18
E.4-b	S-24
E.4-b	S-26
E.4-c	S-28
E.4-d	S-21
E.4-d	S-22
E.4-d	S-19
E.4-d	S-18
E.4-e	SP-64
E.4-e	S-25
E.4-e	S-23
E.5-a	S-09
E.5-a	S-13
E.5-a	S-10
E.5-b	S-13

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	GALL Rev. 1
E.5-c	S-31
E.5-d	S-01
E.6-a	S-10
E.6-a	S-09
F.	SP-61
F.	SP-17
F.	SP-27
F.	SP-30
F.	SP-31
F.	SP-55
F.	SP-29
F.	SP-40
F.	SP-56
F.	SP-41
F.	SP-36
F.	SP-54
F.	SP-39
F.	SP-24
F.	SP-8
F.	SP-58
F.	SP-16
F.1-a	S-16
F.1-b	S-10
F.2-a	S-16
F.2-b	S-10
F.3-a	S-10
F.4-a	S-39
F.4-a	S-22
F.4-a	S-19
F.4-b	S-24
F.4-b	S-26
F.4-c	S-28
F.4-d	S-19
F.4-d	S-22
F.4-e	S-23
F.4-e	S-25
F.4-e	SP-64
G.	SP-32
G.	SP-29
G.	SP-31
G.	SP-36
G.	SP-38

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
G.	SP-60
G.	SP-55
G.	SP-56
G.	SP-30
G.	SP-58
G.	SP-37
G.	SP-25
G.	SP-53
G.	SP-54
G.	SP-39
G.	SP-27
G.	SP-16
G.	SP-63
G.	SP-17
G.	SP-41
G.	SP-8
G.	SP-62
G.	SP-28
G.	SP-26
G.	SP-24
G.1-a	S-16
G.1-b	S-11
G.1-c	S-10
G.1-d	S-12
G.1-e	S-01
G.2-a	S-10
G.3-a	S-10
G.4-a	S-10
G.4-a	S-13
G.4-b	S-13
G.4-c	S-31
G.4-d	S-01
G.5-a	S-26
G.5-a	S-24
G.5-b	S-27
G.5-b	S-28
G.5-c	S-23
G.5-c	S-25
G.5-c	SP-64
G.5-d	S-17
G.5-d	S-20
H.	S-40

Table VIIIA. Relationship of Steam and Power Conversion (SPC) System IDs in GALL V. 2	
GALL Rev. 0	**GALL Rev. 1**
H.	S-32
H.	S-33
H.	S-34
H.1-a	S-30
H.1-b	S-42
H.1-b	S-41
H.1-b	S-29
H.2-a	S-02
H.2-b	S-03
I.	SP-35
I.	SP-10
I.	SP-13
I.	SP-6
I.	SP-5
I.	SP-23
I.	SP-34
I.	SP-15
I.	SP-12
I.	SP-11
I.	SP-4
I.	SP-33
I.	SP-9
I.	SP-2
I.	SP-1

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11. ABSTRACT *(200 words or less)*

This document establishes the basis for the changes that constitute Revision 1 to NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," and Revision 1 to NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR).

The technical changes that were made when revising the guidance contained in NUREG-1801 are captured in this document, along with the basis for the change. Changes to NUREG-1800, many of which derive from the changes to NUREG-1801, are also discussed in this document. Consequently, this document provides an understanding of the underlying rationale that NRC used in developing the current revisions of these guidance documents.

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