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Bases Document for Revision to:
Generic Aging Lessons Learned (GALL) Report – NUREG-1801, Revision 1
Standard Review Plan for License Renewal (SRP-LR) – NUREG-1800, Revision1

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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 the developing the current revisions of these guidance documents.

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I. Introduction

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 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 the 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, and
- 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 Volume1 and the SRP-LR present summary information reflecting the AMR table data in GALL Volume 2. To roadmap the development of some of these tables, Appendix B to this NUREG was created which describes this summarization process.

I.A.1. Roll-Up Methodology

The original version of the GALL Report and the SRP-LR 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 technical necessary. Hence, an applicant would be less consistent with the GALL Report than it could 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 PT 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 GALL, 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 XI of was added to the revised GALL Report to standardize and define terminology used in the document.

I.A.2. 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 and approved interim staff guidance (ISGs), and more recent operating experience.

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 assessed if the basis was appropriate for inclusion into the revised guidance documents. If so, it was added 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.A.3. Operating Experience

Extended operation of nuclear reactors necessitates critical analysis of existing experience (Lochbaum, 2004). 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.

Domestic Operating Experience: The NRC Office of Research provided a listing of 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 team subsequently modified AMR line item R-68 and added AMR line item RP-22. 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.

Foreign Operating Experience: 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.A.4. 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.A.5. Clarifications to the Audit and Review Process (SRP-LR only)

A large number of changes made to the GALL Report required a parallel change to the SRP-LR. Those types of changes are discussed in the preceding paragraphs B.1 through B.4 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 split between 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.

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.

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 & 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/pr 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.

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

Table II.A presents the new AMR line items that are based on new MEAP combinations applicable to mechanical systems.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-01 EP-02	Piping, piping components, and piping elements	Aluminum	Air with borated water leakage	Loss of material/ boric acid corrosion	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 item to the GALL Report. As shown in VCSNS SER 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 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-02 EP-04 SP-01	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 item to the GALL Report. As shown in RNP SER 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 be applicable 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-03 EP-05 RP-01 SP-02	Piping, piping components, and piping elements	Steel	Concrete	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 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 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-04	Piping, piping components, and piping elements	Steel	Dry air	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 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.) Thus components are not subject to moisture in a dry air environment.
AP-05 EP-06 SP-03	Piping, piping components, and piping elements	Steel	Lubricating oil (no water pooling)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 3.1.2.4.1, the staff has accepted the position that steel in a lubricating oil environment with no water pooling 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 as cited in Metals Handbook, Volume 1 and 13, Ninth Edition, American Society for Metals International, 1987. Components are not subject to wetting if their surfaces remain oil-coated.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-06 EP-07 SP-04	Piping, piping components, and piping elements	Steel	Gas	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in RNP SER 3.1.2.4.1.2, the staff has accepted the position that steel in an inert 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.
AP-07 EP-08 RP-02	Piping, piping components, and piping elements	Cast austenitic stainless steel	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 3.1.2.4.2, the staff has accepted the position that CASS 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 austenitic steels are resistant to general corrosion, crevice corrosion and pitting; cast austenitic stainless steel can be expected to have better corrosion resistance than wrought austenitic stainless steel. Where surface temperatures <250°C, extensive industry experience suggests that there will not be a problem of CASS corrosion in air.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-08	Piping, piping components, and piping elements	Copper-alloy	Dry air	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in St. Lucie SER 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-09 EP-09 SP-05	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 item to the GALL Report. As shown in VCSNS SER 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. Most of the gaseous internal environments to which components within the scope of license renewal may be subjected include: air, nitrogen, carbon dioxide, freon, halon. Industry experience suggests that copper piping exposed to an internal gaseous operating condition will be resistant to any age-related degradation.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-10 EP-11 SP-07	Piping, piping components, and piping elements	Copper-alloy	Lubricating oil (no water pooling)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 3.1.2.4.1, the staff has accepted the position that copper alloy in a lubricating oil environment with no water pooling 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 metals are not corroded by the hydrocarbon components of lubricants; lubrication oils are not good electrolytes and the oil film on the wetted surfaces of components tends to minimize the potential for corrosion. Another reference is the Corrosion Handbook, Uhlig, H.H., John Wiley & Sons, May 1948.
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 item to the GALL Report. As shown in RNP SER 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. This conclusion is based on the fact that the corrosive rating for various copper alloys in boric acid is described in RNP SER section 3.5.2.4.1.2 as "excellent: resists corrosion under almost all conditions of service" as cited in Metals Handbook, Volume 13, Corrosion, American Society for Metals, 1987, page 617.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-12 EP-36 RP-11 SP-08	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 item to the GALL Report. As shown in FCS SER 3.0.3.7.3, the staff has accepted the position that loss of material from general, 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. This program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-13 EP-14	Ducting	Galvanized Steel	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 3.3.2.5.4, the staff has accepted the position that galvanized 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 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-14 EP-15 SP-09	Piping, piping components, and piping elements	Glass	Air – indoor uncontrolled (Ext)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 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 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. Ref: Handbook of Glass Properties, N. P. Bansal and R. H. Doremua, Academic Press 1986, pg. 646.
AP-15 EP-16 SP-10	Piping, piping components, and piping elements	Glass	Lubricating oil	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-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 item to the GALL Report. As shown in the St. Lucie SER 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.
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 item to the GALL Report. As shown in RNP SER 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 only rarely).

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-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 item to the GALL Report. As shown in Ginna SER 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.
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 item to the GALL Report. As shown in VCSNS SER 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. In fact, concrete is used as a coating to protect steel (Steelwork Corrosion Control, D. A. Bayliss and D.H. Deacon, 2002).

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-20	Piping, piping components, and piping elements	Stainless steel	Dry air	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in St. Lucie SER 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-21 EP-21 SP-14	Piping, piping components and piping elements	Stainless Steel	Lubricating oil (no water pooling)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in RNP SER 3.3.2.4.4.1, the staff has accepted the position that stainless steel in a lubricating oil environment with no water pooling 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 metals are not corroded by the hydrocarbon components of lubricants; lubrication oils are not good electrolytes and the oil film on the wetted surfaces of components tends to minimize the potential for corrosion. (Ref: Corrosion Handbook, Uhlig, H.H., John Wiley & Sons, May 1948)

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	The gas environments within the scope of license renewal include gases (such as nitrogen, carbon dioxide, freon, and halon). An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 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, (which would be the situation for the gases referenced above) (Ref: Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555), Ninth Edition, American Society for Metals International, 1980 and 1987).
AP-25	Piping, piping components, and piping elements	Steel with internal lining or coating	Raw water	Loss of material/ lining or coating degradation	XI.M20, "Open-Cycle Cooling Water System"	An approved precedent exists for adding the loss of material due to degradation of the internal lining or coating of steel piping, piping components, and piping elements. In the 2001 Version of NUREG-1801, an analogous AMR line item is that of VII C1.1-a where steel, bronze, brass, stainless steel, or copper-nickel piping and fittings (with or without internal lining or coating) are subjected to raw water[1] and are vulnerable to loss of material which is managed by AMP XI.M20 "Open-Cycle Cooling Water System"

[1] Raw water is analgous to untreated water

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of preload/ stress relaxation	XI.M18, "Bolting Integrity"	A previously-approved staff position exists for adding this material, environment, aging effect and program combination item for the auxiliary system in GALL'05. GALL'01 considered this MEAP combination for RCS steam generators (IVD2.1-k as an example). As noted in EPRI NP-5769, steel gaskets can be subject to stress relaxation 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, the AMP XI.M18, "Bolting Integrity" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-27	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of material/ general, pitting and crevice corrosion	XI.M18, "Bolting Integrity"	A previously-approved staff position exists for adding this material, environment, aging effect and program combination item for the auxiliary system in GALL'05. GALL'01 considered a similar MEAP 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'05, 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, the AMP XI.M18, "Bolting Integrity" will 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	Bolting	Steel	Air - indoor outdoor (External)	Loss of material/ general, pitting and crevice corrosion	XI.M18, "Bolting Integrity"	A previously-approved staff position exists for adding this material, environment, aging effect and program combination item for the auxiliary system in GALL'05. GALL'01 considered a similar MEAP 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'05, 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, the AMP XI.M18, "Bolting Integrity" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-29 SP-28	Piping, piping components, and piping elements	Gray cast iron	Untreated water	Loss of material/ selective leaching	XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 3.3.2.4.5 and FCS Unit 1 SER 3.3.2.4.1, the staff has accepted the position that gray cast iron in an untreated water environment exhibits a loss of material due to selective leaching and therefore requires management by a program. This MEAP combination is added to GALL'05 VII.G to address the potential for selective leaching in gray cast iron components in the fire protection system. The aging effect is adequately managed by Chapter 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	Piping, piping components, and piping elements	Steel	Lubricating oil	Loss of material/ general, 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 item to the GALL Report. As shown in Ft. Calhoun Unit 1 SER 3.3.2.4.4, the staff has accepted the position that steel in a lubricating oil environment exhibits a loss of material and therefore requires 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.
AP-31 SP-27	Piping, piping components, and piping elements	Gray cast iron	Treated water	Loss of material/ selective leaching	XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. GALL 2001 considered this MEAP combination for Auxiliary system section 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 grey 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 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 requires management by a program. The aging effect is adequately managed by Chapter XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that zinc is not leaching out, and that the material is not becoming soft.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	Piping, piping components, and piping elements	Copper alloy >15% Zn	Treated water	Loss of material/ selective leaching	XI.M33, "Selective Leaching of Materials"	As shown in FCS Unit 1 SER 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 AMP XI.M33, "Selective Leaching of Materials" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
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'01 Section 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 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-34	Heat exchanger tubes	Copper alloy	Closed cycle cooling water	Loss of material/ pitting, crevice, and galvanic corrosion	XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 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 the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396. This program XI.M21 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-35	Piping, piping components, and piping elements	Aluminum	Fuel oil	Loss of material/general, 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 item 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 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. This program is to be augmented by verifying the effectiveness of fuel oil chemistry control. This augmented XI.M30 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 item to the GALL Report. As shown in FCS SER 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 item to the GALL Report. As shown in Peach Bottom SER 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.
AP-38 EP-26 SP-24	Piping, piping components, and piping elements	Aluminum	Treated water	Loss of material/general, 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.	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in D/QC SER 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 3.2.2.4.1, the aging effect 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. Note that in D/QC SER pages 3-193 thru 3-196 there is implicit acceptance - though one time inspection is not required. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 shell side components	Steel	Lubricating oil	Loss of material/ general, pitting, crevice and microbiologically influenced corrosion, and fouling	A plant-specific aging management program is to be evaluated.	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 3.3.2.2.4, the staff has accepted the position that steel heat exchanger shell in a lubricating oil environment exhibits a loss of material and therefore requires management by a program. Water contained in the lubricating oil will cause corrosion in steel materials. Fouling is also 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-40	Heat exchanger tubes	Steel	Air – outdoor (Ext)	Loss of material/ general, 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 item to the GALL Report. GALL 2001 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'05 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 tubes in outdoor air. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 tubes	Steel	Air – indoor uncontrolled (Ext)	Loss of material/ general, 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 item to the GALL Report. GALL 2001 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'05 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 tubes in indoor uncontrolled air. 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-42 SP-26	Piping, piping components, and piping elements	Gray cast iron	Soil	Loss of material/ selective leaching	XI.M33, "Selective Leaching of Materials"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS Unit 1 SER 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 requires management by a program. GALL'01 considered 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'05 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 program XI.M33 "Selective Leaching of Materials" 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 item to the GALL Report. As shown in FCS Unit 1 SER 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 AMP XI.M33, "Selective Leaching of Materials" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
AP-44	Piping, piping components, and piping elements	Copper-alloy	Fuel oil (Water as a contaminant)	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 item 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 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. This augmented program XI.M30 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 item to the GALL Report. As shown in FCS SER 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 requires management by a program. GALL'01 considered a similar MEAP 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'05 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, etc. The AMP XIM.20, "Open-Cycle Cooling Water System," 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-46 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 (MEAP) combination item to the GALL Report. As shown in FCS SER 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 requires 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 Chapter XI.M33, "Selective Leaching of Materials," which includes hardness test or destructive test to confirm that zinc is not leaching out, and that the material is not becoming soft.
AP-47 SP-32	Piping, piping components, and piping elements	Copper-alloy	Lubricating oil	Loss of material/pitting, crevice and galvanic corrosion	A plant-specific aging management program is to be evaluated.	An approved precedent exists for adding this material, environment, aging effect and program (MEAP) combination item to the GALL Report. As shown in FCS SER 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 requires management by a program. GALL'01 considered a similar MEAP combination for fire protection auxiliary systems (G.7-b) for loss of material in steel and copper alloy due to general, galvanic, pitting, and crevice corrosion (captured in GALL'05 by AMR line-item A-83 in VII.G). This related AMR line-item was created t o address different structures and components. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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, piping components, and piping elements	Glass	Air	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in D/QC SER 3.2.2.4.1 and FCS SER 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 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 Corrosion Guide, 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°C 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.
AP-49	Piping, piping components, and piping elements	Glass	Fuel oil	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 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 Corrosion Resistant Tables, 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-50 EP-28 SP-34	Piping, piping components, and piping elements	Glass	Raw water	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Handbook of Glass Properties, N. P. Bansal and R. H. Doremua, silicate glasses are highly inert. No failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been cited by the nuclear industry. Surface deposits may form due to periodic exposure to water but normal class cleaning with water will remove such deposits (Uhlig & Revie, 2000, pg. 420). The staff has accepted the position that glass in a raw 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.
AP-51 EP-29 SP-35	Piping, piping components, and piping elements	Glass	Treated water	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-52 EP-30	Piping, piping components, and piping elements	Glass	Treated borated water	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in St. Lucie SER 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.
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. 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	XI.M30 Fuel Oil Chemistry	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in the NA/S SER 3.6.4.2 and the FCS SER 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 SP-36	Piping, piping components, and piping elements	Stainless Steel	Raw water	Loss of material/pitting, and crevice, and microbiologically -influenced corrosion	XI.M20 Open Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in ANO-1, Unit 1 SER 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 requires management by a program. The Open-Cycle Cooling Water program 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 item to the GALL Report. As shown in D/QC SER 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 requires 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-57 EP-32	Piping, piping components, and piping elements	Stainless Steel	Treated water	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 item to the GALL Report. As shown in NA/S SER 3.6.2, the staff has accepted the position that stainless steel in a treated water environment exhibits a loss of material and therefore requires 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. 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-59 SP-38	Piping, piping components, and piping elements	Stainless Steel	Lubricating oil	Loss of material/pitting, crevice, and microbiologically influenced 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 item to the GALL Report. As shown in NA/S SER 3.6.2 and FCS SER 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 requires 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-60	Piping, piping components, and piping elements	Stainless Steel	Closed cycle cooling water >60°C (>140°F)	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 item to the GALL Report. GALL'01 considered this MEAP 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'05 by A-68 which addresses heat exchanger shell side components including tubes. This additional AMR line-item is created to also consider the SCC of stainless steel piping, piping components, and piping elements. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 tubes	Stainless Steel	Raw water	Reduction of heat transfer/ fouling	XI.M20 Open Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 3.3.2.4.15, the staff has accepted the position that reduction of heat transfer exhibited by stainless steel heat exchanger tubes 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'01 considered this MEAP 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'05 by S-28 addressing reduction of heat transfer in the PWR steam generator blowdown system heat exchanger tubes. This additional AMR line-item AP-61 is created to also consider the reduction of heat transfer of stainless steel heat exchanger tubes 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.
AP-62 EP-34 SP-40	Heat exchanger tubes	Stainless Steel	Treated water	Reduction of heat transfer/ fouling	XI.M2 Water Chemistry	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 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.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-63 EP-35 SP-41	Heat exchanger tubes	Stainless Steel	Closed cycle cooling water	Reduction of heat transfer/ fouling	XI.M21 Closed Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in Ginna SER 3.3.2.4.2, the staff has implicitly accepted the position that reduction of heat transfer exhibited by stainless steel heat exchanger tubes 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. This program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
AP-64	Piping, piping components, and piping elements	Copper alloy	Treated 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 item to the GALL Report. As shown in FCS SER 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 the Closed-Cycle Cooling Water System AMP which ensures system corrosion inhibitor concentrations are maintained within specified limits of EPRI TR-107396. This program 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-65	Heat exchanger tubes	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 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 AMP XI.M33, "Selective Leaching of Materials" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
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 item to the GALL Report. As shown in VCSNS SER 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-67	Piping, piping components and piping elements	Stainless steel	Waste water (untreated or treated water)	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 for category (a)(2) systems. As shown in VCS SER 3.3.2.4.14 the staff has accepted the position that loss of material from pitting, and crevice corrosion, is exhibited by stainless steel in a waste water environment and therefore requires 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
AP-69	Piping, piping components and piping elements	Steel	Treated water	Loss of material/ general, 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 for category (a)(2) systems. As shown in Farley draft SER section 3.3.2.3.21 the staff has accepted the position that loss of material from general, pitting and crevice corrosion is exhibited by steel in a treated water environment and therefore requires 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
AP-70	Piping, piping components and piping elements	Copper alloy	Treated water	Loss of material/ pitting, crevice, and galvanic 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. As shown in FCS SER 3.0.3.7.3 the staff has accepted the position that loss of material from pitting, crevice, and/or galvanic corrosion, is exhibited by copper alloy in a closed cycle cooling water (treated water) environment and therefore requires 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-71	Piping, piping components and piping elements	Steel	Condensation (internal)	Loss of material/ general, 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 for category (a)(2) systems. As shown in Farley draft SER section 3.3.2.3.19 the staff has accepted the position that loss of material from general, pitting and crevice corrosion is exhibited by steel in a condensation internal (wetted air/gas) environment and therefore requires 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
AP-72	Piping, piping components and piping elements	Stainless Steel	Condensation (internal)	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 for category (a)(2) systems. As shown in Farley draft SER section 3.3.2.3.19 the staff has accepted the position that loss of material from general, pitting and crevice corrosion is exhibited by stainless steel in a condensation internal (wetted air/gas) environment and therefore requires 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-01	Bolting	Steel	Air – outdoor (Ext)	Loss of material/ general, pitting and crevice corrosion	XI.M18, "Bolting Integrity"	The staff has accepted the position that loss of material from general, pitting, and crevice corrosion, exhibited by steel bolting in an outdoor air environment is properly managed by a program which includes the program elements of the Bolting Integrity AMP which includes periodic inspection of closure bolting and ensures timely detection of corrosion and/or leakage. This MEAP is consistent with that of AMR line item V E.2-a in GALL'01. This XI.M18 AMP provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
EP-03	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 item to the GALL Report. As shown in RNP SER 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 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-06	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 item to the GALL Report. As shown in Ginna SER 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-13	Heat exchanger tubes	Copper-alloy	Closed cycle cooling water	Loss of material/ pitting, crevice and galvanic corrosion	XI.M21, "Closed-Cycle Cooling Water System"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-24	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of preload/ stress relaxation	XI.M18, "Bolting Integrity"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in FCS SER 3.2.2.4.1.2, the staff has accepted the position that loss of preload from stress relaxation exhibited by steel bolting in an indoor air environment is properly managed by the Bolting Integrity AMP which includes periodic inspection of closure bolting and ensures timely detection of corrosion and/or leakage. This program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
EP-25	Closure bolting	Steel	Air - indoor uncontrolled (External)	Loss of material/ general, pitting and crevice corrosion	XI.M18, "Bolting Integrity"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in VCSNS SER 3.0.3.7.2, the staff has accepted the position that loss of material from general, pitting, and crevice corrosion, exhibited by steel bolting in an indoor air environment is properly managed by the Bolting Integrity AMP which includes periodic inspection of closure bolting and ensures timely detection of corrosion and/or leakage. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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	XI.M21 Closed Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. GALL'01 considered this MEAP combination for the closed-cycle cooling water system (VII.C2.2-a) which is captured in GALL'05 as the corresponding A-52. Since GALL'01 did not include this MEAP 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. This program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
EP-37	Heat Exchanger Tubes	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 item to the GALL Report. As shown in FCS Unit 1 SER 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 AMP XI.M33, "Selective Leaching of Materials" will 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-10	Piping, piping components, and piping elements	Steel	Closed cycle cooling water	Loss of material/ general, pitting and crevice corrosion	XI.M21 Closed Cycle Cooling Water System	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. GALL'01 considered a similar MEAP 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'05 captured this line item in E-17 but this corresponding AMR line-item RP-10 has been created for the RCS system. The augmented program XI.M21 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
RP-13	Instrument penetration Bottom-mounted guide tube	Stainless steel	Air with 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 item 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 in a air 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 anti-vibration bars	Chrome plated Nickel alloy, 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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensures that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. This programs XI.M19 and XI.M2 provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
RP-15	Steam generator anti-vibration bars	Chrome plated Nickel alloy, 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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensures that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. This programs XI.M19 and XI.M2 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Steam Generator Tubing Integrity and water chemistry programs which ensures that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. Programs XI.M19 and XI.M2 provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
RP-17	Steam Generator Divider Plate	Stainless steel	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 in EPRI TR-105714	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Inservice Inspection and Water chemistry programs which ensures 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. Programs XI.M1 and XI.M2 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-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
RP-21	Steam Generator Divider Plate	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 in EPRI TR-105714 and for Alloy 600, 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.	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Inservice Inspection and Water chemistry programs which ensures that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on steam generator components. The programs XI.M1 and XI.M2 provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation. However, if alloy 600 is used the staff has requested a commitment in the FSAR supplement as stated.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 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 in EPRI TR-105714 and for Alloy 600, 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.	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 is properly managed by the Inservice Inspection and Water chemistry programs which ensures that water chemistry is maintained to appropriate EPRI standards and appropriate inspections are performed on pressurizer components. Programs XI.M1 and XI.M2 provide reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation. However, if alloy 600 is used the staff has requested a commitment in the FSAR supplement as stated.

Table II.A New AMR Line Items based on new 'MEAP' combinations relevant to Mechanical Systems ("A" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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," for PWR secondary water in EPRI TR-102134. 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 item to the GALL Report. As shown in NA/S SER 3.6.2, the staff has accepted the position that stainless steel in a treated water environment exhibits a loss of material and therefore requires 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, and analysis frequencies, and corrective actions for control of reactor water chemistry. Consistent with GALL'01, the AMP is augmented by inspection to confirm that unacceptable degradation is not occurring and that the concentration of chemical contaminants falls within acceptable limits. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 water in EPRI TR-102134. 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 augmentation is still being resolved for SP-33	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. Piping, piping components and piping elements in the PWR steam and power conversion feedwater system (VIII.D1), the SPCS condensate system (VIII.E), the PWR steam generator blowdown system (VIII.F), and the PWR auxiliary feedwater system (VIII.G) if made of stainless steel and exposed to >140°F treated water can be subject to crack initiation and growth due to stress corrosion cracking. GALL'01 considered 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'05 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 PWR conditions as specified. The aging effect is adequately 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 AMP is augmented by inspection to confirm that unacceptable degradation is not occurring. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 requires management by a program. In GALL'01, Ni-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 VCSNS SER 3.1.2.4.7, the staff concludes 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, and 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 in BWRVIP-29 (EPRI-TR 103515) 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 item to the GALL Report. Piping, piping components, and piping elements in the BWR steam and power conversion condensate system (VIII.E). GALL'01 considered 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'05 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, and analysis frequencies, and corrective actions for control of reactor water chemistry. The AMP is augmented by inspection to confirm that unacceptable degradation is not occurring. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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.M21, "Closed Cycle Cooling Water System" 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 item to the GALL Report. Condensate system storage tanks (VIII.E) exposed to treated water are subject to cracking due to SCC, a potential aging mechanism for stainless steels with operating temperatures >140°F. Chlorides, fluorides, and sulfates and dissolved oxygen are contributors to SCC. As shown in NA/S SER 3.5.2, the staff has accepted the position that cracking exhibited by stainless steel in treated water greater than 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. This AMP includes elements of XI.M21, Closed Cycle Water Cooling System. The AMP is augmented by inspection to confirm that unacceptable degradation is not occurring. 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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 in EPRI TR-102134	An approved precedent exists for adding this material, environment, aging effect and program combination item 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. 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 in BWRVIP-29 (EPRI TR-103515). 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 item 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, and analysis frequencies, and corrective actions for control of reactor water chemistry. The AMP is augmented by inspection to confirm that unacceptable degradation is not occurring. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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 in BWRVIP-29 (EPRI TR-103515).	An approved precedent exists for adding this material, environment, aging effect and program combination item 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. This program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
SP-48	Piping, piping components, and piping elements	Steel	Steam	Loss of material/ general, pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	GALL 2001 considered this MEA combination for steam and power conversion systems section VIII item B1.1-a. This additional AMR line item is created for section VIII.J, category (a)(2) systems. 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.
SP-51	Piping, piping components, and piping elements	Steel	Raw water	Loss of material/ general, pitting, crevice and microbiologically influenced corrosion	A plant-specific aging management program is to be evaluated.	GALL 2001 considered this MEA combination for steam and power conversion systems section VII item C3.1-a. This additional AMR line item is created for section VIII.J, category (a)(2) systems. 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" Auxiliary, "E" Engineered Safety Features, R" for Reactor Coolant, "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-52	Piping, piping components, and piping elements	Stainless steel	Raw water	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated.	GALL 2001 considered this MEA combination for steam and power conversion systems section VII item C3.2-a. This additional AMR line item is created for section VIII.J, category (a)(2) systems. 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.

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 & Component Supports" as presented in GALL Vol. II, Chpt. III)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-01	Steel components: Radial beam seats in BWR drywell; RPV support shoes for PWR with nozzle supports; other supports	Lubrite	Air – indoor uncontrolled	Loss of mechanical function/ Corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; elastomer hardening	XI.S6, "Structural Monitoring Program"	Similar to T-28. GALL 2001 considered this MEA combination for Structures section III; item B1.1.3-a, B1.2.2-a, and B1.3.2-a. The Structures Monitoring Program will adequately manage this aging effect by visual inspection for corrosion and distortion.
TP-02	Sliding support bearings and sliding support surfaces	Lubrite	Air – outdoor	Loss of mechanical function/ Corrosion, distortion, dirt, overload, fatigue due to vibratory and cyclic thermal loads; elastomer hardening	XI.S6, "Structural Monitoring Program"	Similar to T-28 and TP-1. The environment is more conservative, outdoor vs. indoor uncontrolled. However aging effect is same. The Structures Monitoring Program will adequately manage this aging effect by visual inspection for corrosion and distortion.

Table II.B New AMR Line Items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures & Component Supports" as presented in GALL Vol. II, Chpt. III)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-03	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel, aluminum	Air with borated water leakage	Loss of material/ boric acid corrosion	XI.M10, "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.
TP-04	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 item to the GALL Report. As shown in Ginna SER 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 "PWR Primary Water Chemistry Guideline," EPRI NP-7077, Revision 2, Project 2493, November 1990.
TP-05	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 item to the GALL Report. As shown in RNP SER 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. On the basis of current industry research and operating experience, dry air on stainless steel will not result in aging that will be of concern during the period of extended operation.

Table II.B New AMR Line Items based on new 'MEAP' combinations relevant to Structures ("T" for "Structures & Component Supports" as presented in GALL Vol. II, Chpt. III)

Item	Structure and/or Component	Material	Environment	Aging Effect/ Mechanism	AMP	Precedent and Technical Basis for New Line-Item
TP-06	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel, aluminum, stainless steel	Air – outdoor	Loss of material/ pitting and crevice corrosion	XI.S6, "Structural Monitoring Program"	An approved precedent exists for adding this material, environment, aging effect and program combination item to the GALL Report. As shown in RNP SER 3.5.2.4.3.2, the staff has accepted the position that galvanized steel and stainless steel in an outdoor air environment results in loss of material due to constant wetting and drying conditions. Aluminum would be susceptible to similar kind of aging effects in the outdoor environment. The Structural Monitoring Program adequately manages the aging effect by performing routine visual inspections of the surface of the structural components.
TP-07	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)	XI.S6, "Structures Monitoring Program"	Similar to C-18. GALL 2001 considered this MEA combination for Containment section II, item A3.3-a, and B4.3-a. This MEA combination was not included in Structures Section III. The Structures Monitoring Program will adequately manage this aging effect based on visual examination for deterioration of seals and gaskets.
TP-08	Support members; welds; bolted connections; support anchorage to building structure	Galvanized steel, aluminum	Air – indoor uncontrolled	Loss of material/ galvanic corrosion	XI.S6, "Structural Monitoring Program"	Difficult to justify loss of materials in this environment. All issued SERs have accepted "no aging effects."

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	XI.E5, "Aging Management Program for Fuse Holder"	An approved precedent exists for adding this material, environment, aging effect and program combination item 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) 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 failure The AMP XI.E5 , "Aging Management Program for Fuse Holders" will provide 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 material – bakelite, phenolic melamine or ceramic, molded polycarbonate and other	Air – indoor uncontrolled (Internal/ External)	None	None	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 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, electrical failure due to (Thermal/ thermoxidative) degradation of organics/thermo plastics, radiation-induced oxidation, moisture intrusion and ohmic heating	XI.E1, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	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 2001 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. This program XI.E1 provides reasonable assurance that the component's intended functions will be maintained within the CLB for the extended period of operation.
LP-04	Phase 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	XI.E4, "Aging Management Program for Bus Ducts"	An approved precedent exists for adding this material, environment, aging effect and program combination item 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 requires management by a program. NRC IN 2000-14 identifies the phenomenon of "torque relaxation" of bus splice plate connecting bolts. The AMP XI.E4, "Aging Management Program for Bus Ducts" will 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-05	Phase 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 due to thermal/ thermoxidative degradation of organics/ thermoplastics, radiation-induced oxidation; moisture/debris intrusion, and ohmic heating	XI.E4, "Aging Management Program for Bus Ducts"	An approved precedent exists for adding this material, environment, aging effect and program combination item 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. The AMP XI.E4, "Aging Management Program for Bus Ducts" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
LP-06	Phase bus Enclosure assemblies	Steel, galvanized steel	Air – indoor and outdoor	Loss of material/ general corrosion	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 item 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 2001 addressed this MEA 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.

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 and surface contamination	A plant-specific aging management program is to be evaluated	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.
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.
LP-10	Phase bus Enclosure assemblies	Elastomers	Air – indoor and outdoor	Hardening and loss of strength/ elastomers degradation	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 2001 included this MEA combination in section V, item B.1-b; and also in section VII, items F1.1-b, et al. The Structural Monitoring Program will 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-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.
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"	Included in GALL to address the metallic portion of connections (similar to fuse holder). The new AMP XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements" will provide reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

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. For example, "Crack initiation and growth/ stress corrosion cracking" was replaced with "Cracking/ stress corrosion cracking" and was not considered a significant change.

The following tables identify the Item Number in the revised GALL, the GALL 2001 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 the GALL Report, Rev. 0 in 2001, 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.

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'01 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	A1.1-a A2.2-a 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.*** ***The weathering index for the continental US is shown***	***No, if stated conditions are satisfied for inaccessible areas***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: Applicable aging management programs (AMPs) for concrete elements in the current Generic Aging Lessons Learned (GALL) report were not clearly stated and (2) some inconsistencies were found between Chapters II and III of the GALL report for the concrete elements. The environment was revised to air-outdoor instead of outside containment to better reflect the actual environment.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						in ASTM C33-90, Fig. 1.		
C-02	Concrete Dome; wall; basemat; ring girder; buttresses	II.A1.1-b II.A2.2-b II.B2.2.1-a II.B3.1.2-a 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 for 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-77***.	***No, if concrete was constructed as stated for inaccessible areas***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to make the AMP consistent with ISG-3 for the following reasons: Applicable aging management programs (AMPs) for concrete elements in the current Generic Aging Lessons Learned (GALL) report were not clearly stated and (2) some inconsistencies were found between Chapters II and III of the GALL report for the concrete elements.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
C-03	Concrete Dome; wall; basemat; ring girder; buttresses	II.A1.1-c II.A2.2-c II.B2.2.1-b II.B3.1.2-b II.B3.2.1-c	Concrete	***Aggressive environment***	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:** ***Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm).*** ***Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.***	***Yes, if environment is aggressive***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to make the AMP consistent with the approved ISG-3 for the following reasons: AMPs for concrete elements in the current GALL report were not clearly stated and (2) some inconsistencies were found between Chapters II and III of the GALL report for the concrete elements. The environment was revised to reflect the actual environment.

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

Item	Structures and/or Components	GALL'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
C-04	Concrete: Dome; wall; basemat; ring girders; buttresses	II.A1.1-d II.A2.2-d II.B2.2.1-c II.B3.1.2-c II.B3.2.1-d	Concrete	***Any***	Expansion and cracking/ 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: Evaluation is needed if investigations, test, and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.***	***No, if the stated conditions are satisfied for inaccessible areas***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III. The environment was revised to "any" since the aging effect could occur in any environment – more dependent on aggregates than environment.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
C-05	Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel	A1.1-e A2.2-e B2.2.1-d B3.1.2-d B3.2.1-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 cracking, loss of bond, and loss of material (spalling, scaling) due to aggressive chemical attack.*** ***Inaccessible Areas: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm).*** ***Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.***	***Yes, if environment is aggressive***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to make the AMP consistent with the approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III. The environment was revised to air-indoor uncontrolled or air-outdoor instead of inside or outside containment to better reflect the actual environment.

IIIA. Changes in Existing AMR Line-Items for Containment Structures (Chapter II in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
C-12	Penetration sleeves	A3.1-a 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)*** Chapter XI.S4, "10 CFR Part 50, Appendix J," and If a coatings program is credited for managing loss of material due to corrosion during the current licensing term (e.g., relief request from IWE), then it is to be continued during the period of extended operation. See Chapter XI.S8, "Protective Coating Monitoring and Maintenance Program"	No No No	NUREG-1667 specifically recommended this examination

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'01 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 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 the subsequent inspections performed did not exhibit degradation related to freeze-thaw should be considered a part of the evaluation,*** ***The weathering index for***	***No, if within the scope of the applicant's structures monitoring program and stated conditions are satisfied for inaccessible areas***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III. The environment was revised to air-outdoor instead of weather exposed to be consistent with section II changes.

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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
						the continental US is shown in ASTM C33-90, Fig.1.		
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 required, 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-77***	***No, if concrete was constructed as stated for inaccessible areas***	The AMP was revised to address clearly both accessible and inaccessible areas. The basis for this revision was to make the AMP consistent with the approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.

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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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	Expansion and cracking/ 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: Evaluation is needed if investigations, test, and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.***	***No, if within the scope of the applicant's structures monitoring program and the stated conditions are satisfied for inaccessible areas***	The AMP was revised to clearly address both accessible and inaccessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.

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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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.***	No, if within the scope of the applicant's structures monitoring program	The AMP was revised to clearly address both accessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.
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	Aggressive environment	Cracking, loss of bond, and loss of material (spalling, scaling)/ corrosion of embedded steel	***Inaccessible Areas: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm). Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.***	***Yes, if environment is aggressive***	The AMP was revised to clearly address inaccessible areas. The basis for this revision was to make the AMP consistent with the approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.

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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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	Aggressive environment	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.***	No, if within the scope of the applicant's structures monitoring program	The AMP was revised to address accessible areas. The basis for this revision was to incorporate approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.
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: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (ph < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm)*** ***Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.***	***Yes, if environment is aggressive***	The AMP was revised to address inaccessible areas. Additionally, further evaluation was required only if an aggressive below-grade environment existed. The basis for this revision was to make AMP consistent with the approved ISG-3 for the following reasons: In GALL'01, the AMPs for concrete elements were unclear, and concrete elements were treated differently in Chpt. II and III.

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'01 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 Section XI, Subsection IWF" or Chapter XI.S6, "Structures Monitoring Program"***	***No, if within the scope of Section XI, IWF or structures monitoring program***	Included "steam generator supports" in the structure/component list to include instances where lubrite supports are used. Also, gives the option of using AMP XI.S3 for those plants that have a Section XI, subsection NF program in place.

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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
R-01 **R-06** **R-89** **R-75** **R-90** **R-218**	IV.D1.1-j IV.D2.1-h IV.C2.5-k IV.C2.5-s IV.A2.7-a IV.A2.2-a IV. A2.7-b IV.D1.1-i	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 in EPRI TR-105714 and for alloy 600, 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.***	***No, but licensee commitments to be confirmed***	The AMP was changed from requiring a plant-specific program to explicitly call out XI.M1 and XI.M2, supplemented by the actions identified by Orders, Bulletins and Generic Letters associated with recent experience with nickel allows to 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. The commitment has to be provided in the FSAR Supplement. Also, added in the further evaluation column the recommendation 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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
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** **R-176** **R-180** **R-181** **R-185** **R-193** **R-202** **R-209** **R-214**	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 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	Stainless steel, nickel alloy, cast austenitic stainless steel	Reactor coolant	Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	***Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714. No further aging management review is necessary if the applicant provides a commitment in the FSAR supplement to (1) to participate in industry programs for investigating and managing aging effects applicable to Reactor Internals, (2) to 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.M16 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 in 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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** **R-199** **R-204** **R-211** **R-215**	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 IV.B4.5-h IV.B4.6-c IV.B4.7-c IV.B4.8-b	Stainless Steel	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 industry programs for investigating and managing aging effects applicable to Reactor Internals, (2)o 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 and further evaluation columns in GALL currently require a plant-specific AMP, participation in industry programs to investigate aging effects and determine appropriate an AMP 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 to be developed in the future for proper management of reactor internals. Also, added in 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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.B2-4H 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- JIV.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 2005) and instead recommend a commitment to be provided in the FSAR Supplement to apply industry programs to be developed in the future for proper management of reactor internals. Also, added in 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-122 **R-127** **R-132** **R-135** **R-141** **R-157** **R-161** **R-164** **R-169** **R-178** **R-188** **R-196** **R-200** **R-205** **R-212** **R-216**	IV.B2.3-c IV.B2.4-e 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.B4.5-i IV.B4.6-d IV.B4.7-d IV.B4.8-c	Stainless steel	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 XI.M16 (the current version of which is no longer acceptable to NRC) 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 in 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-112 **R-118** **R-133** **R-150** **R-162** **R-167** **R-186** **R-194** **R-203** **R-210**	IV.B2.1-i IV.B2.2-d IV.B2.5-e IV.B3.2-b IV.B3.4-e IV.B3.5-b IV.B4.4-b IV.B4.5-b IV.B4.6-b IV.B4.7-b	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, as described in EPRI TR-105714. 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.***	***No, but licensee commitment to be confirmed***	The AMP column was changed to delete XI.M16 (the current version of which is no longer acceptable to NRC) 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 in 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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
R-125	IV.B4.5-g	Stainless steel	***Reactor coolant and high fluence ($>1 \times 10^{21}$ n/cm^2, E >0.1 MeV)***	Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	***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.***	***No, but licensee commitment to be confirmed***	The AMP and further evaluation columns in GALL currently require a plant-specific AMP, participation in industry programs to investigate aging effects and determine appropriate an AMP 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 to be developed in the future for proper management of reactor internals. Also, added in 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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
R-128	IV.B2.4-f	Stainless steel	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	***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.***	***No, but licensee commitment to be confirmed***	The AMP and further evaluation columns in GALL currently require a plant-specific AMP, participation in industry programs to investigate aging effects and determine appropriate an AMP 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 to be developed in the future for proper management of reactor internals. Also, added in 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-24 **R-88**	IV.C2.5-j IV.A2.6-a	Nickel alloy, cast austenitic stainless steel, stainless steel	***Reactor coolant***	Cracking/ primary water 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," and*** ***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.***	***No, unless licensee commitments need to be confirmed***	The AMP was changed from requiring a plant-specific program to explicitly call out XI.M2 and XI.M2 or XI.M32, supplemented by the actions identified by Orders, Bulletins and Generic Letters associated with recent experience with nickel allows to 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. The commitment has to be provided in the FSAR Supplement. Also, added in the further evaluation column the recommendation 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-25 **R-35** **R-76**	IV.C2.5-c IV.C2.5-g IV.D2.1-a IV.A2.2-b	Steel with stainless steel or nickel alloy cladding; or stainless steel	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 in EPRI TR-105714 ***and, for Alloy 600, 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***.	***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 AMP. The staff position would encompass ISGs and branch technical positions published in other regulatory guidance documents. The commitment has to be provided in the FSAR Supplement. Also, added in 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 in EPRI TR-102134	***No.***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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."

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (chapter IV in GALL Vol. 2)							
Item	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
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 in EPRI TR-102134	***No***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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-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 in EPRI TR-102134. For plants with steam generators with carbon steel tube supports where analyses were completed in response to NRC Bulletin 88-02 "Rapidly Propagating Cracks in SG Tubes," the results of those analyses have to be reconfirmed for the period of license renewal.	***No***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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."

IIIC. Changes in Existing AMR Line-Items related to Reactor Vessels, Internals, and Reactor Coolant Systems (chapter IV in GALL Vol. 2)							
Item	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
R-44 **R-47** **R-48**	IV.D1.2-a IV.D1.2-b IV.D1.2-c	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 in EPRI TR-105714	***No***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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 in EPRI TR-102134	***No***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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 feedwater /steam	Loss of material/ wastage and pitting corrosion	Chapter XI.M19, "Steam Generator Tubing Integrity" and Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134	***No***	The AMP and further evaluation columns in the current version of GALL required a review of the effectiveness of XI.M19. As part of the GALL 2005 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."

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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
E-22 **E-34** **E-36**	Containment isolation piping and components internal surfaces	V.C.1-a V.C.1-b V.C.1-b	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. ***See IN 85-30 for evidence of microbiologically influenced corrosion.***	Yes, plant specific	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.
E-42	***Piping, piping components, and piping elements***	***V. B.***	***Steel***	***Soil***	***Loss of material/ general, pitting and crevice 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***	Underground steel piping, piping components, and piping elements exposed to a soil environment are subject to loss of material due to general, pitting, and crevice corrosion. This aging effect can be managed by either surveillance (XI.M28) or inspection. (XI.M34).

IIID. Changes in Existing AMR Line-Items related to Engineered Safety Features (chapter V in GALL Vol. 2)								
Item	**Structures and/or Components**	**GALL'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
E-43	***Motor Cooler***	***V.A V.D.1***	***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 item to the GALL Report. As discussed in Farley 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 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 AMP XI.M33, "Selective Leaching of Materials" will provide 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 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'01 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program**	**Further Evaluation Recommended**	**Basis for Change**
A-15 **A-16**	***Elastomer lining***	***VII.A3.2-a VII.A3.5-a VII.A3.3-a*** ***VII.A4.5-a VII.A4.3-a VII.A4.2-a***	***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 2001 GALL 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.
A-47	Piping, piping components, and piping elements	***VII.G.6-b***	***Copper alloy >15% Zn***	***Raw water***	***Loss of material/, selective leaching and fouling***	***Chapter XI.M33, "Selective Leaching of Materials"***	No	This item was modified to address the potential for selective leaching in copper alloy components with greater than 15% zinc in the Fire Protection system and to identify XI.M33, "Selective Leaching of Materials" as an acceptable AMP. The other aging mechanisms are included
A-80	***Piping and components external surfaces and bolting***	***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, pitting and crevice corrosion***	***A plant specific aging management program is to be evaluated***	***Yes, plant specific***	This line item was added to address the external surface of compressed air components. Similar to A-77, and could have been included in section VII.I.

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'01 Item Number	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Basis for Change
S-39	Heat exchanger tube side components including tubes	VIII. F.4-a	Stainless steel	Treated water >140^{o}F	***Cracking/stress corrosion cracking***	Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134. 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	Cracking of SS heat exchanger tube side components including tubes exposed to treated water and managed by XI.M2 must be a MEAP in VIII.F for PWR Steam Generator Blowdown System Need to include this MEAP to make GALL more comprehensive in its coverage. Similar to SP-44, except for the environment.

IV. 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 the GALL Report: This does not include editorial changes.

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
X.M1	Metal Fatigue of Reactor Coolant Pressure Boundary	Y	Revised the program description to note that examples of critical components are identified in NUREG/CR-6260. Revised monitoring and trending to indicate that the sample of high fatigue usage locations includes the locations identified in NUREG/CR 6260 and any additional critical components in the plant.	III, IV, V, VII, VIII
X.S1	Concrete Containment Tendon Prestress	N	N/A	
X.E1	Environmental Qualification (EQ) of Electrical Components	Y	Deleted reference to GSI-168 in program description. It is no longer an open issue.	VI
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program. Also deleted the term "nominal" for Class 2 Components, Table IWC-2500-1, Examination category C-F-1 welds.	IV
XI.M2	Water Chemistry	N	N/A	IV, V, VII
XI.M3	Reactor Head Closure Studs	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV
XI.M4	BWR Vessel ID Attachment Welds	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M5	BWR Feedwater Nozzle	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV
XI.M6	BWR Control Rod Drive Return Line Nozzle	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV
XI.M7	BWR Stress Corrosion Cracking	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV
XI.M8	BWR Penetrations	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	IV
XI.M9	BWR Vessel Internals	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program. Technical change: Additional inspections required for top guides with neutron fluence exceeding the IASCC threshold ($5x10^{20}$ n/cm^2, E>1 MeV). Some of the top guide locations could experience this high neutron fluence values and are more susceptible to cracking. In D/QC SER section 3.1.2.3.6, the applicant proposed and staff has accepted additional inspections.	IV

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M10	Boric Acid Corrosion	Y	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. Added aluminum to materials affected. Also added requirements for interfaces such that boric acid leakage, however it is found, is evaluated in accordance with this program. Updated references to include applicable documents issued since 2001. The basis for the 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 VCNS SER 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	Program is deleted	not used in GALL05 AMR tables
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	N	N/A	IV, V

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
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 GALL05 AMR tables
XI.M15	Neutron Noise Monitoring	N	N/A	not used in GALL05 AMR tables
XI.M16	PWR Vessel Internals	Y	Program is deleted	not used in GALL05 AMR tables
XI.M17	Flow-Accelerated Corrosion	N	N/A	IV, V, VII
XI.M18	Bolting Integrity	N	N/A	IV, V, VII, VIII

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M19	Steam Generator Tube Integrity	Y	The following changes were made: 1) Eliminating reference to "staff review of NEI 97-06" & eliminating 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. 2) Clarifying that the AMP scope includes steam generator sleeves and plugs. This will make the AMP consistent with the line item in GALL volume 2 section IV. 3) Including tube support lattice bars and tube support plates made of carbon steel in the AMP scope, and eliminating the requirement for NRC plant-specific review of the 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 and lattice bars 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 for these programs. In addition, subsequent NRC plant-specific review of the steam generator tube integrity AMP for these components is not necessary.	IV

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M20	Open-Cycle Cooling Water System	N	N/A	V, VII
XI.M21	Closed-Cycle Cooling Water System	Y	Modified the first paragraph to clarify that the focus is on ensuring intended functions are not compromised by aging. 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.	V, VII
XI.M22	Boraflex Monitoring	N	N/A	VII
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	N	N/A	VII
XI.M24	Compressed Air Monitoring	N	N/A	VII
XI.M25	BWR Reactor Water Cleanup System	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	VII

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M26	Fire Protection	Y	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 a 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 are not related to aging management. Therefore, the staff position is to revise XI.M26 to eliminate the halon/carbon dioxide system inspections for charging pressure, valve lineups, and automatic mode of operation.” ISG-4 also changed the visual inspection interval from specific interval to plant specific interval based on plant operating experience and engineering evaluation.	VII

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 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 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. In most cases, sprinkler systems are in place several years before the operating license is issued. However, sprinkler systems in some plants may have been installed after the plant was placed in operation. 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.	VII
XI.M28	Buried Piping and Tanks Surveillance	N		V, VII, VIII
XI.M29	Aboveground Carbon Steel Tanks	N		VII, VIII
XI.M30	Fuel Oil Chemistry	N		VII

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 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. All capsules placed in storage must be maintained for future insertion. Any changes to storage requirements must be approved by the NRC, as required by 10CFR 50, Appendix H.”	IV
XI.M32	One-Time Inspection	Y	Modified the Program Description to clarify the purpose and role of one-time 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 AE/Ms. Also added clarification regarding the 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.	V, VII, VIII

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.M33	Selective Leaching of Materials	N	N/A	V, VII
XI.M34	Buried Piping and Tanks Inspection	Y	Periodic inspection is replaced by opportunistic inspection. It is anticipated the one or more opportunistically inspections will occur within a ten year period, for maintenance purposes or for any other reason. Excavating the piping system periodically just to inspect could increase the chances of damage to the coating and hence, the change to opportunistic inspection.	V, VII, VIII
XI.S1	ASME Section XI, Subsection IWE	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	II
XI.S2	ASME Section XI, Subsection IWL	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	II
XI.S3	ASME Section XI, Subsection IWF	Y	Administrative changes were implemented to identify the latest ASME Section XI edition and addenda, as approved by the NRC in 10CFR50.55a. A footnote was also added for 10CFR50.55a which allows the applicant to use the edition that was indicated in the plant's 10-year ISI program.	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	III, VI, VII
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants	N	N/A	III
XI.S8	Protective Coating Monitoring and Maintenance Program	N	N/A	II

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.E1	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	N	N/A	VI
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 the original GALL. 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 the second method, direct testing of the cable system is performed. This incorporates the alternate method in the proposed ISG-15. Revised the appropriate elements to address these two methods. Clarified that this aging management program 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. Clarified the corrective action element to require engineering evaluation when acceptance criteria are not met.	VI

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 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. Element 2, Preventive Actions – deleted the sentence 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. 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 4, Detection of Aging Effects – Based on above, added the requirement of inspecting for water collection after severe weather related events, but not to exceed two years.	VI
XI.E4	Aging Management Program for Bus Ducts	New	This is a new program included in the January 2005 GALL version. Per Ginna SER section 3.6.2.4.4.2, and D/QC SER section 3.6.2.4.1, the industry has proposed and the staff has accepted plant specific programs that are similar to this new proposed program. This is an inspection program that inspects bolted connections, internal portions of bus ducts, bus insulating systems, and bus supports for signs of aging degradation. 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

GALL AMP	AMP	AMP Revised (Y or N)	Summary of Change and its Basis	Referenced GALL05 Chapters
XI.E5	Aging Management Program for Fuse Holders	New	This is a new program included in January 2005 GALL version to address metallic clamp portion of fuse holders. 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. In VCS SER section 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.	VI
XI.E6	Electrical Cable Connections Not Subject To 10 CFR 50.49 Environmental Qualification Requirements	New	This is a new program included in January 2005 GALL version to address metallic parts of the cable connection. SAND 96-0344, "Aging Management Guidelines For Electrical Cable and Terminations," indicated that several plants identified terminations loosening. The program requires a representative sample of cable connections to be tested. 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

V. Abbreviations, Acronyms, and Designations

The following table presents definitions or explainations of abbreviations, acronyms and designations used within the SRP-LR, the GALL Report and this document.

Term	Definition/Explaination
A	ASTM nomenclature
ACI	American Concrete Institute
ACSR	aluminum core steel reinforced
ADS	automatic depressurization system
AFW	auxiliary feedwater
ALARA	as low as reasonably achievable
AMP	aging management program
AMR	aging management review
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATWS	anticipated transienst without scram
B&PV	boiler and pressure vessel
B&W	Babcock & Wilcox
BWR	boiling water reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Project
CASS	cast austenitic stainless steel
CB	core barrel
CCCW	closed-cycle cooling water
CDF	core damage frequency
CE	Combustion Engineering
CEA	control element assembly
CEDM	control element drive mechanism
CFR	Code of Federal Regulations
CFS	core flood system
CLB	current licensing basis
CLB	cumulative fatigue damage
CRD	control rod drive
CRDM	control rod drive mechanism
CRDRL	control rod drive return line
CRGT	control rod guide tube
CVCS	chemical and volume control system
DBE	design basis events
DC	direct current
DE	Division of Engineering
DHR	decay heat removal
DIPM	Division of Inspection Program Management
DOR	Division of Operating Reactors
DSCSS	drywell and suppression chamber spray system
DSSA	Division of System Safety Analysis
ECCS	emergency core cooling system
ECP	electrochemical potential
EDG	emergency diesel generator
EFPD	effective full power day
EFPY	effective full power years
EOL	end of life
EOLE	end of license extended

Term	Definition/Explaination
EPRI	Electric Power Research Institute
EPU	extended power uprates
EQ	environmental qualification
External	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
FERC	Federal Energy Regulatory Commission
FSAR	Final Safety Analysis Report
FW	feedwater
GALL	Generic Aging Lessons Learned
GE	General Electric
GL	generic letter
GSI	generic safety issue
HAZ	heat affected zone
HELBs	high-energy line breaks
HMWPE	high molecular weither 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
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
INPO	Institute of Nuclear Power Operations
Internal	External 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
ISI	inservice inspection
ITG	Issues Task Group
L	Low carbon content in stainless steels, nominal 0.03%C maximum
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

Term	Definition/Explaination
LRA	License Renewal Application
LRT	leak rate test
LTOP	Low-temperature overpressure protection
LWR	light water reactor
MEAP	materials, environments, aging effects & programs
MFW	main feedwater
MIC	microbiologically influenced corrosion
MRV	minimum required value
MS	main steam
MSR	moisture separator/reheater
MT	magnetic particle testing
NDE	nondestructive examination
NDT	nil-ductility temperature
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association
NG	Nuclear grade, maximum carbon content of .02% C
NPAR	nuclear plant aging research
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NRMS	normalized root mean square
NRR	Office of Nuclear Reactor Regulation
NSAC	Nuclear Safety Analysis Center
NSAC	National Specialty Alloys
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
P&IDS	piping and instrument diagrams
PA	plant assessment
PH	prescription hardening
PLL	predicted lower limit
PM	Project Manager
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
RAIs	requests for additional information
RCCA	rod control cluster assemblies
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCPB	reactor collant pressure boundary
RCS	reactor coolant system
RG	Regulatory Guide
RHR	residual heat removal
RICSIL	rapid information communication services information letter

Term	Definition/Explaination
RIS	Regulatory Issue Summary
RLEP	License Renewal & Environmental Impacts Program
RMS	root mean square
RPV	reactor pressure vessel
RWC	reactor water cleanup
RWST	refueling water storage tank
RWT	refueling water tank
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 evaulation report
SFP	spent fuel pool
SG	steam generator
SIL	services information letter
SIT	safety injection tank
SLC	standby liquid control
SOC	statement of considerations
SOER	significant operating experience report
SRM	source range monitor
SRM	staff requirements memorandum
SRP-LR	standard review plan for license renewal
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
Type 304 forging	Some secondary fabrication processes, such as forging and ring rolling, do impart sufficient reduction to play the major role in establishing material properties. In fact, forgings usually recrystallize more uniformly because forging is an efficient method of introducing large amounts of stored energy in the material.
UCS	Union of Concerned Scientists
UFSAR	updated final safety analysis report
UHS	ultimate heat sink
USE	upper shelf energy
USI	unresolved safety issue
UT	ultrasonic testing
UV	ultraviolet
V.A.	containment spray system
V.B.	standby gas treatment system
V.C.	containment isolation system
VIP	vessel and internals project
VV	vent valuve

Term	Definition/Explaination
Wrought structure	Wrought Structure and Ductility. Another aspect of material control ensures that the final forging has undergone sufficient plastic deformation to achieve the wrought structure necessary for development of the mechanical properties on which the design was based.
WSLR	within the scope of license renewal
XLPE	cross linked polyethylene

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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 & Component Supports, "IV" for Reactor Vessel, Internals, & 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.

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 & Component Supports, "IV" for Reactor Vessel, Internals, & 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 & Location of Terms used in AMR Tables	
Referring Chapters in GALL’05	**Standardized Expression**
IV	Baffle/former assembly Baffle and former plates
IV	Baffle/former assembly Baffle/former bolts
V, VII, VIII	Bolting
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
VIII	BWR heat exchanger shell side components
VIII	BWR tanks
IV	CEA Shroud Assemblies
IV	CEA shroud assemblies CEA shroud extension shaft guides
IV	CEA Shroud Assemblies CEA shrouds bolts
IV	Class 1 piping, piping components, and piping elements
IV	Class 1 piping, fittings and branch connections < NPS 4
IV	Class 1 piping, fittings and primary nozzles, safe ends, manways, and flanges
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
II	Concrete Dome; wall; basemat; ring girder; buttresses
II	Concrete: Dome; wall; basemat; ring girders; buttresses; reinforcing steel
II	Concrete: Foundation; subfoundation
III	Concrete: All
III	Concrete: Below-grade exterior; foundation
III	Concrete: Exterior above and below grade; foundation; interior slab
III	Concrete: Interior and above-grade exterior
VI	Conductor insulation for electrical cables and connections
VI	Conductor insulation for electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR)
VI	Conductor insulation for inaccessible medium-voltage (2kV to 15kV) 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

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
IV	Control rod drive head penetration Nozzle
IV	Control rod drive head penetration Pressure housing
IV	Control rod guide tube (CRGT) assembly CRGT spacer screws Flange-to-upper grid screws
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	Core barrel (CB) CB flange (upper) CB outlet nozzles Thermal shield
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 Lower internals assembly-to-core barrel bolts Core barrel-to-thermal shield bolts
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 and core plate Core shroud (upper, central, lower)
IV	Core shroud and core plate Shroud support structure (shroud support cylinder, shroud support plate, shroud support legs)
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 & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**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 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 and components
VII	Ducting and components external surfaces
VII	Ducting and components internal surfaces
V, VII	Ducting, piping and components external surfaces
V, VII	Ducting, piping and components internal surfaces
III	Earthen water-control structures: Dams, embankments, reservoirs, channels, canals
VII	Elastomer lining
V	Elastomer seals
VII	Elastomer seals and components
VI	Electrical equipment subject to 10 CFR 50.49 EQ requirements
IV, V. VII, VIII	External surfaces
VII	Fire barrier penetration seals
VII	Fire-rated doors
IV	Flow distributor assembly Flow distributor head and flange 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

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
IV	Fuel supports and control rod drive assemblies Orificed fuel support
VI	Fuse Holders (Not Part of a Larger Assembly)
VI	Fuse Holders (Not Part of a Larger Assembly) Metallic Clamp
V, VII, VIII	Heat exchanger shell side components
V, VII	Heat exchanger shell side components including tubes
VII	Heat exchanger tube side components including tubes
V, VII, VIII	Heat exchanger tubes
V	Heat exchanger tubes (serviced by open-cycle cooling water)
III	High strength bolting for NSSS component supports
VI	High voltage insulators
VII	High-pressure pump Casing and closure bolting
IV	Instrument penetrations and primary side nozzles
IV	Instrumentation Intermediate range monitor (IRM) dry tubes Source range monitor (SRM) dry tubes Incore neutron flux monitor guide tubes
IV	Instrumentation support structures Flux thimble guide tubes
IV	Isolation condenser tube side components
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

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**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 Incore guide tube spider castings
IV	Lower grid assembly Lower grid rib-to-shell forging screws Lower internals assembly-to- thermal shield bolts Guide blocks and bolts Shock pads and 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 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 Lower support plate column bolts Clevis insert bolts
IV	Lower internal assembly Lower core plate Radial keys and clevis inserts
IV	Lower internal assembly Lower support casting Lower support plate columns
IV	Lower internal assembly Lower support forging Lower support plate columns
III	Masonry walls: All

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
IV	Nozzle safe ends 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 Inlet Outlet Safety injection
IV	Nozzles Control rod drive return line
IV	Nozzles Feedwater
IV	Nozzles Low pressure coolant injection or RHR injection mode
IV	Nozzles Inlet Outlet Safety injection
V	Orifice (miniflow recirculation)
V	Partially encased tanks with breached moisture barrier
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
II	Personnel airlock; equipment hatch: Locks, hinges, and closure mechanisms
VI	Phase bus - Bus/connections
VI	Phase bus - Enclosure assemblies
VI	Phase bus - Insulation/insulators
IV, VII	Piping and components external surfaces and bolting
V	Piping and components internal surfaces
IV, V, VII, VIII	Piping, piping components, and piping elements
V, VII	Piping, piping components, and piping elements and tanks
IV, V	Piping, piping components, and piping elements greater than or equal to 4 NPS

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
IV	Plenum cover and plenum cylinder Plenum cover assembly Plenum cylinder Reinforcing plates
IV	Plenum cover and plenum cylinder Top flange-to-cover bolts Bottom flange-to-upper grid screws
IV	Pressure boundary and structural FW and AFW nozzles and safe ends Steam nozzles and safe ends
IV	Pressure vessel support Skirt support
IV	Pressurizer Integral support
IV	Pressurizer Spray head
IV	Pressurizer components
IV	Pressurizer instrumentation penetrations and heater sheaths and sleeves
IV	Pressurizer relief tank Tank shell and heads Flanges and nozzles
II	Prestressing system: Tendons; anchorage components
IV	Pump and valve closure bolting
IV	Pump and valve seal flanges
VIII	PWR heat exchanger shell side components
IV	RCCA guide tube assemblies RCCA guide tube bolts RCCA guide tube support pins
IV	RCCA guide tube assemblies RCCA guide tubes
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
IV	Reactor vessel internals components
VII	Regenerative heat exchanger tube and shell side components including tubes
V	Safety injection tank (accumulator)
II	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
IV	Steam generator closure bolting
IV	Steam generator components

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
IV	Steam generator components Such as, secondary side nozzles (vent, drain, and instrumentation)
IV	Steam generator components Upper and lower heads Tube sheets
IV	Steam generator feedwater impingement plate and support
IV	Steam generator shell assembly (for OTSG), upper and lower shell, and transition cone (for recirculating steam generator)
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
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
II	Steel elements: Liner; liner anchors; integral attachments
II	Steel elements: Suppression chamber shell (interior surface)
II	Steel elements: Torus; vent line; vent header; vent line bellows; downcomers
VII	Structural fire barriers – walls, ceilings and floors
VII	Structural Steel
III	Support members; welds; bolted connections; support anchorage to building structure
IV	Support skirt and attachment welds
VI	Switchyard bus and connections
V, 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	Tube support lattice bars
IV	Tube support plates

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
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
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)

A.1.1 Structures and/or Components: Listing & Location of Terms used in AMR Tables	
Referring Chapters in GALL'05	**Standardized Expression**
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, 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 where the pressure exceeds 275 psi or 200ºF (93ºC)
Bus duct	Bus ducts are electrical buses installed on electrically insulated supports and are constructed with all phase conductors enclosed in a separate metal enclosure or a common metal enclosure.
Closure bolting (in high-pressure or high-temperature systems)	Closure bolting in systems where the pressure exceeds 275 psi or 200ºF (93C) For example, Alloy 718, approved up to 566ºC in ASME Section III, Subsection NH, and types 304 and 316 stainless steels, with allowable stress intensities for bolting up to 704ºC, are considered for high-temperature closure bolting.
Ducting and components	Ducting and components includes heating, ventilation, and air conditioning (HVAC) components. Examples include ductwork, ductwork fittings, access doors, closure bolts, equipment frames and housing
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. The insulators evaluated for license renewal are those used to support and insulate high voltage electrical components in switchyards, switching stations and transmission lines.
Phase bus	Bus that is enclosed [either within its own enclosure (duct or inside a vault) that is not part of an active component such as a switchgear, load center, or motor control center]
Piping, piping components, and piping elements	This general category includes the designated material surfaces exposed to the designated environments in 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.
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

A.1.2 Definition of Selected Consolidated Structures and Components	
Term	**Definition as used in this document**
	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.
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 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 NUREG-1801, 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, for a few results in the remaining RCS 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 NUREG. Within the NUREG, 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 NUREG 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 aging management review (AMR) tables in Chapters II, III, IV, V, VI, VII, and VIII of NUREG-1801, Rev. 1.

A.2.1 Listing, Location & 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 & Component Supports, “IV” for Reactor Vessel, Internals, & 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, & Frequency of AMR Terms		
Material	**Referring Chpt.**	**Total**
Aluminum	V	3
	VII	5
	VIII	2
Aluminum / Silver Plated Aluminum Copper / Silver Plated Copper; Stainless steel, steel	VI	1
Aluminum, copper, bronze, stainless steel, galvanized steel	VI	1
Aluminum, steel	VI	1
Boraflex	VII	2
Boral, boron steel	VII	2
CASS, carbon steel with stainless steel cladding	IV	1
Cast austenitic stainless steel	IV	14
	V	3
	VII	4
Chrome plated Nickel alloy, stainless steel, Nickel alloy	IV	2
Concrete	II	6
Concrete block	III	1
Concrete; porous concrete	II	1
Concrete; steel	II	1
Copper alloy	IV	1
	V	5
	VI	1
	VII	16
	VIII	6
Copper alloy <15% Zn	V	1
	VII	1
Copper alloy >15% Zn	IV	1
	V	3
	VII	7
	VIII	2
Elastomers	V	1
	VI	1
	VII	8
Elastomers such as EPDM rubber	III	1
Elastomers, rubber and other similar materials	II	1
Galvanized steel	V	1
	VII	1
Galvanized steel, aluminum	III	2
Galvanized steel, aluminum, stainless steel	III	1
Glass	V	5
	VII	7
	VIII	5
Gray cast iron	V	1
	VII	6
	VIII	3

A.2.1 Materials: Listing, Location, & Frequency of AMR Terms		
Material	**Referring Chpt.**	**Total**
High- strength low-alloy steel SA 193 Gr. B7	IV	1
High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 Ksi)	IV	4
High-strength low-alloy steel, stainless steel	IV	2
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, yield strength >150 ksi	III	1
Lubrite	III	3
Nickel alloy	IV	22
	V	1
	VII	2
	VIII	1
Nickel alloy or nickel alloy cladding	IV	2
Nickel alloy, cast austenitic stainless steel, stainless steel	IV	2
Nickel-based alloys	VIII	1
Non-metallic (e.g., Rubber)	III	1
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; porous concrete	III	1
Reinforced concrete; grout	III	1
SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	IV	1
Stainless steel	II	2
	III	4
	IV	74
	V	23
	VII	36
	VIII	28
Stainless steel, cast austenitic stainless steel	IV	10
Stainless steel, cast austenitic stainless steel (nickel alloy welds and/or buttering)	IV	1
Stainless steel, cast austenitic stainless steel, nickel alloy	IV	7
Stainless steel, cast austenitic stainless steel, nickel alloy, PH Stainless Steel forging	IV	1
Stainless steel, nickel alloy	IV	38
Stainless steel, nickel alloy, PH Stainless Steel forging	IV	2
Stainless steel, PH stainless steel forging, CASS	IV	1
Stainless steel; dissimilar metal welds	II	1

A.2.1 Materials: Listing, Location, & Frequency of AMR Terms		
Material	**Referring Chpt.**	**Total**
Stainless steel; steel	II	2
	IV	7
	VII	1
Stainless steel; steel with stainless steel cladding	IV	5
	VII	4
Steel	II	6
	III	5
	IV	23
	V	32
	VII	49
	VIII	35
Steel (with or without coating or wrapping)	VII	1
	VIII	1
Steel (with or without stainless steel cladding)	IV	4
Steel (without lining/coating or with degraded lining/coating)	VII	1
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 internal lining or coating	VII	1
Steel with stainless steel cladding	IV	5
	V	1
	VII	1
Steel with stainless steel or nickel alloy cladding; or stainless steel	IV	2
Steel with stainless steel or nickel-alloy cladding	IV	1
Steel, galvanized steel	VI	1
Steel, stainless steel, cast austenitic stainless steel, carbon steel with nickel-alloy or stainless steel cladding, nickel-alloy	IV	1
Steel; Copper alloys	III	1
Steel; Dissimilar metal welds	II	1
Steel; Graphite plate	II	1
Steel; Stainless steel	VII	1
Steel; Stainless steel; Dissimilar metal welds	II	2
Various	III	1
Various metals used for electrical contacts	VI	1
Various organic polymers (e.g., EPR, SR, EPDM, XLPE)	VI	3
Various polymeric and metallic materials	VI	1
Grand Total of AMR Line Items		*644*

A.2.2 Selected Descriptions of Materials

Table A.2.3 correlates what was referenced in GALL 2001 to what is used in GALL 2005 including reference to the nomenclature in the unified numbering system (UNS).

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 percent of silica, 4 percent of polydimethyl siloxane polymer, and 50 percent of 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 boron absorber in spent fuel storage pools. The AMP XI.M22 is used as a reference for Boraflex monitoring.
Boral, boron steel	Boron steel is steel with boron content ranging from 1 to a few per cent. Boral is material consisting of boron carbide sandwiched between aluminum. Boron steel absorbs neutrons and thus is often used as a control rod to help control the neutron flux.
Cast austenitic stainless steel (CASS)	Cast stainless steels containing ferrite in an austenitic matrix. Examples of cast austenitic stainless steel (CASS) designations that were specifically referenced in GALL 2001 that comprise this category include CF-3M, CF-8 or CF-8M.
Copper alloy <15% Zn	Copper, copper nickel, brass, bronze <15% Zn, Aluminum bronze < 8% Al – These materials are resistant to stress corrosion cracking, selective leaching and pitting and crevice corrosion. May be identified simply as copper alloy when these aging mechanisms are not at issue.
Copper alloy >15% Zn	Copper, brass and other alloys >15% Zn, Aluminum bronze > 8% Al – These materials are susceptible to stress corrosion cracking, selective leaching (except for inhibited brass) and pitting and crevice corrosion. May be identified simply as copper alloy when these aging mechanisms are not at issue.
Elastomers	Elastomers include rubber, EPT, EPDM, PTFE, ETFE, viton, vitril, neoprene, silicone elastomer, etc
Galvanized steel	Steel coated with zinc (usually by immersion or electrodeposition); the Zn coating is capable 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.
Glass	All glass materials
Gray cast iron	This form of cast iron is the most common of the iron alloys used in nuclear plants. This cast iron is susceptible to selective leaching.
High strength low alloy steel - Maximum tensile strength <1172 MPa (<170 Ksi)	High-strength Fe-Cr-Ni-Mo low alloy steel bolting materials that are subject to stress corrosion cracking. Examples of high strength alloy steel designations that were specifically referenced in GALL 2001 that comprise this category include SA540-Gr. B23/24, SA193-Gr. B8, Grade L43 (AISI4340)
High-strength low-alloy steel SA 193 Gr. B7	Bolting fabricated from SA193-Gr. B8 austenitic steel, comparable to AISI 304 (UNS# S30400) is also susceptible to stress corrosion cracking.
High-strength steel	High-strength low-alloy steel as referenced in GALL2001 (such as V.E.2-b, VIII.H.2-b)

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
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, molded polycarbonate)
Low-alloy steel, yield strength >150 ksi	High strength bolting for NSSS component supports is fabricated from low-alloy steel, yield strength >150 ksi
Lubrite	Lubrite is bronze to ASTM B22 alloy 905 with G 10 lubricant.
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 2001 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 forging	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 2001 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, 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.
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, or duplex stainless steel (Cr content >11%) Examples of stainless steel designations that were specifically referenced in GALL 2001 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 416.

A.2.2 Selected Descriptions of Materials	
Standardized Expression	**Description and Technical Justification**
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. Examples of steel designations that were specifically referenced in GALL 2001 that comprise this category include ASTM A 36, ASTM A 285, ASTM A759, SA36, SA106-GrB, SA155-Gr KCF70, SA193-Gr. B7, SA194 -Gr. 7, SA302-Gr B, SA320-Gr. L43 (AISI 4340), SA333-Gr6, SA336, SA508-64, class 2, SA508-Cl 2 or Cl 3, SA516-Gr70, SA533-Gr B, SA540-Gr. B23/24, SA582

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 (2001 version) 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 the 2001 version of the GALL report that referenced the metal as found in column 1. The fifth column provides the term used in the 2005 GALL Vol, 2 AMR line-items replacing the term in column 1. The last column below provides some explanation for the substitution.

A.2.3 Metals Background for GALL Update

Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation 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 (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation 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 2001)	Steel	As described for A7

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation 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 (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation 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%)
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

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation Term**
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
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

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation Term**
SA155-Gr KCF70 **UNS#: unknown** *** Grade CF 70 was apparently intended standard for GALL2001.	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
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

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation Term**
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%)
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

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation Term**
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
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 ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation Term**
SA-336 **UNS#: (depends on class)** *** SA-336, Class F1 was apparently the intended GALL2001 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 GALL2001 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 ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation 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 (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation 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 GALL2001.	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
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

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation Term**
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%)
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 (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation 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%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation 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%)
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%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation 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%)
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%)
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%)

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition (‘GALL2001’)	**Metal Description**	**Designation/ Specification Ref.**	**‘GALL2001’ Ref, orig. usage**	**Bases Term for Materials Consolidation in ‘GALL2005’**	**Explanation for Usage of Materials Consolidation 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
			VIIC1.1	Aluminum	Pure aluminum
				Aluminum alloys	Alloys of aluminum
				Copper alloy < 15% Zn	Copper, copper nickel, brass, bronze <15% Zn, Aluminum bronze < 8% Al – These materials are resistant to stress corrosion cracking, selective leaching and pitting and crevice corrosion. May be identified simply as copper alloy when these aging mechanisms are not at issue.

A.2.3 Metals Background for GALL Update					
Metal Designation or Definition ('GALL2001')	**Metal Description**	**Designation/ Specification Ref.**	**'GALL2001' Ref, orig. usage**	**Bases Term for Materials Consolidation in 'GALL2005'**	**Explanation for Usage of Materials Consolidation Term**
				Copper alloy >15% Zn	Copper, brass and other alloys >15% Zn, Aluminum bronze > 8% Al – These materials are susceptible to stress corrosion cracking, selective leaching (except for inhibited brass) and pitting and crevice corrosion. May be identified simply as copper alloy when these aging mechanisms are not at issue.

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, & 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 & Component Supports, "IV" for Reactor Vessel, Internals, & 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, & 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
Aggressive environment	II	1
	III	4
Air	VII	1
	VIII	1
Air – indoor	VI	1
Air – indoor and outdoor	VI	4
Air – indoor controlled (External)	V	1
	VII	2
	VIII	1
Air – indoor uncontrolled	II	9
	III	6
	IV	2
	V	1
	VII	6
Air – indoor uncontrolled or air outdoor	II	3
	III	1
Air – indoor uncontrolled (External)	III	2
	IV	3
	V	12
	VII	17
	VIII	7
Air – indoor uncontrolled (Internal)	V	3

Table A.3.1 Environments: Listing, Location, & Frequency of AMR Terms		
Environment	Referring Chapters	Total # references
	VII	3
Air – indoor uncontrolled (Internal/External)	V	1
	VI	1
Air – indoor uncontrolled >35°C (>95°F) (Internal)	VII	1
Air – indoor uncontrolled or air - outdoor	II	6
	III	8
Air – outdoor	II	1
	III	4
	VI	4
	VII	4
Air – outdoor (External)	V	2
	VII	5
	VIII	3
Air and steam	V	1
Air with borated water leakage	III	3
	IV	2
	V	6
	VI	1
	VII	6
	VIII	2
Air with leaking secondary-side water and/or steam	IV	1
Air with metal temperature up to 288°C (550°F)	IV	2
Air with reactor coolant leakage	IV	13
Air with steam or water leakage	V	2
	VII	3
	VIII	2
Any	II	1
	III	2
Closed cycle cooling water	IV	3
	V	8
	VII	9
	VIII	6
Closed cycle cooling water >60°C (>140°F)	VII	2
Concrete	IV	2
	V	2
	VII	2
	VIII	2
Condensation	VII	1
Condensation (External)	V	2
	VII	3
	VIII	1
Condensation (Internal)	V	2
	VII	5
Diesel exhaust	VII	2
Dried Air	VII	3
Fuel oil	VII	5
Fuel oil (Water as a contaminant)	VII	1

Table A.3.1 Environments: Listing, Location, & Frequency of AMR Terms		
Environment	Referring Chapters	Total # references
Gas	IV	1
	V	3
	VII	4
	VIII	4
Lubricating oil	V	2
	VII	7
	VIII	6
Lubricating oil (no water pooling)	V	2
	VII	3
	VIII	3
Moist air	VII	1
Raw water	V	7
	VII	23
	VIII	10
Reactor coolant	IV	142
Reactor coolant >250°C (>482°F)	IV	3
Reactor coolant >250°C (>482°F) and neutron flux	IV	9
Reactor coolant and high fluence (>1 x 1021 n/cm2, E >0.1 MeV)	IV	1
Reactor coolant and neutron flux	IV	24
Reactor coolant and secondary feedwater/steam	IV	2
Reactor coolant/ steam	IV	1
Secondary feedwater	IV	1
Secondary feedwater/ steam	IV	16
Sodium pentaborate solution	VII	1
Soil	II	1
	III	1
	V	2
	VII	4
	VIII	3
Steam	VIII	12
System temperature up to 288°C (550°F)	IV	3
System temperature up to 340°C (644°F)	IV	2
Treated borated water	IV	1
	V	3
	VII	8
Treated borated water >250°C (>482°F)	V	1
Treated borated water >60°C (>140°F)	IV	1
	V	2
	VII	4
Treated water	V	11
	VII	20
	VIII	15
Treated water >250°C (>482°F)	V	1
Treated water >60°C (>140°F)	V	1
	VII	7
	VIII	4
Untreated water	V	2

Table A.3.1 Environments: Listing, Location, & Frequency of AMR Terms		
Environment	Referring Chapters	Total # references
	VII	1
	VIII	2
Untreated water or raw water	V	1
Various	III	1
Waste water (untreated or treated water)	VII	1
Water – flowing	II	2
	III	3
Water – flowing Water – standing	III	1
Water - flowing under foundation	III	1
Water – standing	III	2
(blank)	(blank)	
Grand Total		644

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 (GALL 2001, VI.A1-c)
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 (GALL 2001, VI.A1-b)
Adverse localized environment caused by heat, radiation, or moisture in the presence of oxygen or > 60-year service limiting temperature	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 caused by heat, radiation, oxygen, moisture, or voltage (GALL 2001, VI.B1-a)
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 2001 that comprise this category include: • Inside or outside containment
Air – indoor controlled (External)	The environment to which the external surface of the component or structure is exposed - - Indoor air in a humidity controlled (e.g., air conditioned) environment
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 2001 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)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
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 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 [1, 2] Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: Internal: occasional exposure to moist air; external: ambient plant air environment
Air – indoor uncontrolled or air - outdoor	Indoor air on systems with temperatures higher than the dew point – Condensation can occur but only rarely – equipment surfaces are normally dry. Alternatively, the aging effect could occur outdoors. Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Inside or outside containment
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 2001 that comprise this category include: • Weather exposed • Outside containment
Air and steam	Exposed normally to air and periodically to steam. Since this is for FAC, there is no temperature threshold and thus the temperature parameters of environment need not be defined Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Air and steam up to 320°C (608°F)
Air with borated water leakage	Air and untreated borated 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 2001 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 secondary manways and handhole covers 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 (revised from IV.D2.1-l)
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 (revised from GALL 2001 IV.C2.5-v)
Air with reactor coolant leakage	Air and reactor coolant or steam leakage on high temperature systems. Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Air, leaking reactor coolant water and/or steam at 288°C (550°F)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
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 2001 that comprise this category include: • Air, moisture, humidity, and leaking fluid
Any	Could be any environment indoors or outdoors, aging effect not dependent on environment. Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Inside or outside containment
Closed cycle cooling water	Treated water subject to the closed cycle cooling water chemistry program Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • 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
Closed cycle cooling water >60°C (>140°F)	Closed cycle cooling water >60°C (>140°F) thus allowing the possibility of stainless steel SCC. Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • In the BWR reactor water cleanup system, the nonregenerative heat exchanger reactor coolant water at 288°C (550°F) and 10MPa max. pressure. (VII.E3.4-a)
Concrete	Components embedded in concrete
Condensation (Internal/External)	The environment to which the internal or external surface of the component or structure is exposed Air and condensation with the potential for boric acid leakage on surfaces of indoor systems with temperatures below the dew point – condensation is considered untreated water due to potential for surface contamination
Diesel Exhaust	Gases, fluids, particulates present in a diesel engine exhaust Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Hot diesel engine exhaust gases containing moisture and particulates
Dried Air	Air that has been treated to reduce the dew point well below the system operating temperature
Fuel oil	Fuel oil used for combustion engines with possible water contamination
Gas	Inert gases such as carbon dioxide, freon, halon, nitrogen
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 2001 that comprise this category include: • Lubricating oil (with contaminants and/or moisture

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
Lubricating oil (no water pooling)	Piping, piping components, and piping elements (whether copper, stainless steel, or steel) when exposed to lubricating oil that does not have water pooling will not be subject to aging degradation because there are no relevant aging mechanisms.
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.
Raw water	Raw untreated fresh, salt, or ground water Examples of environment descriptors that were specifically referenced in GALL 2001 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 2001 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 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 2001 that comprise this category include: Chemically treated borated water up to 340°C (644°F) fluence $>10^{17}$ n/cm^2 (E >1 MeV)
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 2001 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.

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
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 2001 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 2001 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
Saturated air	Steel closure bolting in the compressed air system exposed to saturated air will be subject to loss of material due to general, pitting, and crevice corrosion. The compressed air monitoring AMP is utilized.
Secondary feedwater	In the recirculating steam generator, the steel pressure boundary and structural feedwater impingement plate and support are exposed to secondary feedwater environment and can experience loss of section thickness due to erosion.
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 2001 that comprise this category include: • Up to 300°C (572°F) secondary-side water chemistry at 5.3-7.2 MPa
Sodium pentaborate solution	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 2001 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 2001 that comprise this category include: • Soft soil; changes in groundwater conditions (III) • Soil (VII) • Soil and ground water (VIII)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
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 2001 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 2001 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 2001 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 2001 that comprise this category include: • Chemically treated oxygenated (BWR) or borated (PWR) water
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 2001 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 2001 that comprise this category include: • Chemically treated borated water at temperature 25–340°C (77-644°F)
Treated water	Treated or demineralized water – This environment is used where the context of the MEAP combination makes the type of treated water apparent; e.g., if the program is for PWR secondary water chemistry, the treated water is from the PWR secondary system. When the aging effect is not temperature dependent, it is counterproductive to define environment temp Examples of environment descriptors that were specifically referenced in GALL 2001 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)

A.3.2 Selected Descriptions of Environments	
Standardized Expression	**Description and Technical Justification**
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 2001 that comprise this category include: • Chemically treated oxygenated (BWR) or borated (PWR) water • Chemically treated borated water up to 340°C (644°F)
Untreated water or raw water	Water that may contain contaminants including oil and boric acid depending on the location – includes originally treated water that is not monitored by a chemistry program. Untreated is a very broad term that overlaps with raw water in that leaking groundwater can be included. Examples of environment descriptors that were specifically referenced in GALL 2001 that comprise this category include: • Moisture, water
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 2001 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 2001 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. [1]
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. [2,3]
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; Reference 4]. 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.

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, & 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 & Component Supports, “IV” for Reactor Vessel, Internals, & 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/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	VII	2
Corrosion of connector contact surfaces/ intrusion of borated water	VI	1
Crack growth/ cyclic loading	IV	1
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	1
	III	3
Cracking/ cyclic loading	IV	6
	VII	1
Cracking/ cyclic loading (CLB fatigue analysis does not exist)	II	2
Cracking/ cyclic loading, stress corrosion cracking	V	1
	VII	2
	VIII	1
Cracking/ flow-induced vibration	IV	1
Cracking/ intergranular attack	IV	1
Cracking/ outer diameter stress corrosion cracking	IV	1
Cracking/ primary water stress corrosion cracking	IV	12
Cracking/ stress corrosion cracking	II	3
	III	1
	IV	16
	V	2
	VII	11
	VIII	6
Cracking/ stress corrosion cracking	III	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**
Loss of material/pitting and crevice corrosion		
Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	IV	10
	V	1
Cracking/ stress corrosion cracking, cyclic loading	VII	2
Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	VII	2
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	25
Cracking/ stress corrosion cracking, primary water stress corrosion cracking	IV	4
Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	IV	10
Cracking/ thermal and mechanical loading	IV	2
Cracks and distortion due to increased stress levels from settlement	II	1
	III	1
Cumulative fatigue damage/ fatigue	IV	13
	V	3
	VII	7
	VIII	2
Cumulative fatigue damage/ fatigue (Only if CLB fatigue analysis exists)	II	2
	III	1
Degradation of insulator quality/ presence of any salt deposits and surface contamination	VI	1
Denting/ corrosion of carbon steel tube support plate	IV	1
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, and moisture.	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 material	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	VI	1
Expansion and cracking/ reaction with aggregates	II	1
	III	2
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

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
Increase in porosity and permeability, cracking, loss of material (spalling, scaling)/ aggressive chemical attack	II	1
	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	1
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	
Loosening of bolted connections/ thermal cycling and ohmic heating	VI	1
Loss of fracture toughness/ neutron irradiation embrittlement	IV	8
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
Loss of material (spalling, scaling) and cracking/ freeze-thaw	II	1
	III	2
Loss of material, loss of form/ erosion, settlement, sedimentation, frost action, waves, currents, surface runoff, seepage	III	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/ 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
Loss of material/ erosion, general, pitting, and crevice corrosion	IV	1
Loss of material/ fretting and wear	IV	1
Loss of material/ galvanic corrosion	III	1
Loss of material/ general (steel only), pitting and crevice corrosion	III	1
	IV	1
	VII	1
Loss of material/ general and pitting corrosion	III	2
	VII	1
Loss of material/ general corrosion	V	8

A.4.1 Occurrence of Aging Effect/ Aging Mechanisms in GALL Report Vol. 2, Rev. 1		
Aging Effect/ Aging Mechanism	**Referring Chapters**	**Total # references**
	VI	1
	VII	6
	VIII	4
Loss of material/ general corrosion and fouling	V	1
Loss of material/ general pitting, crevice, and microbiologically influenced corrosion	VIII	1
Loss of material/ general, pitting, and crevice corrosion	II	4
	IV	3
	V	10
	VII	23
	VIII	13
Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	V	1
	VII	3
	VIII	2
Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	V	2
	VII	6
	VIII	2
Loss of material/ lining or coating degradation	VII	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
	V	7
	VII	14
	VIII	14
Loss of material/ pitting and crevice corrosion (only for steel after lining degradation)	VII	1
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 and crevice corrosion, and selective leaching	VII	1
Loss of material/ pitting, crevice, and galvanic corrosion	IV	1
	V	2
	VII	4
	VIII	2
Loss of material/ pitting, crevice, and microbiologically influenced corrosion	VII	6
	VIII	4
Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	V	3
	VII	3
	VIII	1
Loss of material/ selective leaching	IV	1
	V	3
	VII	10
	VIII	5
Loss of material/ selective leaching and general corrosion	VII	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/ 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	17
	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	2
	IV	7
	V	22
	VI	1
	VII	27
	VIII	18
Reduction in concrete anchor capacity due to local concrete degradation/ service-induced cracking or other concrete aging mechanisms	III	1
Reduction in foundation strength, cracking, differential settlement/ erosion of porous concrete subfoundation	II	1
	III	1
Reduction of heat transfer/ fouling	V	4
	VII	4
	VIII	4
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	1
	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

A.4.2 Aging Effects

Table A.4.2 idefines 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 connector contact surfaces can be caused by borated water intrusion.
Crack growth	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 2001 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
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
Degradation of insulator quality	Degradation of insulator quality can result from the presence of any salt deposits, surface contamination
Denting	Denting can result from corrosion of carbon steel tube support plates.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
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 have as its root cause • Thermal or thermoxidative degradation of organics, • Radiation-induced oxidation, • Radiolysis and photolysis (UV sensitive materials only) of organics • Moisture intrusion • 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, 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.
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.
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
Increase in porosity, permeability	
Increased hardness, shrinkage and loss of strength	Elastomers can experience increased hardness, shrinkage, and loss of strength due to weathering.
Increased resistance of connection	Increased resistance of connection in electrical transmission conductors and connections can be caused by oxidation or loss of preload.
Increased resistance of connection	Increased resistance of connection can result from oxidation or loss of pre-load
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.
Loosening of bolted connections	The loosening of bolted bus duct connections due to thermal cycling can result from ohmic heating
Loss of conductor strength	Loss of conductor strength in electrical transmission lines can result from corrosion
Loss of fracture toughness	Loss of fracture toughness can result from various aging mechanisms including thermal aging, thermal aging embrittlement, and neutron irradiation embrittlement.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
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 in closure bolting is due to stress relaxation.
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.
Macrofouling	Macrofouling can result from biofouling.
Loss of material	Biofouling listed in NUREG-1801 as aging mechanism is assumed to be the plugging of components due to biological growth or material. Although plugging of a component affects only flow, an active intended function outside the purview of license renewal, the term macrofouling is used to address fouling that causes plugging as opposed to fouling that causes loss of heat transfer, and includes plugging from any source, including biological. Loss of material can result from biofouling and general, pitting, crevice, and microbiologically influenced corrosion (MIC).
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.
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.

A.4.2 Aging Effects	
Standardized Expression	**Description and Technical Justification**
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	A decrease in a component's ability to transfer heat, usually from fouling by a buildup (from whatever source) on the heat transfer surface or the obstruction of an opening allowing flow which affects heat transfer rates. Biofouling when used as an associated aging mechanism is the plugging of components due to the presence or growth of biological material. Although plugging of a component (a reduction of flow) involves an active intended function (which is outside the purview of license renewal), plugging which affects the passive function of heat transfer is within the purview of license renewal.
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.
Wall thinning	This is the term used throughout GALL'05 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. [16]
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 sulphur-based acid-rain degradation. Minimum degradation thresholds are 500 ppm chlorides and 1500 ppm sulphates. [16]
Biofouling	Biofouling is an aging mechanism that results from the growth of a biological organism. Biofouling can contribute to two aging effects, loss of material or reduction in heat transfer. A biological growth can accelerate the loss of material by creating surface conditions, such as crevices, that can accelerate corrosion mechanisms that can impair the passive function of the pressure boundary. Additionally, the presence of biological material, such as mussels, can cause plugging of heat transfer tube openings, which reduces heat transfer rates, a passive function.
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. [19]
Borated Water Intrusion	Influx of borated water.
Boric acid corrosion	Corrosion by Boric acid. 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.
Cladding degradation	This refers to the degradation of the stainless steel cladding (via any applicable degradation process for stainless steel/applicable environment described in NUREG 1801). The specific component/material/ environment item is described in A4.2.1 in VII A4-3 of NUREG 1801. It is not a special process.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
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. [13, 14]
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. [9]
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. [11,12] 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. [13]
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.
Crevice Corrosion (only for steel after lining/cladding degradation)	Same as crevice corrosion in above.
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. (GALL2001 II.A3.3-a, IIB4.3-b)
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

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
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. [17,18]
Elastomer hardening	Degradation in elastic properties of the elastomer.
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.
Erosion of porous concrete subfoundation	Erosion (as defined above) of the concrete subfoundation
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. [9]
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	Fatigue is defined as the 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. 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. [15]
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.
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. [9,10]
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, and two-metal corrosion.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
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.
Intergranular attack (IGA)	In austenitic stainless steels, the precipitation of Cr carbides, usually at grain boundaries, on exposure to temperatures of about 550-850 degrees C, leaves 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).
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 the concrete. Once the calcium hydroxide has been leached away, other cementitious 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. [9]
Mechanical loading	Applied loads of mechanical origins rather than from other sources such as thermal.
Mechanical wear	Fatigue of copper clamps in fuse holders can be partially attributed to frequent manipulation, which is really a subset of mechanical wear. Other examples include mechanical wear of electrical lines due to wind blowing on transmission conductors. Another is the mechanical wear of locks, hinges, and closure mechanisms.
Microbiologically influenced corrosion (MIC)	Corrosion that is affected by the action of microorganisms in the environment.
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. [12]
Ohmic heating	Ohmic heating is a thermal stressor that may be induced via conductors passing through electrical penetrations. Ohmic heating is generally significant only for power circuit penetrations.[5]
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. [14]

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
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. [17]
Photolysis	Chemical reactions induced or assisted by light.
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 degradation 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
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	See Radiation hardening, temperature, humidity, sustained vibratory loading.
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. [17]
Radiolysis	Chemical reactions induced or assisted by radiation.
Radiolysis and photolysis (UV sensitive materials only) of organics	See Radiolysis and Photolysis.
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. [16]
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 (dezincification or graphitic corrosion are examples). Selective corrosion of one or more components of a solid solution alloy.

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. [16]
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. [9]
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 be loosened and the preload may be lost. Radiation can also cause stress relaxation in highly stressed members such as bolts. [13]
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	At operating temperatures of 500 to 650^{0}F cast austenitic stainless steel (CASS) exhibits 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 are not affected by either of the processes. [12]
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.
Thermal Embrittlement	See thermal aging embrittlement.
Thermal loading	Loading due to thermal sources.
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. [11]
Various mechanisms	
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.

A.4.3 Aging Mechanisms	
Standardized Expression	**Description and Technical Justification**
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. [13]
Water trees	The predominant cause of failures in underground polymeric cables is water treeing. The water tree is a diffuse structure of microvoids (generally unconnected, Swiss cheese-like holes) in the polymer. As the cable nears the end of its reliable life, electrical trees begin to grow from this water tree. Once an electrical tree starts growing, the cable will fail.
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.
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. [12]
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 the Bases Document, 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 2005 AMR tables.

A.5.1 Listing, Location, and Frequency of AMPs

Tabal A.5.1 presents a listing of the listing, location, & 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 & Component Supports, "IV" for Reactor Vessel, Internals, & 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, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
A plant specific aging management program that determines the thickness of the lower portion of the tank is to be evaluated. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	1
A plant specific aging management program that monitors the degradation of the components is to be evaluated. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	VII	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 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 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.	III	1
	IV	4
	V	17
	VI	4
	VII	41
	VIII	13
A plant-specific aging management program is to be evaluated. As noted in Combustion Engineering (CE) Information Notice (IN) 90-04 and NRC IN 91-19 and LER 50-362/90-05-01, this form of degradation has been detected only in certain CE System 80 steam generators.	IV	1
A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	V	4
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
Applicant must provide a commitment in the FSAR supplement to submit, for NRC review and approval, an inspection plan for tube support lattice bars as based upon staff approved NEI 97-06 guidelines, or other alternative regulatory basis for steam generator degradation management, at least 24 months prior to the extended period.	IV	1
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	VI	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
Environmental Qualification Requirements Used in Instrumentation Circuits"		
Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	1
Chapter XI.E4, "Aging Management Program for Bus Ducts"	VI	2
Chapter XI.E5, "Aging Management Program for Fuse Holders"	VI	1
Chapter XI.E6, "Electrical Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements"	VI	
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 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	1
Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components Inspection in accordance with ASME Section XI does not require volumetric examination of pipes less than NPS 4. A plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred and the component intended function will be maintained during the extended period of operation. The AMPs are to be augmented by verifying that service-induced weld cracking is not occurring in the small-bore piping less than NPS 4, including pipe, fittings, and branch connections. See Chapter XI.M32, “One-Time Inspection” for an acceptable verification method.	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 in BWRVIP-29 (EPRI TR-103515)	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 in BWRVIP-29 (EPRI TR-103515) The AMP in Chapter XI.M1 is to be augmented to detect cracking due to stress corrosion cracking and cyclic loading or loss of material due to pitting and crevice corrosion, and verification of the effectiveness of the program 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	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 in BWRVIP-29 (EPRI TR-103515) Inspection in accordance with ASME Section XI does not require volumetric examination of pipes less than NPS 4. A plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred and the	IV	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
component intended function will be maintained during the extended period of operation.		
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 in EPRI TR-105714	IV	4
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 in EPRI TR-105714 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 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714 Inspection in accordance with ASME Section XI does not require volumetric examination of pipes less than NPS 4. A plant-specific destructive examination or a nondestructive examination (NDE) that permits inspection of the inside surfaces of the piping is to be conducted to ensure that cracking has not occurred and the component intended function will be maintained during the extended period of operation.	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 in BWRVIP-29 (EPRI TR-103515)	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 in EPRI TR-105714 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 1 components and Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714 and, for Alloy 600, 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	11
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 in EPRI TR-105714.	IV	1
Chapter XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," for Class 1 components and recommendations of NRC I&E Bulletin 88-09 "Thimble Tube Thinning in Westinghouse Reactors," described below: In response to I&E Bulletin 88-09, an inspection program, with technical justification, is to be established and is to include (a) an appropriate thimble tube wear acceptance criterion, e.g., percent through-wall loss, and includes allowances for inspection methodology and wear scar geometry uncertainty, (b) an appropriate inspection frequency, e.g., every refueling outage, and (c) inspection methodology such as eddy current technique that is capable of adequately detecting wear of the thimble tubes. In addition, corrective actions include isolation or replacement if a thimble tube	IV	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
fails to meet the above acceptance criteria. Inspection schedule is in accordance with the guidelines of I&E Bulletin 88-09.		
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 2 components and Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	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 in EPRI TR-102134 As noted in NRC Information Notice IN 90-04, general and pitting corrosion of the shell exists, the AMP guidelines in Chapter XI.M1 may not be sufficient to detect general and pitting corrosion, and additional inspection procedures are to be developed.	IV	1
Chapter XI.M10, “Boric Acid Corrosion”	III	2
	IV	1
	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	1
	IV	10
	V	5
	VII	5
	VIII	5
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714.	IV	2
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134	IV	8
Chapter XI.M19, “Steam Generator Tubing Integrity” and Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134. 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.M2, "Water Chemistry"	V	1
	VII	1
	VIII	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
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	1
	VII	1
	VIII	1
Chapter XI.M2, "Water chemistry" for PWR primary water, as described in EPRI TR-105714. 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	34
Chapter XI.M2, "Water Chemistry Program" and monitoring of the spent fuel pool water level	III	1
Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR□105714 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," for PWR primary water in EPRI TR□105714 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	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," and 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	2
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
Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515).	VII	1
	VIII	2
Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515). 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
	VII	5
	VIII	7
Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	V	2
	VII	2
Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714 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

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134	VIII	4
Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134 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	7
Chapter XI.M20, "Open-Cycle Cooling Water System"	V	4
	VII	15
	VIII	6
Chapter XI.M21, "Closed Cycle Cooling Water System" 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	1
Chapter XI.M21, "Closed-Cycle Cooling Water System," and Chapter XI.M33, "Selective Leaching of Materials"	VII	1
Chapter XI.M21, "Closed-Cycle Cooling Water System"	IV	2
	V	6
	VII	8
	VIII	5
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	2
Chapter XI.M26, "Fire Protection," and Chapter XI.M30, "Fuel Oil Chemistry"	VII	1
Chapter XI.M26, "Fire Protection"	VII	4
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
Chapter XI.M29, "Aboveground Carbon Steel Tanks"	VII	1
	VIII	1
Chapter XI.M3, "Reactor Head Closure Studs"	IV	3
Chapter XI.M30, "Fuel Oil Chemistry"	VII	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	3
Chapter XI.M31, "Reactor Vessel Surveillance"	IV	3
Chapter XI.M33, "Selective Leaching of Materials"	IV	1
	V	3
	VII	11
	VIII	5
Chapter XI.M4, "BWR Vessel ID Attachment Welds," and Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515)	IV	1
Chapter XI.M5, "BWR Feedwater Nozzle"	IV	1
Chapter XI.M6, "BWR Control Rod Drive Return Line Nozzle"	IV	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
Chapter XI.M7, “BWR Stress Corrosion Cracking,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	IV	4
	V	1
	VII	2
Chapter XI.M8, “BWR Penetrations,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	IV	1
Chapter XI.M9, “BWR Vessel Internals,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	IV	9
Chapter XI.S1, “ASME Section XI, Subsection IWE” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/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. 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 ” and Chapter XI.S4, “10 CFR Part 50, Appendix J” Evaluation of 10 CFR 50.55a/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,” (Note: IWE examination category E-F, surface examination of dissimilar metal welds, is recommended) Chapter XI.S4, “10 CFR Part 50, Appendix J,” and If a coatings program is credited for managing loss of material due to corrosion during the current licensing term (e.g., relief request from IWE), then it is to be continued during the period of extended operation. See Chapter XI.S8, “Protective Coating Monitoring and Maintenance Program”	II	1
Chapter XI.S1, “ASME Section XI, Subsection IWE”	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 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. 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 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” and If a coatings program is credited for managing loss of material due	II	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
to corrosion during the current licensing term (e.g., relief request from IWE), then it is to be continued during the period of extended operation. See Chapter XI.S8, "Protective Coating Monitoring and Maintenance Program."		
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 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" and If a coatings program is credited for managing loss of material due to corrosion during the current licensing term (e.g., relief request from IWE), then it is to be continued during the period of extended operation. See Chapter XI.S8, "Protective Coating Monitoring and Maintenance Program."	II	1
Chapter XI.S1, "ASME Section XI, Subsection IWE" and 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/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. 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.S1, "ASME Section XI, Subsection IWE," Chapter XI.S4, "10 CFR Part 50, Appendix J," and If a coatings program is credited for managing loss of material due to corrosion during the current licensing term (e.g., relief request from IWE), then it is to be continued during the period of extended operation. See Chapter XI.S8, "Protective Coating Monitoring and Maintenance Program."	II	1
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.S2, "ASME Section XI, Subsection IWL"	II	1
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	II	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
flowing water, if there is documented evidence that confirms the in-place concrete was constructed in accordance with the recommendations in ACI 201.2R-77.		
	III	1
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: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (pH < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm). Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.	II	1
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: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	II	1
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: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (pH < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm). Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.	II	2
	III	1
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" 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 existing concrete has air content of 3% to 6% and subsequent inspections did not exhibit degradation related to freeze-thaw, should be	III	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
considered a part of the evaluation. The weathering index for the continental US is shown in ASTM C33-90, Fig.1.		
Chapter XI.S6, "Structures Monitoring Program"	III	8
	VI	2
	VII	1
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.	III	1
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" 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: Evaluation is needed if testing and petrographic examinations of aggregates performed in accordance with ASTM C295-54, ASTM C227-50, or ACI 201.2R-77 (NUREG-1557) demonstrate that the aggregates are reactive.	III	1
Chapter XI.S6, "Structures Monitoring Program" Erosion of cement from porous concrete subfoundations beneath containment basemats is described in 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" 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" The initial licensing basis for some plants included a program to monitor settlement. If no settlement was evident during the first decade or so, the NRC may have given the licensee approval to discontinue the program. However, 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	1
	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 As described in NUREG-1557, freeze-thaw does not cause loss of material from reinforced concrete in foundations, and 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-	III	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
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.		
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 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-77. 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 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.	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 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
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.	III	2
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. As described in NUREG-1557, aggressive chemical attack on interior and above-grade exterior reinforced concrete is not significant if the concrete is not exposed to an aggressive environment (pH <5.5), or to chloride or sulfate solutions beyond defined limits (>500 ppm chloride, or >1500 ppm sulfate). 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. 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	III	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
ACI 318-63 or ACI 349-85. Therefore, if these conditions are satisfied, aging management is not necessary.		
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
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
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
	IV	9
	V	3
	VII	6
	VIII	2
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	2
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	3
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
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
Inaccessible Areas: Examination of representative samples of below-grade concrete, when excavated for any reason, is to be performed, if the below-grade environment is aggressive (pH < 5.5, chlorides > 500ppm, or sulfates > 1,500 ppm). Periodic monitoring of below-grade water chemistry (including consideration of potential seasonal variations) is an acceptable approach to demonstrate that the below-grade environment is aggressive or non-aggressive.	III	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	II	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
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.		
Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later revisions or update) minimize the potential of SCC, 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, 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	2
Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of license renewal 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. The TLAA is to evaluate the impact of neutron embrittlement on: (a) the RTPTS value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature, the plant's pressure-temperature limits, (c) the Charpy upper shelf energy, and (d) the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. 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
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 exceeding 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, 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 May 7, 2000 letter. 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 license renewal for all ferritic materials that have a neutron fluence of greater than 1017 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 RTPTS value based on the requirements in 10 CFR 50.61, (b) the adjusted reference temperature, the plant's pressure temperature limits, (c) the Charpy upper shelf energy, and (d) the equivalent margins analyses performed in accordance with 10 CFR Part 50, Appendix G. 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 1017 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, the plant's pressure-temperature limits, (b) the Charpy upper shelf energy, and (c) the	IV	1

A.5.1 Listing, Location, & Frequency of AMPs used in GALL 2005 AMR Tables		
Aging Management Program (AMP)	**Ref. Chpt.**	**Total # Refs.**
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).		
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	58
None	III	2
	IV	7
	V	22
	VI	1
	VII	27
	VIII	18
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
Plant-specific aging management program The implementation of 10 CFR 50.55a and 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	1
Grand Total of AMR Line-Items in GALL Vol. 2, Rev. 1		**644**

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 & 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.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
Aluminum	Air – indoor controlled (External)	None	None	VII	77	AP-36	J.
	Air – indoor uncontrolled (Internal/External)	None	None	V	32	EP-3	F.
	Air with borated water leakage	Loss of material/ boric acid corrosion	Boric Acid Corrosion	V	29	EP-2	D2.
				VII	72	AP-1	A3. E1.
	Fuel oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Fuel Oil Chemistry. The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See One-Time Inspection for an acceptable verification program.	VII	25	AP-35	H1. H2.
	Gas	None	None	VII	79	AP-37	J.
				VIII	35	SP-23	I.
	Treated water	Loss of material/ general, pitting, and crevice corrosion	Water chemistry and one-time inspection	V	10	EP-26	D2.
				VIII	2	SP-24	D1. D2. E. F. G.
			Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See One-Time Inspection for an acceptable verification program.	VII	15	AP-38	A4. E3. E4.
Boraflex	Treated borated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Boraflex Monitoring	VII	71	A-86	A2.1-a
	Treated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Boraflex Monitoring	VII	30	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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Boral, boron steel	Treated borated water	Reduction of neutron-absorbing capacity and loss of material/ general corrosion	Plant specific	VII	29	A-88	A2.1-b
	Treated water	Reduction of neutron-absorbing capacity and loss of material/ general corrosion	Plant specific	VII	29	A-89	A2.1-b
CASS, carbon steel with stainless steel cladding	Reactor coolant	Cracking/ stress corrosion cracking	Water chemistry (and Inservice Inspection for components that do not meet the material guidelines of NUREG-0313).	IV	68	R-09	C2.3-b C2.4-b
Cast austenitic stainless steel	Air – indoor uncontrolled (External)	None	None	IV	71	RP-02	E.
				V	35	EP-8	F.
				VII	76	AP-7	J.
	Reactor coolant	Cracking/ stress corrosion cracking	Water chemistry (and plant specific for components that do not meet the material guidelines of NUREG-0313).	IV	15	R-05	C2.1-e C2.2-g C2.5-i
	Reactor coolant >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Inservice inspection. Thermal aging susceptibility screening is not required, inservice inspection requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	IV	47	R-08	C1.2-c C1.3-b C2.3-c C2.4-c

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
			Thermal aging embrittlement of CASS	IV	49	R-52	C1.1-g C2.1-f C2.2-e C2.5-l
						R-77	A2.2-d
	Reactor coolant >250°C (>482°F) and neutron flux	Loss of fracture toughness/ thermal aging and neutron irradiation embrittlement	Thermal aging and neutron irradiation embrittlement	IV	43	R-101	B1.4-c
						R-103	B1.5-a
					67	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
						R-191	B4.4-g
						R-206	B4.6-e
	Treated borated water >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Thermal aging embrittlement of CASS	V	30	E-47	D1.1-b
	Treated water	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	VII	2	A-42	E3.2-b
	Treated water >250°C (>482°F)	Loss of fracture toughness/ thermal aging embrittlement	Thermal aging embrittlement of CASS	V	14	E-11	D2.1-d
	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	VII	32	A-101	E4.3-a
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	BWR Reactor Water Cleanup System	VII	31	A-41	E3.2-a

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP-LR ID	Related Item	Location in AMR Chpt.
Chrome plated Nickel alloy, stainless steel, Nickel alloy	Secondary feedwater/ steam	Cracking/ stress corrosion cracking	Steam generator tubing integrity and water chemistry	IV	62	RP-14	D1.
		Loss of material/ crevice corrosion and fretting	Steam generator tubing integrity and water chemistry	IV	62	RP-15	D1.
Copper alloy	Air – indoor uncontrolled (External)	None	None	V	35	EP-10	F.
				VIII	32	SP-6	I.
	Closed cycle cooling water	Loss of material/ pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	V	17	EP-13	A. D1. D2.
						EP-36	A. B. D1. D2.
				VII	38	AP-12	A3. A4. C2. E1. E3. E4. F1. F2. F3. F4. H1. H2.
						AP-34	E1. F1. F3.
				VIII	14	SP-8	E. F. G.
			Closed-cycle cooling water system and One-Time Inspection	IV	45	RP-11	C2.
	Condensation (External)	Loss of material/ pitting and crevice corrosion	Plant specific	VII	23	A-46	F1.2-a F2.2-a F3.2-a F4.2-a
	Dried Air	None	None	VII	80	AP-8	J.

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Fuel oil (Water as a contaminant)	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Fuel Oil Chemistry. The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See One-Time Inspection for an acceptable verification program.	VII	26	AP-44	H1. H2. G.
	Gas	None	None	V	38	EP-9	F.
				VII	79	AP-9	J.
				VIII	35	SP-5	I.
	Lubricating oil	Loss of material/ pitting, crevice, and galvanic corrosion	Plant specific	VII	24	AP-47	C1. C2. E1. E4. G. H2.
				VIII	13	SP-32	A. D1. D2. E. G.
	Lubricating oil (no water pooling)	None	None	V	37	EP-11	F.
				VII	80	AP-10	J.
				VIII	36	SP-7	I.
	Raw water	Loss of material/ pitting and crevice corrosion	Open-Cycle Cooling Water System	VII	61	A-43	C3.1-a C3.2-a
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	VII	59	AP-45	H2.
				VIII	22	SP-31	E. F. G.
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	Fire Water System	VII	51	A-45	G.6-b
			Open-Cycle Cooling Water System	VII	57	A-44	C1.1-a C1.2-a
						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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
		Reduction of heat transfer/ fouling	Open-Cycle Cooling Water System	VII	60	A-72	C1.3-b
	Treated water	Loss of material/ pitting and crevice corrosion	Plant specific	VII	23	AP-70	K.
		Loss of material/ pitting, crevice, and galvanic corrosion	Closed-Cycle Cooling Water System	VII	38	AP-64	A4. C2. E3. E4.
Copper alloy <15% Zn	Air with borated water leakage	None	None	V	40	EP-12	F.
				VII	81	AP-11	J.
Copper alloy >15% Zn	Air with borated water leakage	Loss of material/ boric acid corrosion	Boric Acid Corrosion	V	29	EP-38	E.
				VII	72	AP-66	I.
	Closed cycle cooling water	Loss of material/ selective leaching	Selective Leaching of Materials	IV	48	RP-12	C2.
				V	18	EP-27	A. B. D1. D2.
						EP-37	A. B. D1. D2.
				VII	65	AP-43	A3. A4. C2.E1. E3. E4. F1. F2. F3. F4. H1. H2.
				VIII	15	SP-29	E. F. G.
	Raw water	Loss of material/ selective leaching	Selective Leaching of Materials	VII	65	A-47	C1.1-a C1.2-a C3.1-a C3.2-a G.6-b
						A-66	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'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
						AP-46	H2.
				VIII	15	SP-30	E. F. G.
	Treated water	Loss of material/ selective leaching	Selective Leaching of Materials	VII	65	AP-32	A4. C2. E3. E4. K.
						AP-65	E1. F1. F3.
Elastomers	Air – indoor uncontrolled	Hardening and loss of strength/ elastomer degradation	Plant specific	V	6	E-06	B.1-b B.2-b
		Increased hardness, shrinkage and loss of strength/ weathering	Fire Protection	VII	46	A-19	G.1-a G.2-a G.3-a G.4-a
	Air – indoor uncontrolled (External)	Hardening and loss of strength/ elastomer degradation	Plant specific	VII	10	A-36	F1.1-b F1.4-b F2.1-b F2.4-b F3.1-b F3.4-b F4.1-b
		Loss of material/ wear	Plant specific	VII	28	A-73	F1.1-c F2.1-c F3.1-c F4.1-c
	Air – indoor uncontrolled (Internal)	Loss of material/ wear	Plant specific	VII	28	A-18	F1.1-c F2.1-c F3.1-c F4.1-c

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Air – indoor uncontrolled >35°C (>95°F) (Internal)	Hardening and loss of strength/ elastomer degradation	Plant specific	VII	10	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	Fire Protection	VII	46	A-20	G.1-a G.2-a G.3-a G.4-a
	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	11	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	11	A-16	A4.2-a A4.2-b A4.3-a A4.3-b A4.5-a A4.5-b
Galvanized steel	Air – indoor uncontrolled	None	None	VII	74	AP-13	J.
	Air – indoor uncontrolled (External)	None	None	V	35	EP-14	F.
Glass	Air	None	None	VII	75	AP-48	J.
				VIII	31	SP-33	I.
	Air – indoor uncontrolled (External)	None	None	V	33	EP-15	F.
				VII	75	AP-14	J.
				VIII	31	SP-9	I.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Fuel oil	None	None	VII	75	AP-49	J.
	Lubricating oil	None	None	V	33	EP-16	F.
				VII	75	AP-15	J.
				VIII	31	SP-10	I.
	Raw water	None	None	V	33	EP-28	F.
				VII	75	AP-50	J.
				VIII	31	SP-34	I.
	Treated borated water	None	None	V	39	EP-30	F.
				VII	75	AP-52	J.
	Treated water	None	None	V	33	EP-29	F.
				VII	75	AP-51	J.
				VIII	31	SP-35	I.
Gray cast iron	Closed cycle cooling water	Loss of material/ pitting and crevice corrosion, and selective leaching	Closed-Cycle Cooling Water System and Selective Leaching of Materials	VII	43	A-50	C2.3-a
	Raw water	Loss of material/ selective leaching	Selective Leaching of Materials	VII	67	A-51	C1.5-a
	Soil	Loss of material/ selective leaching	Selective Leaching of Materials	VII	67	AP-42	C1. C3. G. H1. H2.
				VIII	16	SP-26	E. G.
		Loss of material/ selective leaching and general corrosion	Selective Leaching of Materials	VII	66	A-02	C1.1-c C3. G.
	Treated water	Loss of material/ selective leaching	Selective Leaching of Materials	V	19	E-43	A. D1.
				VII	67	AP-31	A3. A4. C2. E1. E3. E4. F1. F2. F3. F4. G.
				VIII	16	SP-27	E. F. G.

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP-LR ID	Related Item	Location in AMR Chpt.
	Untreated water	Loss of material/ selective leaching	Selective Leaching of Materials	VII	67	AP-29	C1. C3. G. H2.
				VIII	16	SP-28	G.
High-strength low-alloy steel SA 193 Gr. B7	System temperature up to 288°C (550°F)	Loss of preload/ stress relaxation	Bolting Integrity	IV	44	R-27	C1.2-e C1.3-f
High-strength low alloy steel Maximum tensile strength < 1172 MPa (<170 Ksi)	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Reactor head closure studs	IV	61	R-71	A2.1-c
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Reactor head closure studs	IV	42	R-60	A1.1-c
		Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-73	A2.1-e
		Loss of material/ wear	Reactor head closure studs	IV	61	R-72	A2.1-d
High-strength low-alloy steel, stainless steel	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Bolting Integrity	IV	44	R-11	C2.3-e C2.4-e C2.5-n
		Loss of preload/ stress relaxation	Bolting Integrity	IV	44	R-12	C2.3-g C2.4-g C2.5-p

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
High-strength steel	Air with steam or water leakage	Cracking/ cyclic loading, stress corrosion cracking	Bolting Integrity	V	20	E-03	E.2-b
				VII	34	A-04	I.
				VIII	27	S-03	H.2-b
			Plant specific	VII	7	A-104	E1.
Nickel alloy	Air – indoor uncontrolled (External)	None	None	IV	71	RP-03	E.
				V	35	EP-17	F.
				VII	76	AP-16	J.
				VIII	32	SP-11	I.
	Raw water	Loss of material/ pitting and crevice corrosion	Open-Cycle Cooling Water System	VII	61	AP-53	C1. C3.
	Reactor coolant	Cracking/ primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	22	R-01	D1.1-j D2.1-h
						R-75	A2.2-a
						R-89	A2.7-a
						R-90	A2.7-b
						RP-21	D1.
			Steam generator tubing integrity and water chemistry	IV	63	R-40	D1.2-i D1.2-j D2.2-f D2.2-g
						R-44	D1.2-a D2.2-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
			Water Chemistry and One-Time Inspection or Inservice Inspection and provide commitment in FSAR supplement to submit AMP delineating commitments to Orders, Bulletins, or Generic Letters that inspect stipulated components for cracking of wetted surfaces.	IV	23	R-88	A2.6-a
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	IV	32	R-21	C1.1-f
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	BWR vessel internals and water chemistry	IV	35	R-96	B1.1-f
			Inservice inspection, and water chemistry	IV	39	R-95	B1.1-e
			Inservice inspection, water chemistry, and augmented inspection of the access hole cover welds	IV	41	R-94	B1.1-d
	Reactor coolant and secondary feedwater/steam	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-46	D2.2-e
			TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	IV	2	R-45	D1.2-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Reactor coolant/ steam	Cracking/ primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	22	RP-22	C2.
	Secondary feedwater/ steam	Cracking/ intergranular attack	Steam generator tubing integrity and water chemistry	IV	64	R-48	D1.2-c D2.2-c
		Cracking/ outer diameter stress corrosion cracking	Steam generator tubing integrity and water chemistry	IV	64	R-47	D1.2-b D2.2-b
		Cracking/ stress corrosion cracking	Water Chemistry and One-Time Inspection or Inservice Inspection.	IV	69	R-36	D2.1-i
		Denting/ corrosion of carbon steel tube support plate	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	57	R-43	D1.2-g
		Loss of material/ fretting and wear	Steam generator tubing integrity and water chemistry	IV	64	R-49	D1.2-e D2.2-d
		Loss of material/ wastage and pitting corrosion	Steam generator tubing integrity and water chemistry	IV	65	R-50	D1.2-f

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Nickel alloy or nickel alloy cladding	Reactor coolant	Cracking/ primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	22	R-06	C2.5-k C2.5-s C2.5-m
						R-218	D1.1-i
Nickel alloy, cast austenitic stainless steel, stainless steel	Reactor coolant	Cracking/ primary water stress corrosion cracking	Water Chemistry and One-Time Inspection or Inservice Inspection and provide commitment in FSAR supplement to submit AMP delineating commitments to Orders, Bulletins, or Generic Letters that inspect stipulated components for cracking of wetted surfaces.	IV	23	R-24	C2.5-j
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	BWR vessel internals and water chemistry	IV	35	R-100	B1.4-a
Nickel-based alloys	Steam	Loss of material/ pitting and crevice corrosion	Water Chemistry	VIII	29	SP-18	B1.
Reinforced concrete	Air – indoor uncontrolled	Concrete cracking and spalling/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	VII	49	A-90	G.1-b G.2-b G.3-b G.4-b G.5-a

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
		Loss of material/ corrosion of embedded steel	Fire Protection and Structures Monitoring Program	VII	50	A-91	G.1-c G.2-c G.3-c G.4-c G.5-b
	Air – outdoor	Concrete cracking and spalling/ freeze-thaw, aggressive chemical attack, and reaction with aggregates	Fire Protection and Structures Monitoring Program	VII	49	A-92	G.1-b G.2-b G.3-b G.4-b
		Loss of material/ corrosion of embedded steel	Fire Protection and Structures Monitoring Program	VII	50	A-93	G.1-c G.2-c G.3-c G.4-c
SA508-Cl 2 forgings clad with stainless steel using a high-heat-input welding process	Reactor coolant	Crack growth/ cyclic loading	TLAA	IV	12	R-85	A2.5-b
Stainless steel	Air – indoor uncontrolled (External)	None	None	IV	71	RP-04	E.
				V	35	EP-18	F.
				VII	76	AP-17	J.
				VIII	32	SP-12	I.
	Air with borated water leakage	None	None	IV	73	RP-05	E.
				V	40	EP-19	F.
				VII	81	AP-18	J.

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Bolting Integrity	IV	44	R-78	A2.2-e
			Plant specific	IV	14	R-74	A2.1-f
						RP-13	A2.
		Loss of material/ wear	Bolting Integrity	IV	44	R-79	A2.2-f
		Loss of preload/ stress relaxation	Bolting Integrity	IV	44	R-80	A2.2-g
	Closed cycle cooling water	Loss of material/ pitting and crevice corrosion	Closed-Cycle Cooling Water System	V	21	E-19	A.6-c D1.5-a D1.6-a D2.4-c
						EP-33	A. C. D1. D2.
				VII	39	A-52	C2.2-a
				VIII	17	S-25	E.4-e F.4-e G.5-c
						SP-39	E. F. G.
		Reduction of heat transfer/ fouling	Closed-Cycle Cooling Water System	V	22	EP-35	A. D1. D2.
				VII	40	AP-63	C2. E3. E4.
				VIII	18	SP-41	E. F. G.
	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	Plant specific	VII	6	AP-60	C2. E3. E4.
	Concrete	None	None	IV	72	RP-06	E.
				V	34	EP-20	F.
				VII	78	AP-19	J.
				VIII	34	SP-13	I.
	Condensation (External)	Loss of material/ pitting and crevice corrosion	Plant specific	VII	23	A-09	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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Condensation (Internal)	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated. Pitting and crevice corrosion of tank bottoms are of concern because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	V	4	E-14	D2.1-e
			Plant specific	VII	23	A-12	F1.4-a F2.4-a F3.4-a
						AP-72	K.
	Diesel exhaust	Cracking/ stress corrosion cracking	Plant specific	VII	5	AP-33	H2.
	Dried Air	None	None	VII	80	AP-20	J.
	Fuel oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Fuel Oil Chemistry	VII	54	AP-54	G. H1. H2.
	Gas	None	None	IV	70	RP-07	E.
				V	38	EP-22	F.
				VII	79	AP-22	J.
				VIII	35	SP-15	I.
	Lubricating oil	Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Plant specific	VII	27	AP-59	C1. C2. E1. E4. H2. G.
				VIII	12	S-20	G.5-d
						SP-38	A. D1. D2. E. G.
		None	None	V	34	EP-21	F.
	Lubricating oil (no water pooling)	None	None	VII	80	AP-21	J.
				VIII	36	SP-14	I.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Raw water	Loss of material/ pitting and crevice corrosion	Open-Cycle Cooling Water System	VII	61	A-53	C3.2-a
			Plant specific	VIII	11	SP-52	J.
		Loss of material/ pitting and crevice corrosion, and fouling	Fire Water System	VII	52	A-55	G.6-a G.6-b
			Open-Cycle Cooling Water System	VII	58	A-54	C1.1-a C1.2-a C1.4-a C1.6-a
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	VII	59	AP-55	H2.
				VIII	22	SP-36	E. F. G.
		Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	V	8	E-36	C.1-b
			Open-Cycle Cooling Water System	V	23	E-20	A.6-a D1.6-b D2.4-a
				VIII	19	S-26	E.4-b F.4-b G.5-a
		Reduction of heat transfer/ fouling	Open-Cycle Cooling Water System	V	28	E-21	A.6-b D1.6-c D2.4-b
				VII	60	AP-61	C1. C3. G. H2.
				VIII	28	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'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Reactor coolant	Changes in dimensions/Void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	26	R-107	B2.1-b
						R-117	B2.2-b
						R-121	B2.3-b
						R-124	B2.4-b
						R-126	B2.4-d
						R-131	B2.5-b
						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-199	B4.5-h
						R-215	B4.8-b
		Cracking/ cyclic loading	Plant specific	IV	17	R-102	B1.4-d
		Cracking/ flow-induced vibration	Plant specific	IV	20	RP-18	B1.
		Cracking/ stress corrosion cracking	Inservice inspection, and water chemistry	IV	59	R-217	C2.5-r
						RP-17	D1.
			Inservice Inspection, Water chemistry, and a plant specific examination	IV	16	R-02	C2.1-g C2.2-h
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	IV	32	R-22	C1.1-f C1.3-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
			BWR vessel internals and water chemistry	IV	34	R-104	B1.5-c
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	BWR vessel internals and water chemistry	IV	35	R-105	B1.6-a
						R-92	B1.1-a
						R-93	B1.1-b
						R-97	B1.1-g
						R-98	B1.2-a
						R-99	B1.3-a
		Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	30	R-106	B2.1-a
						R-116	B2.2-a
						R-120	B2.3-a
						R-123	B2.4-a
						R-130	B2.5-a
						R-143	B2.6-a
						R-146	B3.1-a
						R-155	B3.3-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

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
						R-181	B4.3-b
						R-193	B4.5-a
						R-209	B4.7-a
						R-214	B4.8-a
		Loss of material/ wear	Inservice inspection	IV	52	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
			Inservice inspection and recommendations of NRC IEB 88-09	IV	56	R-145	B2.6-c
		Loss of preload/ stress relaxation	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	18	R-108	B2.1-d
						R-184	B4.3-e
						R-201	B4.5-j
	Reactor coolant and high fluence (>1 x 1021 n/cm2, E >0.1 MeV)	Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	29	R-125	B2.4-c, B4.5-g

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	8	R-128	B2.4-f
		Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	13	R-122	B2.3-c
						R-127	B2.4-e
						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-200	B4.5-i
						R-216	B4.8-c
	Sodium pentaborate solution	Cracking/ stress corrosion cracking	Water Chemistry for BWR. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See One-Time Inspection for an acceptable verification program.	VII	4	A-59	E2.1-a E2.2-a E2.3-a E2.4-a

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Soil	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated. Pitting and crevice corrosion of tank bottoms are of concern because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	V	4	EP-31	D1. D2.
			Plant specific	VII	23	AP-56	C1. C3. G. H1. H2.
				VIII	11	SP-37	E. G.
	Steam	Cracking/ stress corrosion cracking	Water Chemistry	VIII	20	SP-44	B1.
			Water chemistry and one-time inspection	VIII	8	SP-45	B2.
		Loss of material/ pitting and crevice corrosion	Water Chemistry	VIII	29	SP-43	B1.
						SP-46	B2.
	Treated borated water	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	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
		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.	V	7	E-24	D1.2-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Water Chemistry	V	31	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	70	A-97	A2.1-c
		Cracking/ stress corrosion cracking, cyclic loading	Water Chemistry and a plant-specific verification program. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.	VII	9	A-69	E1.8-b
			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	TLAA, evaluated in accordance with 10 CFR 54.21(c)	V	1	E-16	D2.1-b
				VII	2	A-62	E3.1-b E3.2-b E4.1-b
		Loss of material/ pitting and crevice corrosion	Plant specific	V	3	E-33	C.1-b
						EP-32	D2.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
				VII	23	AP-57	C2. E3. K.
			Water chemistry and one-time inspection	VIII	10	S-13	E.5-b
						S-14	E.5-b G.4-b
						S-21	E.4-a E.4-d
						S-22	E.4-a E.4-d F.4-a F.4-d
						SP-16	D1. F. G. E. D2.
			Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See One-Time Inspection for an acceptable verification program.	VII	22	A-58	A4.1-a A4.6-a E4.1-a
		Reduction of heat transfer/ fouling	Water Chemistry	V	24	EP-34	A. D2.
				VII	69	AP-62	A4. E3.
				VIII	21	SP-40	E. F.
	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	VII	32	A-61	E4.1-c E4.3-a
			Closed-cycle cooling water system and One-Time Inspection	VIII	9	SP-42	E.
			Plant specific	VII	6	A-85	E3.3-d
			Water Chemistry	VII	70	A-96	A2.1-c
			Water chemistry and one-time inspection	VIII	8	S-39	F.4-a
						SP-17	E. D1. F. G.
						SP-19	E.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	V	15	E-37	D2.1-c D2.3-c
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking	BWR Reactor Water Cleanup System	VII	31	A-60	E3.1-a
	Untreated water	Loss of material/ pitting, crevice, and microbiologically influenced corrosion, and fouling	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	V	8	E-34	C.1-b
	Untreated water or raw water	Loss of material/ pitting and crevice corrosion	A plant-specific aging management program is to be evaluated. Pitting and crevice corrosion of tank bottoms are of concern because moisture and water can egress under the tank due to cracking of the perimeter seal from weathering.	V	4	E-01	D1.8-c
	Waste water (untreated or treated water)	Loss of material/ pitting and crevice corrosion	Plant specific	VII	23	AP-67	K.
Stainless steel, cast austenitic stainless steel	Reactor coolant	Changes in dimensions/Void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	26	R-110	B2.1-f
						R-139	B2.5-l
						R-182	B4.3-c

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	IV	32	R-20	C1.1-f C1.2-b C1.3-c
		Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	30	R-109	B2.1-e
						R-138	B2.5-k
						R-149	B3.2-a
						R-159	B3.4-a
						R-180	B4.3-a
						R-202	B4.6-a
Stainless steel, cast austenitic stainless steel (nickel alloy welds and/or buttering)	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Inservice inspection, and water chemistry	IV	58	R-83	A2.4-b
Stainless steel, cast austenitic stainless steel, nickel alloy	Reactor coolant	Changes in dimensions/Void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	26	R-151	B3.2-c

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
						R-160	B3.4-b
						R-168	B3.5-c
						R-204	B4.6-c
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	27	R-76	A2.2-b
		Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	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
						R-54	B3.2-f B3.4-d B3.5-g B4.1-d B4.2-d B4.3-f B4.5-f B4.6-f

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Stainless steel, cast austenitic stainless steel, nickel alloy, PH Stainless Steel forging	Reactor coolant	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	IV	2	R-189	B4.4-e
Stainless steel, nickel alloy	Air with reactor coolant leakage	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	10	R-61	A1.1-d
	Reactor coolant	Changes in dimensions/Void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	26	R-113	B2.1-j
						R-119	B2.2-e
						R-134	B2.5-f
						R-163	B3.4-f
						R-195	B4.5-c
						R-211	B4.7-c
		Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	BWR Stress Corrosion Cracking and Water Chemistry	IV	32	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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
			BWR vessel ID attachment welds and water chemistry	IV	33	R-64	A1.2-e
		Cracking/ stress corrosion cracking, intergranular stress corrosion cracking, cyclic loading	BWR penetrations and water chemistry	IV	31	R-69	A1.5-a
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	28	R-112	B2.1-i
						R-118	B2.2-d
						R-133	B2.5-e
						R-150	B3.2-b
						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
		Loss of material/ wear	Inservice inspection	IV	52	R-115	B2.1-l
						R-170	B3.5-e
		Loss of preload/ stress relaxation	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	18	R-114	B2.1-k

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
						R-129	B2.4-h
						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
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	13	R-135	B2.5-g
						R-164	B3.4-g
						R-169	B3.5-d
						R-196	B4.5-d
						R-205	B4.6-d
						R-212	B4.7-d
Stainless steel, nickel alloy, PH Stainless Steel forging	Reactor coolant	Changes in dimensions/Void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	26	R-187	B4.4-c

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement, void swelling	FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	13	R-188	B4.4-d
Stainless steel, PH stainless steel forging, CASS	Reactor coolant	Cracking/ stress corrosion cracking, irradiation-assisted stress corrosion cracking	Water Chemistry and FSAR supplement commitment to (1) participate in industry RVI aging programs (2) implement applicable results (3) submit for NRC approval > 24 months before the extended period an RVI inspection plan based on industry recommendation.	IV	30	R-185	B4.4-a
Stainless steel; steel	Air with metal temperature up to 288°C (550°F)	Cracking/ cyclic loading	Inservice inspection	IV	53	R-19	C2.5-v
		Loss of material/ wear	Bolting Integrity	IV	44	R-29	C1.2-d C1.3-e
	Reactor coolant	Cracking/ stress corrosion cracking and intergranular stress corrosion cracking	Inservice Inspection, Water chemistry, and a plant specific examination	IV	9	R-03	C1.1-i
			Inservice inspection, water chemistry, and plant-specific verification program	IV	11	R-15	C1.4-a
		Cracking/ thermal and mechanical loading	Inservice Inspection and a plant specific examination (one-time inspection)	IV	21	R-55	C1.1-i

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Loss of material/ general (steel only), pitting and crevice corrosion	Inservice inspection, water chemistry, and plant-specific verification program	IV	5	R-16	C1.4-b
	System temperature up to 340°C (644°F)	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-18	C2.3-d C2.4-d C2.5-t C2.5-w
	Treated borated water	Cracking/ cyclic loading	Plant specific	VII	3	A-76	E1.5-a
Stainless steel; steel with stainless steel cladding	Closed cycle cooling water	Loss of material/ microbiologically influenced corrosion	Closed-Cycle Cooling Water System	VII	41	A-67	E3.4-b E4.4-a
	Closed cycle cooling water >60°C (>140°F)	Cracking/ stress corrosion cracking	Plant specific	VII	6	A-68	E3.4-a
	Reactor coolant	Cracking/ cyclic loading	Inservice inspection	IV	54	R-56	C2.1-c
		Cracking/ stress corrosion cracking	Inservice inspection, and water chemistry	IV	59	R-07	C2.2-f C2.5-h D1.1-i C2.5-m
						R-30	C2.1-c
		Cracking/ thermal and mechanical loading	Inservice Inspection and a plant specific examination (one-time inspection)	IV	21	R-57	C2.1-g C2.2-h
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Inservice inspection, and water chemistry	IV	59	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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
	Treated water	Loss of material/ pitting and crevice corrosion	Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See One-Time Inspection for an acceptable verification program.	VII	22	A-70	A4.4-b
	Treated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Plant specific	VII	6	A-71	E3.4-a
Steel	Air – indoor controlled (External)	None	None	V	36	EP-4	F.
				VII	77	AP-2	J.
				VIII	33	SP-1	I.
	Air – indoor uncontrolled	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-70	A1.7-a
						R-91	A2.8-a
				VII	2	A-34	E1.1-a E1.3-a E1.7-a E1.8-a E3.2-c
		Loss of material/ wear	Fire Protection	VII	47	A-21	G.1-d G.2-d G.3-d G.4-d G.5-c
	Air – indoor uncontrolled (External)	Cumulative fatigue damage/ fatigue	TLAA to be evaluated for structural girders of cranes. See the Standard Review Plan, Section 4.7 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	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	VII	55	A-07	B.1-b

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
			Plant specific	V	2	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-44	E.
				VII	12	A-77	I.1-b
						A-80	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a
				VIII	5	S-29	H.1-b
		Loss of material/ general, pitting, and crevice corrosion	Bolting Integrity	V	25	EP-25	E.
				VII	35	AP-27	I.
				VIII	27	S-34	H.
			Plant specific	V	11	E-40	B.1-a
				VII	16	A-10	F1.1-a F1.4-a F2.1-a F2.4-a F3.1-a F3.4-a F4.1-a
						A-105	F1.
						AP-41	F1. F2. F3. F4. G. H2.
			Structures Monitoring Program	VII	68	A-94	A1.1-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Loss of material/ wear	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	VII	56	A-05	B.2-a
		Loss of preload/ stress relaxation	Bolting Integrity	V	25	EP-24	E.
				VII	35	AP-26	I.
				VIII	27	S-33	H.
	Air – indoor uncontrolled (Internal)	Loss of material/ general corrosion	Plant specific	V	2	E-25	B.2-a
						E-29	A.2-a A.5-a D2.5-a
		Loss of material/ general corrosion and fouling	Plant specific	V	13	E-04	D2.5-b
		Loss of material/ general, pitting, and crevice corrosion	Plant specific	VII	16	A-08	F1.1-a F2.1-a F3.1-a F4.1-a
						A-11	F1.4-a F2.4-a F3.4-a
	Air – outdoor	Loss of material/ wear	Fire Protection	VII	47	A-22	G.1-d G.2-d G.3-d G.4-d
	Air – outdoor (External)	Loss of material/ general corrosion	Aboveground steel tanks	VIII	23	S-31	E.5-c G.4-c
			Plant specific	V	2	E-45	E.
				VII	12	A-78	I.1-b
				VIII	5	S-41	H.1-b
		Loss of material/ general, pitting, and crevice corrosion	Aboveground steel tanks	VII	33	A-95	H1.4-b

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
			Bolting Integrity	V	25	EP-1	E.
				VII	36	AP-28	I.
				VIII	27	S-32	H.
			Plant specific	VII	16	A-24	H1.1-a H1.2-a H1.3-a
						AP-40	G. H2.
	Air and steam	Wall thinning/ flow-accelerated corrosion	Flow-accelerated corrosion	V	16	E-07	D2.1-f
	Air with borated water leakage	Loss of material/ boric acid corrosion	Boric Acid Corrosion	IV	50	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

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
				V	29	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	72	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	30	S-30	H.1-a
						S-40	H.

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
	Air with leaking secondary-side water and/or steam	Loss of material/ erosion	Inservice inspection	IV	55	R-31	D2.1-l
	Air with reactor coolant leakage	Cracking/ stress corrosion cracking	Bolting Integrity	IV	44	R-10	D1.1-l
	Air with steam or water leakage	Loss of material/ general corrosion	Bolting Integrity	VII	37	A-03	I.
		Loss of material/ general, pitting, and crevice corrosion	Bolting Integrity	V	25	E-02	E.2-a
				VIII	27	S-02	H.2-a
	Closed cycle cooling water	Loss of material/ general, pitting, and crevice corrosion	Closed-Cycle Cooling Water System	V	26	E-17	A.6-c D1.5-a D1.6-a D2.4-c
				VII	42	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
						A-63	A3.4-a A4.4-a E1.8-c E4.4-a C2. E3. F1. F2. F3. F4.
				VIII	24	S-23	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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
			Closed-cycle cooling water system and One-Time Inspection	IV	46	RP-10	C2.
	Concrete	None	None	IV	72	RP-01	E.
				V	36	EP-5	F.
				VII	78	AP-3	J.
				VIII	34	SP-2	I.
	Condensation	Loss of material/ general, pitting, and crevice corrosion	Compressed Air Monitoring	VII	44	A-103	D.2-a
	Condensation (External)	Loss of material/ general corrosion	Plant specific	V	2	E-30	C.1-a
						E-46	E.
				VII	12	A-81	I.1-b
				VIII	5	S-42	H.1-b
	Condensation (Internal)	Loss of material/ general and pitting corrosion	Compressed Air Monitoring	VII	45	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	Plant specific	V	11	E-27	D2.1-e
				VII	16	AP-71	K.
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Plant specific	VII	19	A-13	F1.1-a F2.1-a F3.1-a F4.1-a
	Dried Air	None	None	VII	80	AP-4	J.
	Fuel oil	Loss of material/ general, pitting, and crevice corrosion	Fire Protection and Fuel Oil Chemistry	VII	48	A-28	G.8-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Fuel Oil Chemistry. The AMP is to be augmented by verifying the effectiveness of fuel oil chemistry control. See One-Time Inspection for an acceptable verification program.	VII	20	A-30	H1.4-a H2.5-a
	Gas	None	None	V	38	EP-7	F.
				VII	79	AP-6	J.
				VIII	35	SP-4	I.
	Lubricating oil	Loss of material/ general, pitting, and crevice corrosion	A plant specific aging management program that determines the thickness of the lower portion of the tank is to be evaluated. See One-Time Inspection for an acceptable verification program.	VII	13	A-82	G.7-a
			A plant specific aging management program that monitors the degradation of the components is to be evaluated. See One-Time Inspection for an acceptable verification program.	VII	14	A-83	G.7-b
			Plant specific	VII	16	AP-30	C1. C2. E1. E4. F1. F2. F3. F4. G. H2.
				VIII	3	SP-25	A. D1. D2. E. G.
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Plant specific	VIII	6	S-17	G.5-d

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Plant specific	VII	21	AP-39	H2.
	Lubricating oil (no water pooling)	None	None	V	37	EP-6	F.
				VII	80	AP-5	J.
				VIII	36	SP-3	I.
	Moist air	Loss of material/ general, pitting, and crevice corrosion	Plant specific	VII	16	A-23	H2.2-a H2.3-a
	Raw water	Loss of material/ general pitting, crevice, and microbiologically influenced corrosion	Plant specific	VIII	6	SP-51	J.
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Open-Cycle Cooling Water System	VII	62	A-31	C3.1-a C3.2-a C3.3-a
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	V	9	E-22	C.1-a
			Fire Water System	VII	53	A-33	G.6-a G.6-b
			Open-Cycle Cooling Water System	V	27	E-18	A.6-a D1.6-b D2.4-a

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
				VII	63	A-32	C1.2-a C1.5-a C1.6-a H2.1-b
						A-64	C1.3-a
				VIII	25	S-24	E.4-b F.4-b G.5-a
		Reduction of heat transfer/ fouling	Open-Cycle Cooling Water System	V	28	E-23	D2.4-b
				VIII	28	S-27	G.5-b
	Reactor coolant	Loss of material/ general, pitting, and crevice corrosion	Inservice inspection, and water chemistry	IV	40	R-59	A1.1-a
		Loss of material/ wear	Inservice inspection	IV	52	R-87	A2.5-f
		Wall thinning/ flow-accelerated corrosion	Flow-accelerated corrosion	IV	38	R-23	C1.1-a C1.1-c C1.3-a
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	IV	6	R-67	A1.3-e
	Secondary feedwater	Loss of material/ erosion	Plant specific	IV	19	R-39	D1.1-e
	Secondary feedwater/ steam	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-33	D1.1-a D1.1-b D2.1-d D2.1-g
		Ligament cracking/ corrosion	Steam generator tubing integrity and water chemistry	IV	66	R-42	D1.2-k

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
		Loss of material/ erosion, general, pitting, and crevice corrosion	Steam generator tubing integrity and water chemistry	IV	66	RP-16	D1.
		Loss of material/ general, pitting, and crevice corrosion	Inservice inspection, and water chemistry	IV	4	R-34	D1.1-c D2.1-e
		Wall thinning/ flow-accelerated corrosion	Combustion Engineering (CE) System 80 steam generator feedwater ring inspection	IV	24	R-51	D1.3-a
			Flow-accelerated corrosion	IV	51	R-37	D1.1-d
						R-38	D2.1-f
			FSAR supplement commitment to submit an inspection plan for tube support lattice bars for NRC review and approval, at least 24 months prior to the extended period.	IV	25	R-41	D1.2-h
	Soil	Loss of material/ general, pitting, and crevice corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	V	12	E-42	B.
	Steam	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	VIII	1	S-08	B1.1-b B2.1-c
		Loss of material/ general, pitting, and crevice corrosion	Plant specific	VIII	3	SP-48	J.
			Water chemistry and one-time inspection	VIII	2	S-04	A.1-b A.2-b C.1-b C.2-b J.
						S-06	A.1-b A.2-b C.1-b C.2-b J.

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
		Loss of material/ pitting and crevice corrosion	Water Chemistry	VIII	29	S-05	B2.1-a B2.2-b
						S-07	B1.1-a B1.2-a
		Wall thinning/ flow-accelerated corrosion	Flow-accelerated corrosion	VIII	26	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 J.
	System temperature up to 288°C (550°F)	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c) check Code limits for allowable cycles (less than 7000 cycles) of thermal stress range	IV	3	R-28	C1.2-f C1.3-g
		Loss of material/ wear	Bolting Integrity	IV	44	R-26	C1.2-d C1.3-e
	System temperature up to 340°C (644°F)	Loss of preload/ stress relaxation	Bolting Integrity	IV	44	R-32	D1.1-f D2.1-k
	Treated water	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	V	1	E-10	D2.1-b
				VII	2	A-37	E4.1-b
				VIII	1	S-11	D1.1-b D2.1-c G.1-b
		Loss of material/ general, pitting, and crevice corrosion	Plant specific	V	11	E-31	C.1-a
			Water chemistry and one-time inspection	V	10	E-08	D2.1-a D2.2-a D2.3-b

A.6. Summary of MEAP Combinations in GALL Vol. 2 AMR Tables							
Material	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Programs**	**Referring GALL'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
				VIII	2	S-09	D2.1-b D2.2-b D2.3-b E.1-b E.2-b E.3-a E.5-a E.6-a
						S-10	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
						S-18	E.4-a E.4-d
						S-19	E.4-a E.4-d F.4-a F.4-d
			Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See One-Time Inspection for an acceptable verification program.	VII	15	A-35	E4.1-a E4.2-a

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
		Wall thinning/ flow-accelerated corrosion	Flow-accelerated corrosion	V	16	E-09	D2.3-a
				VIII	26	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
	Untreated water	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Plant specific	V	5	E-32	C.1-a
		Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Plant specific	VIII	4	S-12	G.1-d
Steel	Treated water	Loss of material/ general, pitting, and crevice corrosion	Plant specific	VII	16	AP-69	K.
Steel (with or without coating or wrapping)	Soil	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion	Buried Piping and Tanks Surveillance or Buried Piping and Tanks Inspection	VII	18	A-01	H1.1-b C1.1-b C3. G.
				VIII	7	S-01	E.5-d G.1-e G.4-d

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Steel (with or without stainless steel cladding)	Reactor coolant	Cracking/ cyclic loading	CRD return line nozzle	IV	36	R-66	A1.3-c
			Feedwater nozzle	IV	37	R-65	A1.3-b
	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	Reactor vessel surveillance	IV	7	R-63	A1.2-d
			TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	IV	6	R-62	A1.2-c
Steel (without lining/coating or with degraded lining/coating)	Raw water	Loss of material/ general, pitting, crevice, and microbiologically influenced corrosion, and fouling	Open-Cycle Cooling Water System	VII	63	A-38	C1.1-a
Steel with elastomer lining	Treated borated water	Loss of material/ pitting and crevice corrosion (only for steel after lining degradation)	Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See 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)	Water Chemistry. The AMP is to be augmented by verifying the effectiveness of water chemistry control. See 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'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Steel with internal lining or coating	Raw water	Loss of material/ lining or coating degradation	Open-Cycle Cooling Water System	VII	64	AP-25	C1. C3. H2.
Steel with stainless steel cladding	Reactor coolant and neutron flux	Loss of fracture toughness/ neutron irradiation embrittlement	Reactor vessel surveillance	IV	7	R-82	A2.3-b
						R-86	A2.5-c
			TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99. The applicant may choose to demonstrate that the materials of the nozzles are not controlling for the TLAA evaluations.	IV	6	R-81	A2.3-a
						R-84	A2.5-a
	Treated borated water	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c)	IV	1	R-13	C2.6-a
	Treated borated water >60°C (>140°F)	Cracking/ stress corrosion cracking	Water Chemistry	V	31	E-38	D1.7-b
			Water Chemistry for PWR primary water	VII	73	A-56	A3.3-b
Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	Cracking/ cyclic loading	Inservice inspection, and water chemistry	IV	60	R-58	C2.5-c C2.5-g

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
		Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	27	R-25	C2.5-c C2.5-g
Steel with stainless steel or nickel-alloy cladding	Reactor coolant	Cracking/ stress corrosion cracking, primary water stress corrosion cracking	Inservice Inspection and Water Chemistry, and for Alloy 600, FSAR supplement commitment to implement applicable plant commitments to (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines.	IV	27	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'O5 Chpt.**	**SRP -LR ID**	**Related Item**	**Location in AMR Chpt.**
Steel, stainless steel, cast austenitic stainless steel, carbon steel with nickel-alloy or stainless steel cladding, nickel-alloy	Reactor coolant	Cumulative fatigue damage/ fatigue	TLAA, evaluated in accordance with 10 CFR 54.21(c) and environmental effects are to be addressed for Class 1 components	IV	2	R-04	A1.1-b A1.2-a A1.2-b A1.3-a A1.3-d A1.4-b A1.5-b A1.6-a A2.1-b A2.2-c A2.3-c A2.4-a A2.5-d C1.1-b C1.1-d C1.1-e C1.1-h C1.2-a C1.3-d C2.1-a C2.1-b C2.2-a C2.2-b C2.2-c C2.3-a C2.4-a C2.5-a C2.5-d C2.5-e C2.5-f C2.5-q D1.1-h D2.1-c

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

Material	Environment	Aging Effect/ Mechanism	Aging Management Programs	Referring GALL'O5 Chpt.	SRP -LR ID	Related Item	Location in AMR Chpt.
Steel; Stainless steel	Diesel exhaust	Loss of material/ general (steel only), pitting and crevice corrosion	Plant specific	VII	17	A-27	H2.4-a

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18. 2004 Annual Book of ASTM Standards, Volume 09.01, ASTM International, 2004.
19. NRC GL 96-04: “Boraflex Degradation in Spent Fuel Pool Storage Racks,” NRC, Rockville, Md, 1996.
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APPENDIX B
Audit Tools

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Introduction

GALL Volume 1, which summarizes GALL Volume 2 (GV2), and the SRP-LR tables preserve some of the distinctions of the GV2 tables; however they do not preserve the material or environment information, both of which are often useful when organizing the LRA to align it with Volume 1 of GALL (GV1). The audit tools that follow are intended to bridge that gap. Stakeholder comments are requested regarding the value of including this section in the final document and on changes that might make the tables more useful if it were to be included.

To understand the organization of the audit tools, SRP-LR, and GV1 tables, it is helpful to understand how the rollup was established. The objective for the rollup of the "Items" in the mechanical chapters (RCS, ESF, Aux, and SPC) of GV2 into the summary-level tables in GV1 and the SRP-LR was to group sets of components together that were likely to be subject to the same aging management activities, with the same requirements for further evaluation, for the same reasons. Therefore, components within a system with the same aging effect/mechanism, further evaluation required, and aging management program are associated with a particular ID in the GV1 and SRP-LR tables. The items in the Components, Structures and Electrical chapters in GV2 (Chapters II, III and VI) were already grouped as commodities, and therefore, such audit tools were not considered necessary
To accomplish the rollup, the GV2 data was reviewed and sets of components identified and summary descriptions developed. Audit tools were constructed to facilitate assessments of and changes to the rollup, including the SRP-LR paragraph reference assignments and the discussions contained therein.

The organization of the GV1 and SRP-LR tables is to put the items for which further evaluation is required first, in the order in which they are addressed in the SRP-LR text. These are followed by items (if any) for which commitments are to be verified. Then come the items for which no further evaluation is required if the specified "standard" aging management programs (as defined in Chapter XI of GV2) are used. Within this subset, the order is alphabetical, based on the first character in the AE/M field, then the next field to the right, and so forth. Finally, the items are listed for which there are no aging effects that require management.

The audit tools that follow show the collections of the GV2 AMR table rows that were rolled up into the tables in GV1 and the SRP-LR. Similar audit tools were found useful in developing the rolled-up entries for the GV1 and SRP-LR table entries for aging effect/mechanism (AE/M), further evaluation required (FER), aging management program (AMP), and component. They also facilitated development of the SRP-LR reference statements in the text sections of the SRP-LR and staff review of the detail in GV2 and the completeness, accuracy, and consistency of the rollup. Given their usefulness in preparing the draft guidance document updates, audit tools are included here in the event they may facilitate stakeholder review.

The GV1 and SRP-LR entries for AE/M, FE, AMP, and component are omitted in the tables that follow because of space limitations (to include them would either require the use of 11x14 paper or a reduced font size). It is thought that the GV2 information for AE/M, FER, AMP, and Structure/Component is more useful in understanding the set of components expected to be addressed by a particular row in the tables found in GV1 and the SRP-LR.

The audit 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. 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.

B.1 Reactor Coolant System Audit Tool

Table B.1 presents the reactor collant system audit 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	3.1.2.2.1.1	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).	High-strength low alloy steel - - Maximum tensile strength < 1172 MPa (<170 Ksi)	Air with reactor coolant leakage	R-73	Closure head - - Stud assembly	A2.1-e
						Nickel alloy	Reactor coolant and secondary feedwater/ steam	R-46	Tubes and sleeves	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
						Stainless steel, cast austenitic 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
								R-54	Reactor vessel internals components	B3.2-f B3.4-d B3.5-g B4.1-d B4.2-d B4.3-f B4.5-f B4.6-f
						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	Air – indoor uncontrolled	R-70	Support skirt and attachment welds	A1.7-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-91	Pressure vessel support - - Skirt support	A2.8-a
							Secondary feedwater/ steam	R-33	Steam generator components	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 - Same as above	C2.6-a
2	Cumulative fatigue damage	3.1.2.2.1.2	BWR / 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 accepta	Nickel alloy	Reactor coolant and secondary feedwater/ steam	R-45	Tubes and sleeves	D1.2-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
						Stainless steel, cast austenitic stainless steel, nickel alloy, PH Stainless Steel forging	Reactor coolant	R-189	Reactor vessel internals components	B4.4-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
						Steel, stainless steel, cast austenitic stainless steel, carbon steel with nickel-alloy or stainless steel cladding, nickel-alloy	Reactor coolant	R-04	Piping, piping components, and piping elements; flanges; heater sheaths and sleeves; penetrations; pressure housings; pump casing/cover; spray head; thermal sleeves; vessel shell heads and welds	A1.1-b A1.2-a A1.2-b A1.3-a A1.3-d A1.4-b A1.5-b A1.6-a A2.1-b A2.2-c A2.3-c A2.4-a A2.5-d C1.1-b C1.1-d C1.1-e C1.1-h C1.2-a C1.3-d C2.1-a C2.1-b C2.2-a C2.2-b C2.2-c C2.3-a C2.4-a C2.5-a C2.5-d C2.5-e C2.5-f C2.5-q D1.1-h D2.1-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
3	Cumulative fatigue damage	3.1.2.2.1.3	BWR / PWR	Yes, - TLAA	Fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation; check Code limits for allowable cycles (less than 7000 cycles) of thermal stress range. See the Standard Review Plan, Section 4.3 “Metal Fatigue,” for ac	Steel	System temperature up to 288°C (550°F)	R-28	Pump and valve closure bolting	C1.2-f C1.3-g
4	Loss of material due to general, pitting and crevice corrosion	3.1.2.2.2.1	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 in EPRI TR-102134 - - As noted in NRC Information Notice IN 90-04, general	Steel	Secondary feedwater/ steam	R-34	Steam generator shell assembly (for OTSG), upper and lower shell, and transition cone (for recirculating steam generator)	D1.1-c D2.1-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
5	Loss of material due to 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.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and - - Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI - TR-103515) - - The AMP in Chapter XI.M1 is to be augmented to	Stainless steel; steel	Reactor coolant	R-16	Isolation condenser tube side components	C1.4-b
6	Loss of fracture toughness due to 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 exceeding 1017 n/cm2 (E >1 MeV) at the end of the license renewal term. Aspec	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
					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 1017 n/cm2 (E >1 MeV) at the end of the license renewal term	Steel	Reactor coolant and neutron flux	R-67	Nozzles - - Low pressure coolant injection or RHR injection mode	A1.3-e
					Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of license renewal 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. T	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
					Neutron irradiation embrittlement is a time-limited aging analysis (TLAA) to be evaluated for the period of license renewal for all ferritic materials that have a neutron fluence of greater than 1017 n/cm2 (E >1 MeV) at the end of the license renewal term	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
7	Loss of fracture toughness due to neutron irradiation embrittlement	3.1.2.2.3.2	BWR / PWR	Yes, plant specific	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

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	Loss of fracture toughness due to neutron irradiation embrittlement	3.1.2.2.3.3	PWR	No, but licensee commitment 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 aand managing aging effects on reactor internals; (2) evaluate and implement the re	Stainless steel	Reactor coolant and neutron flux	R-128	Baffle/former assembly - - Baffle/former bolts	B2.4-f
9	Cracking due to Stress corrosion cracking and intergranular stress corrosion cracking	3.1.2.2.4.1	BWR	Yes, - parameters monitored/ inspected and detection of aging effects are 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 in BWRVIP-29 (EPRI TR-103515) - - Inspection in accordance with ASME Section XI does	Stainless steel; steel	Reactor coolant	R-03	Class 1 piping, fittings and branch connections < NPS 4	C1.1-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
10	Cracking due to Stress corrosion cracking and intergranular stress corrosion cracking	3.1.2.2.4.2	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	R-61	Top head enclosure - - Vessel flange leak detection line	A1.1-d
11	Cracking due to Stress corrosion cracking and intergranular stress corrosion cracking	3.1.2.2.4.3	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 in BWRVIP-29 (EPRI - TR-103515) - - The AMP in Chapter XI.M1 is to be augmented to	Stainless steel; steel	Reactor coolant	R-15	Isolation condenser tube side 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
12	Crack growth due to 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-	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
13	Loss of fracture toughness due to neutron irradiation embrittlement, void swelling	3.1.2.2.6	PWR	No, but licensee commitment 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 aand managing aging effects on reactor internals; (2) evaluate and implement the re	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

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-132	Lower internal assembly - - Lower core plate	B2.5-c
								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-200	Core barrel assembly - - Baffle/former bolts and screws	B4.5-i
								R-216	Thermal shield	B4.8-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
						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
								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

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	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
						Stainless steel, nickel alloy, PH Stainless Steel forging	Reactor coolant and neutron flux	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
14	Cracking due to 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	R-74	Closure head - - Vessel flange leak detection line	A2.1-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
					A plant-specific aging management program is to be evaluated.	Stainless steel	Air with reactor coolant leakage	RP-13	Instrument penetration - - Bottom-mounted guide tube	A2.
15	Cracking due to 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 revisions or update) minimize the potential of SCC, and material selection according to the NUREG-0313, Rev. 2 guidelines of ≤0.035% C a	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
16	Cracking due to stress corrosion cracking	3.1.2.2.7.3	PWR	Yes, - parameters monitored/ inspected and detection of aging effects are 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 PWR primary water in EPRI TR-105714 - - Inspection in accordance with ASME Section XI does not	Stainless steel	Reactor coolant	R-02	Class 1 piping, fittings and branch connections < NPS 4	C2.1-g C2.2-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
17	Cracking due to cyclic loading	3.1.2.2.8	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
18	Loss of preload due to stress relaxation	3.1.2.2.9	PWR	No, but licensee commitment 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 aand managing aging effects on reactor internals; (2) evaluate and implement the re	Stainless steel	Reactor coolant	R-108	Upper internals assembly - - Hold-down spring	B2.1-d
								R-184	Control rod guide tube (CRGT) assembly - Flange-to-upper grid screws	B4.3-e
								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-129	Baffle/former assembly - - Baffle/former bolts	B2.4-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-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 D160 - Core shroud tie rods	B3.4-h
								R-192	Core support shield assembly - - Core support shield-to-core barrel bolts	B4.4-h
								R-197	Core barrel assembly - - Lower internals assembly-to-core barrel bolts - Core barrel-to-thermal shield bolts	B4.5-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-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
19	Loss of material due to 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
20	Cracking due to 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**
21	Cracking due to thermal and mechanical loading	3.1.2.2.12	BWR / PWR	Yes, - parameters monitored/ inspected and detection of aging effects are to be evaluated	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components - - Inspection in accordance with ASME Section XI does not require volumetric examination of pipes less than NPS 4. A plant-specific destructiv	Stainless steel; steel	Reactor coolant	R-55	Class 1 piping, fittings and branch connections < NPS 4	C1.1-i
						Stainless steel; steel with stainless steel cladding	Reactor coolant	R-57	Class 1 piping, fittings and branch connections < NPS 4	C2.1-g C2.2-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
22	Cracking due to primary water stress corrosion cracking	3.1.2.2.13.1	PWR	No, but licensee commitments 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 in EPRI TR-105714 and, for Alloy 600, provide a commitment in the FSAR supplement to i	Nickel alloy	Reactor coolant	R-01	Instrument penetrations and primary side nozzles and welds	D1.1-j D2.1-h
								R-75	Control rod drive head penetration - - Nozzle and welds	A2.2-a
								R-89	Penetrations - - Instrument tubes (bottom head)	A2.7-a
								R-90	Penetrations - - Head vent pipe (top head) - Instrument tubes (top head)	A2.7-b
								RP-21	Steam Generator - - Divider Plate	D1.
							Reactor coolant/ steam	RP-22	Pressurizer 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
						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
								R-218	Pressure boundary and structural - - Primary nozzles, safe ends, and welds	D1.1-i
23	Cracking due to primary water stress corrosion cracking	3.1.2.2.13.2	PWR	No, unless licensee commitments need to be confirmed	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," and - provide a commitment in the FSAR supplement to submit a plant-specific AMP deline	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
						Nickel alloy, cast austenitic stainless steel, stainless steel	Reactor coolant	R-24	Pressurizer -- Spray head	C2.5-j
24	Wall thinning due to flow-accelerated corrosion	3.1.2.2.14.1	PWR (CE)	Yes, plant-specific	A plant-specific aging management program is to be evaluated. As noted in Combustion Engineering (CE) Information Notice (IN) 90-04 and NRC IN 91-19 and LER 50-362/90-05-01, this form of degradation has been detected only in certain CE System 80 steam gen	Steel	Secondary feedwater/ steam	R-51	Upper assembly and separators -- Feedwater inlet ring and support	D1.3-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
25	Wall thinning due to flow-accelerated corrosion	3.1.2.2.14.2	PWR	No, but licensee commitment to be confirmed	Applicant must provide a commitment in the FSAR supplement to submit, for NRC review and approval, an inspection plan for tube support lattice bars as based upon staff approved NEI 97-06 guidelines, or other alternative regulatory basis for steam generato	Steel	Secondary feedwater/ steam	R-41	Tube support lattice bars	D1.2-h
26	Changes in dimensions due to void swelling	3.1.2.2.15	PWR	No, but licensee commitment 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 aand managing aging effects on reactor internals; (2) evaluate and implement the re	Stainless steel	Reactor coolant	R-107	Upper internals assembly - - Upper support plate - Upper core plate - Hold-down spring	B2.1-b
								R-117	RCCA guide tube assemblies - - RCCA guide tubes	B2.2-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-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-131	Lower internal assembly - - Lower core plate - Radial keys and clevis inserts	B2.5-b
								R-144	Instrumentation support structures - - Flux thimble guide tubes	B2.6-b
								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

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-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
								R-199	Core barrel assembly - - Baffle/former bolts and screws	B4.5-h
								R-215	Thermal shield	B4.8-b
						Stainless steel, cast austenitic stainless steel	Reactor coolant	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-139	Lower internal assembly - - Lower support forging or casting - Lower support plate columns	B2.5-l
								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
						Stainless steel, cast austenitic stainless steel, nickel alloy	Reactor coolant	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

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-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	B4.6-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
						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
								R-134	Lower internal assembly - - Fuel alignment pins - Lower support plate column bolts - Clevis insert bolts	B2.5-f
								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-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
								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
						Stainless steel, nickel alloy, PH Stainless Steel forging	Reactor coolant	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

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	Cracking due to stress corrosion cracking, primary water stress corrosion cracking	3.1.2.2.16	PWR	No, but licensee commitments 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 in EPRI TR-105714 and, for Alloy 600, provide a commitment in the FSAR supplement to i	Stainless steel, cast austenitic stainless steel, nickel alloy	Reactor coolant	R-76	Control rod drive head penetration - - Pressure housing	A2.2-b
						Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	R-25	Pressurizer components	C2.5-c C2.5-g
						Steel with stainless steel or nickel-alloy cladding	Reactor coolant	R-35	Steam generator components - - Upper and lower heads - Tube sheets	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
28	Cracking due to stress corrosion cracking, primary water stress corrosion cracking, irradiation-assisted stress corrosion cracking	3.1.2.2.17	PWR	No, but licensee commitment to be confirmed	Chapter XI.M2, "Water chemistry" for PWR primary water, as described in EPRI TR-105714. 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 investiga	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
								R-133	Lower internal assembly - - Fuel alignment pins - Lower support plate column bolts - Clevis insert bolts	B2.5-e
								R-150	CEA shroud assemblies - - CEA shrouds bolts	B3.2-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-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
								R-194	Core barrel assembly - - Lower internals assembly-to-core barrel bolts - Core barrel-to-thermal shield bolts	B4.5-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
								R-203	Lower grid assembly - - Lower grid rib-to-shell forging screws - Lower internals assembly-to- thermal shield bolts - Guide blocks and bolts - Shock pads and bolts	B4.6-b
								R-210	Flow distributor assembly - - Shell forging-to-flow distributor bolts	B4.7-b
29	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking	3.1.2.2.18.1	PWR	No, but licensee commitment 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 aand managing aging effects on reactor internals; (2) evaluate and implement the re	Stainless steel	Reactor coolant and high fluence (>1 x 1021 n/cm2, E >0.1 MeV)	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
30	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking	3.1.2.2.18.2	PWR	No, but licensee commitment to be confirmed	Chapter XI.M2, "Water chemistry" for PWR primary water, as described in EPRI TR-105714. 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 investiga	Stainless steel	Reactor coolant	R-106	Upper internals assembly - - Upper support plate - Upper core plate - Hold-down spring	B2.1-a
								R-116	RCCA guide tube assemblies - - RCCA guide tubes	B2.2-a
								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-130	Lower internal assembly - - Lower core plate - Radial keys and clevis inserts	B2.5-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
								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-155	Core support barrel - - Core support barrel upper flange	B3.3-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

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-173	Plenum cover and plenum cylinder - - Top flange-to-cover bolts Bottom flange-to-upper grid screws	B4.1-b
								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-181	Control rod guide tube (CRGT) assembly - - CRGT spacer screws - Flange-to-upper grid screws	B4.3-b
								R-193	Core barrel assembly - Core barrel cylinder (top and bottom flange) - Baffle plates and formers	B4.5-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
								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
						Stainless steel, cast austenitic stainless steel	Reactor coolant	R-109	Upper internals assembly - - Upper support column	B2.1-e
								R-138	Lower internal assembly - - Lower support forging or casting - Lower support plate columns	B2.5-k
								R-149	CEA shroud assemblies	B3.2-a
								R-159	Core shroud assembly - Core shroud tie rods (core support plate attached by welds in later plants)	B3.4-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
								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-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
						Stainless steel, PH stainless steel forging, CASS	Reactor coolant	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

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 due to 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 in BWRVIP-29 (EPRI TR-103515)	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
32	Cracking due to 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 in BWRVIP-29 (EPRI TR-103515)	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-22	Piping, piping components, and piping elements greater than or equal to 4 NPS	C1.1-f C1.3-c
						Stainless steel, cast austenitic stainless steel	Reactor coolant	R-20	Piping, piping components, and piping elements greater than or equal to 4 NPS; nozzle safe ends and associated welds	C1.1-f C1.2-b C1.3-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
						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
33	Cracking due to 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 in BWRVIP-29 (EPRI TR-103515)	Stainless steel, nickel alloy	Reactor coolant	R-64	Vessel shell - - Attachment welds	A1.2-e
34	Cracking due to Stress corrosion cracking and intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M9, “BWR Vessel Internals,” and Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	Stainless steel	Reactor coolant	R-104	Fuel supports and control rod drive assemblies - - Control rod drive housing	B1.5-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
35	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking, irradiation-assisted stress corrosion cracking	NA	BWR	No	Chapter XI.M9, "BWR Vessel Internals," and Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515)	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
						Nickel alloy, cast austenitic stainless steel, 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
						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
								R-92	Core shroud (including repairs) and core plate - - Core shroud (upper, central, lower)	B1.1-a
								R-93	Core shroud and core plate - - Core plate - Core plate bolts (used in early BWRs)	B1.1-b
								R-97	Core shroud and core plate - - LPCI coupling	B1.1-g
								R-98	Top guide	B1.2-a
								R-99	Core spray lines and spargers - - Core spray lines (headers) - Spray rings - Spray nozzles - Thermal sleeves	B1.3-a
36	Cracking due to 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
37	Cracking due to 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
38	Wall thinning due to 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
39	Cracking due to 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 in BWRVIP-29 (EPRI - TR-103515)	Nickel alloy	Reactor coolant	R-95	Core shroud and core plate - - Access hole cover - (mechanical covers)	B1.1-e
40	Loss of material due to general, 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 in BWRVIP-29 (EPRI TR-103515)	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
41	Cracking due to 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 in BWRVIP-29 (EPRI TR-103515) - - Because cracking initiated in crevice regions is not amen	Nickel alloy	Reactor coolant	R-94	Core shroud and core plate - - Access hole cover - (welded covers)	B1.1-d
42	Cracking due to 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
43	Loss of fracture toughness due to 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

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-103	Fuel supports and control rod drive assemblies - - Orificed fuel support	B1.5-a
44	Cracking due to stress corrosion cracking, loss of material due to wear, loss of preload due to stress relaxation	NA	BWR / PWR	No	Chapter XI.M18, “Bolting Integrity”	High-strength 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
						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
								R-12	Closure bolting	C2.3-g C2.4-g C2.5-p
						Stainless steel	Air with reactor coolant leakage	R-78	Control rod drive head penetration - - Flange bolting	A2.2-e
								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
								R-80	Control rod drive head penetration -- Flange bolting	A2.2-g
						Stainless steel; steel	Air with metal temperature up to 288°C (550°F)	R-29	Pump and valve seal flange closure bolting	C1.2-d C1.3-e
						Steel	Air with reactor coolant leakage	R-10	Closure bolting	D1.1-l
							System temperature up to 288°C (550°F)	R-26	Pump and valve closure bolting	C1.2-d C1.3-e
							System temperature up to 340°C (644°F)	R-32	Steam generator closure bolting	D1.1-f D2.1-k
45	Loss of material due to 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.

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
46	Loss of material due to 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.
47	Loss of fracture toughness due to 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 requireme	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
48	Loss of material due to 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.
49	Loss of fracture toughness due to 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

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-77	Control rod drive head penetration - - Pressure housing	A2.2-d
50	Loss of material due to 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
51	Wall thinning due to 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
								R-38	Pressure boundary and structural - - FW and AFW nozzles and safe ends - Steam nozzles and safe ends	D2.1-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
52	Loss of material due to 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
								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

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-190	Core support shield assembly - - Core support shield cylinder - (top flange) - VV assembly locking device	B4.4-f
								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
53	Cracking due to 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

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	Cracking due to 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
55	Loss of material due to 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
56	Loss of material due to wear	NA	PWR	No	Chapter XI.M1, “ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD,” for Class 1 components and recommendations of NRC I&E Bulletin 88-09 “Thimble Tube Thinning in Westinghouse Reactors,” described below: In response to I&E Bulletin 88-0	Stainless steel	Reactor coolant	R-145	Instrumentation support structures - - Flux thimble tubes	B2.6-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
57	Denting due to corrosion of steel tube support plate	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and - - Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134. - - For plants that could experience denting at the upper support plates, the applicant should evaluate potential	Nickel alloy	Secondary feedwater/ steam	R-43	Tubes	D1.2-g
58	Cracking due to 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 in EPRI TR-105714.	Stainless steel, cast austenitic 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
59	Cracking due to 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 in EPRI TR-105714	Stainless steel	Reactor coolant	R-217	Pressurizer heater sheaths and sleeves, and heater bundle diaphragm plate	C2.5-r
								RP-17	Steam Generator - - Divider Plate	D1.
						Stainless steel; steel with stainless steel cladding	Reactor coolant	R-07	Class 1 piping, fittings and primary nozzles, safe ends, manways, and flanges	C2.2-f C2.5-h D1.1-i C2.5-m
								R-30	Reactor coolant system piping and fittings - - Cold leg - Hot leg - Surge line - Spray line	C2.1-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
					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 primary water in EPRI TR-105714	Stainless steel; steel with stainless steel cladding	Treated borated water >60°C (>140°F)	R-14	Pressurizer relief tank - - Tank shell and heads - Flanges and nozzles	C2.6-c
60	Cracking due to 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 in EPRI TR-105714 - - Cracks in the pressurizer cladding could propagate fro	Steel with stainless steel or nickel alloy cladding; or stainless steel	Reactor coolant	R-58	Pressurizer components	C2.5-c C2.5-g
61	Cracking due to stress corrosion cracking; loss of material due to 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-71	Closure head - - Stud assembly	A2.1-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-72	Closure head - - Stud assembly	A2.1-d
62	Cracking due to stress corrosion cracking, loss of material due to crevice corrosion and fretting	NA	PWR	No	Chapter XI.M19, "Steam Generator Tubing Integrity" and - - Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134	Chrome plated Nickel alloy, stainless steel, Nickel alloy	Secondary feedwater/ steam	RP-14	Steam generator - - anti-vibration bars	D1.
								RP-15	Steam generator - - anti-vibration bars	D1.
63	Cracking due to 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 in EPRI TR-105714.	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

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
64	Cracking due to OD stress corrosion cracking and intergranular attack, loss of material due to fretting and wear	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and - - Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134	Nickel alloy	Secondary feedwater/ steam	R-47	Tubes and sleeves	D1.2-b D2.2-b
								R-48	Tubes and sleeves	D1.2-c D2.2-c
								R-49	Tubes and sleeves	D1.2-e D2.2-d
65	Loss of material due to wastage and pitting corrosion	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and - - Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134	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
66	Loss of material due to erosion, general, pitting, and crevice corrosion, ligament cracking due to corrosion	NA	PWR	No	Chapter XI.M19, “Steam Generator Tubing Integrity” and - - Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134	Steel	Secondary feedwater/ steam	R-42	Tube support plates	D1.2-k
								RP-16	Steam generator - - tube bundle wrapper	D1.
67	Loss of fracture toughness due to 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
								R-140	Lower internal assembly - - Lower support casting - Lower support plate columns	B2.5-m
								R-153	CEA shroud assemblies	B3.2-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-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
68	Cracking due to stress corrosion cracking	NA	PWR	No	Monitoring and control of primary water chemistry in accordance with the guidelines in EPRI TR-105714 (Rev. 3 or later revisions or update) minimize the potential of SCC, and material selection according to the NUREG-0313, Rev. 2 guidelines of ≤0.035% C a	CASS, carbon steel with stainless steel cladding	Reactor coolant	R-09	Class 1 pump casings and valve bodies	C2.3-b C2.4-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
69	Cracking due to 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
70	None	NA - No AEM or AMP	BWR / PWR	No	None	Stainless steel	Gas	RP-07	Piping, piping components, and piping elements	E.
71	None	NA - No AEM or AMP	BWR / PWR	No	None	Cast austenitic stainless steel	Air – indoor uncontrolled (External)	RP-02	Piping, piping components, and piping elements	E.
						Nickel alloy	Air – indoor uncontrolled (External)	RP-03	Piping, piping components, and piping elements	E.
						Stainless steel	Air – indoor uncontrolled (External)	RP-04	Piping, piping components, and piping elements	E.
72	None	NA - No AEM or AMP	BWR / PWR	No	None	Stainless steel	Concrete	RP-06	Piping, piping components, and piping elements	E.
						Steel	Concrete	RP-01	Piping, piping components, and piping elements	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
73	None	NA - No AEM or AMP	PWR	No	None	Stainless steel	Air with borated water leakage	RP-05	Piping, piping components, and piping elements	E.

B.2 Engineered Safety Features Audit Tool

Table B.2 presents the engineered safety features audit 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	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
							Treated water	E-16	Piping, piping components, and piping elements	D2.1-b
						Steel	Treated water	E-10	Piping, piping components, and piping elements	D2.1-b
2	Loss of material due to general corrosion	3.2.2.2.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	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-44	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
							Air – indoor uncontrolled (Internal)	E-25	Ducting, piping and components internal surfaces	B.2-a
								E-29	Piping and components internal surfaces	A.2-a A.5-a D2.5-a
							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.
3	Loss of material due to pitting and crevice corrosion	3.2.2.2.3.1	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Treated water	E-33	Containment isolation piping and components internal surfaces	C.1-b
								EP-32	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
4	Loss of material due to 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 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	Untreated water or raw water	E-01	Partially encased tanks with breached moisture barrier	D1.8-c
					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
							Soil	EP-31	Piping, piping components, and piping elements	D1. D2.
5	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	3.2.2.2.4	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Steel	Untreated water	E-32	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
6	Hardening and loss of strength due to 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	B.1-b B.2-b
7	Loss of material due to 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
8	Loss of material due to pitting, crevice, and microbiologically influenced corrosion, and fouling	3.2.2.2.7.1	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Stainless steel	Raw water	E-36	Containment isolation piping and components internal surfaces	C.1-b
							Untreated water	E-34	Containment isolation piping and components internal surfaces	C.1-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
9	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	3.2.2.2.7.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated. See IN 85-30 for evidence of microbiologically influenced corrosion.	Steel	Raw water	E-22	Containment isolation piping and components internal surfaces	C.1-a
10	Loss of material due to 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" -- 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 in BWRVIP-29 (EPRI TR-103515). - - 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
11	Loss of material due to general, pitting and crevice corrosion	3.2.2.2.8.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Air – indoor uncontrolled (External)	E-40	Ducting closure bolting	B.1-a
							Condensation (Internal)	E-27	Piping and components internal surfaces	D2.1-e
							Treated water	E-31	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
12	Loss of material due to general, pitting and crevice corrosion	3.2.2.2.8.3	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	Soil	E-42	Piping, piping components, and piping elements	B.
13	Loss of material due to general corrosion and fouling	3.2.2.2.9	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 fracture toughness due to 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

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	Cracking due to 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 in BWRVIP-29 (EPRI TR-103515)	Stainless steel	Treated water >60°C (>140°F)	E-37	Piping, piping components, and piping elements	D2.1-c D2.3-c
16	Wall thinning due to flow-accelerated corrosion	NA	BWR	No	Chapter XI.M17, "Flow-Accelerated Corrosion"	Steel	Air and 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
17	Loss of material due to 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 tubes	A. D1. D2.
								EP-36	Piping, piping components, and piping elements	A. B. 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
18	Loss of material due to 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 tubes	A. B. D1. D2.
19	Loss of material due to selective leaching	NA	BWR / PWR	No	Chapter XI.M33, "Selective Leaching of Materials"	Gray cast iron	Treated water	E-43	Motor Cooler	A. D1.
20	Cracking due to 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
21	Loss of material due to 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 shell side components including tubes	A.6-c D1.5-a D1.6-a D2.4-c
								EP-33	Piping, piping components, and piping elements	A. C. D1. D2.
22	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Stainless steel	Closed cycle cooling water	EP-35	Heat exchanger tubes	A. 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
23	Loss of material due to pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR / PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Stainless steel	Raw water	E-20	Heat exchanger shell side components including tubes	A.6-a D1.6-b D2.4-a
24	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M2, "Water Chemistry"	Stainless steel	Treated water	EP-34	Heat exchanger tubes	A. D2.
25	Loss of material due to general, pitting and crevice corrosion; Loss of preload due to stress relaxation	NA	BWR / PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	EP-24	Closure bolting	E.
								EP-25	Closure bolting	E.
							Air – outdoor (External)	EP-1	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 with steam or water leakage	E-02	Closure bolting	E.2-a
26	Loss of material due to general, pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Steel	Closed cycle cooling water	E-17	Heat exchanger shell side components	A.6-c D1.5-a D1.6-a D2.4-c
27	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR / PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Steel	Raw water	E-18	Heat exchanger shell side components including tubes	A.6-a D1.6-b D2.4-a
28	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M20, “Open-Cycle Cooling Water System”	Stainless steel	Raw water	E-21	Heat exchanger tubes (serviced by open-cycle cooling water)	A.6-b D1.6-c D2.4-b
						Steel	Raw water	E-23	Heat exchanger tubes (serviced by open-cycle cooling water)	D2.4-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
29	Loss of material due to 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.
						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.
30	Loss of fracture toughness due to 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

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
31	Cracking due to stress corrosion cracking	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	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
						Steel with stainless steel cladding	Treated borated water >60°C (>140°F)	E-38	Safety injection tank (accumulator)	D1.7-b
32	None	NA - No AEM or AMP	BWR / PWR	No	None	Aluminum	Air – indoor uncontrolled (Internal/External)	EP-3	Piping, piping components, and piping elements	F.
33	None	NA - No AEM or AMP	BWR / PWR	No	None	Glass	Air – indoor uncontrolled (External)	EP-15	Piping, piping components, and piping elements	F.
							Lubricating oil	EP-16	Piping, piping components, and piping elements	F.
							Raw water	EP-28	Piping, piping components, and piping elements	F.
							Treated water	EP-29	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
34	None	NA - No AEM or AMP	BWR / PWR	No	None	Stainless steel	Concrete	EP-20	Piping, piping components, and piping elements	F.
							Lubricating oil	EP-21	Piping, piping components, and piping elements	F.
35	None	NA - No AEM or AMP	BWR / PWR	No	None	Cast austenitic stainless steel	Air – indoor uncontrolled (External)	EP-8	Piping, piping components, and piping elements	F.
						Copper alloy	Air – indoor uncontrolled (External)	EP-10	Piping, piping components, and piping elements	F.
						Galvanized steel	Air – indoor uncontrolled (External)	EP-14	Ducting	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.
36	None	NA - No AEM or AMP	BWR / PWR	No	None	Steel	Air – indoor controlled (External)	EP-4	Piping, piping components, and piping elements	F.
							Concrete	EP-5	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
37	None	NA - No AEM or AMP	BWR / PWR	No	None	Copper alloy	Lubricating oil (no water pooling)	EP-11	Piping, piping components, and piping elements	F.
						Steel	Lubricating oil (no water pooling)	EP-6	Piping, piping components, and piping elements	F.
38	None	NA - No AEM or AMP	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.
39	None	NA - No AEM or AMP	PWR	No	None	Glass	Treated borated water	EP-30	Piping, piping components, and piping elements	F.
40	None	NA - No AEM or AMP	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.

B.3 Auxiliary Systems Audit Tool

Table B.3 presents the auxiliary systems audit 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	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 Ag	Steel	Air – indoor uncontrolled (External)	A-06	Cranes - Structural girders	B.1-a
2	Cumulative fatigue damage	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).	Cast austenitic stainless steel	Treated water	A-42	Piping, piping components, and piping elements	E3.2-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	Treated borated water	A-100	Heat exchanger shell side components including tubes	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
						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
							Treated water	A-37	Piping, piping components, and piping elements	E4.1-b
3	Cracking due to cyclic loading	3.3.2.2.2	PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel; steel	Treated borated water	A-76	High-pressure pump - - Casing and closure bolting	E1.5-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
4	Cracking due to 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 in BWRVIP-29 (EPRI TR-103515). - - 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	A-59	Piping, piping components, and piping elements	E2.1-a E2.2-a E2.3-a E2.4-a
5	Cracking due to 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	Diesel exhaust	AP-33	Diesel engine exhaust - - Piping, piping components, and piping elements	H2.
6	Cracking due to 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	Closed cycle cooling water >60°C (>140°F)	AP-60	Piping, piping components, and piping elements	C2. E3. E4.
							Treated water >60°C (>140°F)	A-85	Regenerative heat exchanger tube and shell side components including tubes	E3.3-d

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; steel with stainless steel cladding	Closed cycle cooling water >60°C (>140°F)	A-68	Heat exchanger shell side components including tubes	E3.4-a
							Treated water >60°C (>140°F)	A-71	Heat exchanger tube side components including tubes	E3.4-a
7	Cracking due to stress corrosion cracking, cyclic loading	3.3.2.2.4.1	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	High-strength steel	Air with steam or water leakage	A-104	Closure bolting	E1.
8	Cracking due to stress corrosion cracking, cyclic loading	3.3.2.2.4.2	PWR	Yes, plant-specific	Chapter XI.M2, “Water Chemistry,” - for PWR primary water in EPRI TR□105714 - - 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 e	Stainless steel	Treated borated water >60°C (>140°F)	A-84	Regenerative heat exchanger tube and shell side components including tubes	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 due to stress corrosion cracking, cyclic loading	3.3.2.2.4.3	PWR	Yes, plant-specific	Chapter XI.M2, “Water Chemistry,” - for PWR primary water in EPRI TR□105714 - - 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 corrosi	Stainless steel	Treated borated water >60°C (>140°F)	A-69	Heat exchanger tube side components including tubes	E1.8-b
10	Hardening and loss of strength due to 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 (External)	A-36	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
							Air – indoor uncontrolled >35°C (>95°F) (Internal)	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

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
11	Hardening and loss of strength due to elastomer degradation	3.3.2.5.2	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
							Treated water	A-16	Elastomer lining	A4.2-a A4.2-b A4.3-a A4.3-b A4.5-a A4.5-b
12	Loss of material due to general corrosion	3.3.2.2.6	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Air – indoor uncontrolled (External)	A-77	External surfaces	I.1-b
								A-80	Piping and components external surfaces and bolting	D.1-a D.2-a D.3-a D.4-a D.5-a D.6-a
							Air – outdoor (External)	A-78	External surfaces	I.1-b
							Condensation (External)	A-81	External surfaces	I.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
13	Loss of material due to general, pitting and crevice corrosion	3.3.2.2.7.1	BWR / PWR	Yes, detection of aging effects is to be evaluated	A plant specific aging management program that determines the thickness of the lower portion of the tank is to be evaluated. 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
14	Loss of material due to general, pitting and crevice corrosion	3.3.2.2.7.1	BWR / PWR	Yes, detection of aging effects is to be evaluated	A plant specific aging management program that monitors the degradation of the components is to be evaluated. 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

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 due to 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" - - 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 in BWRVIP-29 (EPRI TR-103515). - - 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	E4.1-a E4.2-a
16	Loss of material due to general, 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.	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

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-105	Ducting closure bolting	F1.
								AP-41	Heat exchanger tubes	F1. F2. F3. F4. G. H2.
							Air – indoor uncontrolled (Internal)	A-08	Ducting and components internal surfaces	F1.1-a F2.1-a F3.1-a F4.1-a
								A-11	Ducting, piping and components internal surfaces	F1.4-a F2.4-a F3.4-a
							Air – outdoor (External)	A-24	Piping, piping components, and piping elements	H1.1-a H1.2-a H1.3-a
								AP-40	Heat exchanger tubes	G. H2.
							Condensation (Internal)	AP-71	Piping, piping components and piping elements	K.
							Lubricating oil	AP-30	Piping, piping components, and piping elements	C1. C2. E1. E4. F1. F2. F3. F4. G. H2.
							Moist air	A-23	Piping, piping components, and piping elements	H2.2-a H2.3-a
						Steel -	Treated water	AP-69	Piping, piping components and piping elements	K.

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
17	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.	Steel; Stainless steel	Diesel exhaust	A-27	Diesel engine exhaust - - Piping, piping components, and piping elements	H2.4-a
18	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	3.3.2.2.8.1	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	A-01	Piping, piping components, and piping elements	H1.1-b C1.1-b C3. G.
19	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	3.3.2.2.8.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Condensation (Internal)	A-13	Ducting and components internal surfaces	F1.1-a F2.1-a F3.1-a F4.1-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
20	Loss of material due to general, pitting, crevice, and microbiologically 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
21	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	3.3.2.2.9.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Lubricating oil	AP-39	Heat exchanger shell side components	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**
22	Loss of material due to pitting and crevice corrosion	3.3.2.2.10.1	BWR / PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515). - - 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
						Stainless steel; steel with stainless steel cladding	Treated water	A-70	Heat exchanger tube side components including tubes	A4.4-b
						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
					Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714 - - 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
23	Loss of material due to pitting and crevice corrosion	3.3.2.2.10.2	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
							Treated water	AP-70	Piping, piping components and piping elements	K.
						Stainless steel	Condensation (External)	A-09	Ducting, piping and components external surfaces	F1.4-a F2.4-a F3.4-a
							Condensation (Internal)	A-12	Ducting, piping and components internal surfaces	F1.4-a F2.4-a F3.4-a
								AP-72	Piping, piping components and piping elements	K.

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
							Soil	AP-56	Piping, piping components, and piping elements	C1. C3. G. H1. H2.
							Treated water	AP-57	Piping, piping components, and piping elements	C2. E3. K.
							Waste water (untreated or treated water)	AP-67	Piping, piping components and piping elements	K.
24	Loss of material due to pitting, crevice, and galvanic corrosion	3.3.2.2.11	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Copper alloy	Lubricating oil	AP-47	Piping, piping components, and piping elements	C1. C2. E1. E4. G.. H2.
25	Loss of material due to pitting, crevice, and microbiologically 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.

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
26	Loss of material due to pitting, crevice, and microbiologically 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.	Copper alloy	Fuel oil (Water as a contaminant)	AP-44	Piping, piping components, and piping elements	H1. H2. G.
27	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	3.3.2.2.12.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Lubricating oil	AP-59	Piping, piping components, and piping elements	C1. C2. E1. E4. H2. G.
28	Loss of material due to 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

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
29	Reduction of neutron-absorbing capacity and loss of material due to general corrosion	3.3.2.2.14	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
30	Reduction of neutron-absorbing capacity due to 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
31	Cracking due to Stress corrosion cracking, intergranular stress corrosion cracking	NA	BWR	No	Chapter XI.M25, “BWR Reactor Water Cleanup System”	Cast austenitic stainless steel	Treated water >60°C (>140°F)	A-41	Piping, piping components, and piping elements	E3.2-a
						Stainless steel	Treated water >60°C (>140°F)	A-60	Piping, piping components, and piping elements	E3.1-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
32	Cracking due to stress corrosion cracking	NA	BWR	No	Chapter XI.M7, “BWR Stress Corrosion Cracking,” and - - Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515)	Cast austenitic stainless steel	Treated water >60°C (>140°F)	A-101	Piping, piping components, and piping elements	E4.3-a
						Stainless steel	Treated water >60°C (>140°F)	A-61	Piping, piping components, and piping elements	E4.1-c E4.3-a
33	Loss of material due to general, pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M29, “Aboveground Carbon Steel Tanks”	Steel	Air – outdoor (External)	A-95	Tanks	H1.4-b
34	Cracking due to 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.

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
35	Loss of material due to general, pitting and crevice corrosion, loss of preload due to stress relaxation	NA	BWR / PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – indoor uncontrolled (External)	AP-26	Closure bolting	I.
								AP-27	Closure bolting	I.
36	Loss of material due to general, pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air – outdoor (External)	AP-28	Bolting	I.
37	Loss of material due to general corrosion	NA	BWR / PWR	No	Chapter XI.M18, "Bolting Integrity"	Steel	Air with steam or water leakage	A-03	Closure bolting	I.
38	Loss of material due to 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.

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
								AP-34	Heat exchanger tubes	E1. F1. F3.
							Treated water	AP-64	Piping, piping components, and piping elements	A4. C2. E3. E4.
39	Loss of material due to 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
40	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Stainless steel	Closed cycle cooling water	AP-63	Heat exchanger tubes	C2. E3. E4.
41	Loss of material due to 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 shell side components including tubes	E3.4-b E4.4-a
42	Loss of material due to 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

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-63	Heat exchanger shell side components	A3.4-a A4.4-a E1.8-c E4.4-a C2. E3. F1. F2. F3. F4.
43	Loss of material due to pitting and crevice corrosion, and selective leaching	NA	BWR / PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System,” and 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
44	Loss of material due to general, pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M24, “Compressed Air Monitoring”	Steel	Condensation	A-103	Closure bolting	D.2-a
45	Loss of material due to 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

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
46	Increased elastomer hardness, shrinkage and loss of strength due to 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
47	Loss of material due to 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
48	Loss of material due to 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

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
49	Concrete cracking and spalling due to 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 – 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
							Air – outdoor	A-92	Structural fire barriers – walls, ceilings and floors	G.1-b G.2-b G.3-b G.4-b
50	Loss of material due to 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

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
51	Loss of material due to 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
52	Loss of material due to 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
53	Loss of material due to 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

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
54	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	NA	BWR / PWR	No	Chapter XI.M30, "Fuel Oil Chemistry"	Stainless steel	Fuel oil	AP-54	Piping, piping components, and piping elements	G. H1. H2.
55	Loss of material due to 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
56	Loss of material due to 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

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
57	Loss of material due to 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
								A-65	Heat exchanger tube side components including tubes	C1.3-a
58	Loss of material due to 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
59	Loss of material due to 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.

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-55	Piping, piping components, and piping elements	H2.
60	Reduction of heat transfer due to 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
						Stainless steel	Raw water	AP-61	Heat exchanger tubes	C1. C3. G. H2.
61	Loss of material due to 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
62	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	NA	BWR / PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Steel	Raw water	A-31	Piping, piping components, and piping elements	C3.1-a C3.2-a C3.3-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
63	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion, and fouling	NA	BWR / PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Steel	Raw water	A-32	Piping, piping components, and piping elements	C1.2-a C1.5-a C1.6-a H2.1-b
								A-64	Heat exchanger tube side components including tubes	C1.3-a
						Steel (without lining/coating or with degraded lining/coating)	Raw water	A-38	Piping, piping components, and piping elements	C1.1-a
64	Loss of material due to lining or coating degradation	NA	BWR / PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	Steel with internal lining or coating	Raw water	AP-25	Piping, piping components, and piping elements	C1. C3. 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
65	Loss of material due to 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
								A-66	Heat exchanger tube side components including tubes	C1.3-a
								AP-46	Piping, piping components, and piping elements	H2.
							Treated water	AP-32	Piping, piping components, and piping elements	A4. C2. E3. E4. K.
								AP-65	Heat exchanger tubes	E1. F1. F3.
66	Loss of material due to selective leaching and general corrosion	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.

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 due to selective leaching	NA	BWR / PWR	No	Chapter XI.M33, “Selective Leaching of Materials”	Gray cast iron	Raw water	A-51	Piping, piping components, and piping elements	C1.5-a
							Soil	AP-42	Piping, piping components, and piping elements	C1. C3. G. H1. H2.
							Treated water	AP-31	Piping, piping components, and piping elements	A3. A4. C2. E1. E3. E4. F1. F2. F3. F4. G.
							Untreated water	AP-29	Piping, piping components, and piping elements	C1. C3. G. H2.
68	Loss of material due to 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
69	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M2, "Water Chemistry"	Stainless steel	Treated water	AP-62	Heat exchanger tubes	A4. 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
70	Cracking due to stress corrosion cracking	NA	BWR / PWR	No	Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515).	Stainless steel	Treated water >60°C (>140°F)	A-96	Spent fuel storage racks - - Storage racks - BWR	A2.1-c
					Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714	Stainless steel	Treated borated water >60°C (>140°F)	A-97	Spent fuel storage racks - - Storage racks - PWR	A2.1-c
71	Reduction of neutron-absorbing capacity due to 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
72	Loss of material due to 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.
						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
73	Cracking due to stress corrosion cracking	NA	PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR primary water in EPRI TR-105714	Steel with stainless steel cladding	Treated borated water >60°C (>140°F)	A-56	Piping, piping components, and piping elements	A3.3-b
74	None	NA - No AEM or AMP	BWR / PWR	No	None	Galvanized steel	Air – indoor uncontrolled	AP-13	Piping, piping components, and piping elements	J.
75	None	NA - No AEM or AMP	BWR / PWR	No	None	Glass	Air	AP-48	Piping, piping components, and piping elements	J.
							Air – indoor uncontrolled (External)	AP-14	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
							Fuel oil	AP-49	Piping, piping components, and piping elements	J.
							Lubricating oil	AP-15	Piping, piping components, and piping elements	J.
							Raw water	AP-50	Piping, piping components, and piping elements	J.
							Treated borated water	AP-52	Piping, piping components, and piping elements	J.
							Treated water	AP-51	Piping, piping components, and piping elements	J.
76	None	NA - No AEM or AMP	BWR / PWR	No	None	Cast austenitic stainless steel	Air – indoor uncontrolled (External)	AP-7	Piping, piping components, and piping elements	J.
						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.
77	None	NA - No AEM or AMP	BWR / PWR	No	None	Aluminum	Air – indoor controlled (External)	AP-36	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
						Steel	Air – indoor controlled (External)	AP-2	Piping, piping components, and piping elements	J.
78	None	NA - No AEM or AMP	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.
79	None	NA - No AEM or AMP	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.
80	None	NA - No AEM or AMP	BWR / PWR	No	None	Copper alloy	Dried Air	AP-8	Piping, piping components, and piping elements	J.
							Lubricating oil (no water pooling)	AP-10	Piping, piping components, and piping elements	J.
						Stainless steel	Dried Air	AP-20	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
							Lubricating oil (no water pooling)	AP-21	Piping, piping components, and piping elements	J.
						Steel	Dried Air	AP-4	Piping, piping components, and piping elements	J.
							Lubricating oil (no water pooling)	AP-5	Piping, piping components, and piping elements	J.
81	None	NA - No AEM or AMP	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.

B.4 Steam and Power Conversion Audit Tool

Table B.4 presents the steam and power conversion audit 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	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	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 due to 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" - - 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.

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 BWR water in BWRVIP-29 (EPRI TR-103515). - - 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 J.
							Treated water	S-09	Piping, piping components, and piping elements	D2.1-b D2.2-b D2.3-b E.1-b E.2-b E.3-a E.5-a E.6-a
								S-18	BWR heat exchanger shell side components	E.4-a E.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,” for PWR secondary water in EPRI TR-102134 - - 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 J.
							Treated water	S-10	Piping, piping components, and piping elements	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
								S-19	PWR heat exchanger shell side 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
3	Loss of material due to general, pitting and crevice corrosion	3.4.2.2.2.2	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Lubricating oil	SP-25	Piping, piping components, and piping elements	A. D1. D2. E. G.
							Steam	SP-48	Piping, piping components, and piping elements	J.
4	Loss of material due to 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	Untreated water	S-12	Piping, piping components, and piping elements	G.1-d
5	Loss of material due to general corrosion	3.4.2.2.4	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	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

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
6	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.5.1	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Steel	Lubricating oil	S-17	Heat exchanger shell side components	G.5-d
							Raw water	SP-51	Piping, piping components, and piping elements	J.
7	Loss of material due to general, pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.5.2	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

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
8	Cracking due to stress corrosion cracking	3.4.2.2.6.1	BWR / PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M2, “Water Chemistry,” for BWR water in BWRVIP-29 (EPRI TR-103515). - - 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	B2.
							Treated water >60°C (>140°F)	SP-19	Piping, piping components, and piping elements	E.
					Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134 - - 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 tube side components including tubes	F.4-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
								SP-17	Piping, piping components, and piping elements	E. D1. F. G.
9	Cracking due to stress corrosion cracking	3.4.2.2.6.2	BWR / PWR	Yes, detection of aging effects is to be evaluated	Chapter XI.M21, "Closed Cycle Cooling Water System" - - 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.
10	Loss of material due to 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 in BWRVIP-29 (EPRI TR-103515). - - 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-13	Tanks	E.5-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
								S-21	BWR heat exchanger shell side components	E.4-a E.4-d
					Chapter XI.M2, "Water Chemistry," for PWR primary water in EPRI TR-105714 - - 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 shell side components	E.4-a E.4-d F.4-a F.4-d
					Chapter XI.M2, "Water Chemistry," for PWR secondary water in EPRI TR-102134 - - 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-14	Tanks	E.5-b G.4-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
								SP-16	Piping, piping components, and piping elements	D1. F. G. E. D2.
11	Loss of material due to 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	Raw water	SP-52	Piping, piping components, and piping elements	J.
							Soil	SP-37	Piping, piping components, and piping elements	E. G.
12	Loss of material due to pitting, crevice, and microbiologically influenced corrosion	3.4.2.2.8	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	Stainless steel	Lubricating oil	S-20	Heat exchanger shell side components	G.5-d
								SP-38	Piping, piping components, and piping elements	A. D1. D2. E. G.
13	Loss of material due to pitting, crevice, and galvanic corrosion	3.4.2.2.9	BWR / PWR	Yes, plant-specific	A plant-specific aging management program is to be evaluated.	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**
14	Loss of material due to 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.
15	Loss of material due to 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	E. F. G.
16	Loss of material due to 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.
							Treated water	SP-27	Piping, piping components, and piping elements	E. F. G.
							Untreated water	SP-28	Piping, piping components, and piping elements	G.
17	Loss of material due to 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 tube side 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.
18	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M21, “Closed-Cycle Cooling Water System”	Stainless steel	Closed cycle cooling water	SP-41	Heat exchanger tubes	E. F. G.
19	Loss of material due to 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 tube side components	E.4-b F.4-b G.5-a
20	Cracking due to stress corrosion cracking	NA	BWR / PWR	No	Chapter XI.M2, “Water Chemistry,” for PWR secondary water in EPRI TR-102134	Stainless steel	Steam	SP-44	Piping, piping components, and piping elements	B1.
21	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M2, "Water Chemistry"	Stainless steel	Treated water	SP-40	Heat exchanger tubes	E. F.

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 due to 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	E. F. G.
						Stainless steel	Raw water	SP-36	Piping, piping components, and piping elements	E. F. G.
23	Loss of material due to general corrosion	NA	BWR / PWR	No	Chapter XI.M29, "Aboveground Carbon Steel Tanks"	Steel	Air – outdoor (External)	S-31	Tanks	E.5-c G.4-c
24	Loss of material due to general, pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M21, "Closed-Cycle Cooling Water System"	Steel	Closed cycle cooling water	S-23	Heat exchanger tube side 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
25	Loss of material due to general, pitting, crevice, 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 tube side components	E.4-b F.4-b G.5-a
26	Wall thinning due to 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 J.
							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

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
27	Loss of material due to general, pitting and crevice corrosion; cracking due to cyclic loading, stress corrosion cracking; loss of preload due to stress relaxation	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
						Steel	Air – indoor uncontrolled (External)	S-33	Closure bolting	H.
								S-34	Closure bolting	H.
							Air – outdoor (External)	S-32	Bolting	H.
							Air with steam or water leakage	S-02	Closure bolting	H.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
28	Reduction of heat transfer due to fouling	NA	BWR / PWR	No	Chapter XI.M20, "Open-Cycle Cooling Water System"	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
29	Loss of material due to pitting and crevice corrosion	NA	BWR / PWR	No	Chapter XI.M2, "Water Chemistry," for BWR water in BWRVIP-29 (EPRI TR-103515).	Stainless steel	Steam	SP-46	Piping, piping components, and piping elements	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 in EPRI TR-102134	Nickel-based alloys	Steam	SP-18	Piping, piping components, and piping elements	B1.
						Stainless steel	Steam	SP-43	Piping, piping components, and piping elements	B1.
						Steel	Steam	S-07	Piping, piping components, and piping elements	B1.1-a B1.2-a
30	Loss of material due to 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.

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**
31	None	NA - No AEM or AMP	BWR / PWR	No	None	Glass	Air	SP-33	Piping, piping components, and piping elements	I.
							Air – indoor uncontrolled (External)	SP-9	Piping, piping components, and piping elements	I.
							Lubricating oil	SP-10	Piping, piping components, and piping elements	I.
							Raw water	SP-34	Piping, piping components, and piping elements	I.
							Treated water	SP-35	Piping, piping components, and piping elements	I.
32	None	NA - No AEM or AMP	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.
33	None	NA - No AEM or AMP	BWR / PWR	No	None	Steel	Air – indoor controlled (External)	SP-1	Piping, piping components, and 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
34	None	NA - No AEM or AMP	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.
35	None	NA - No AEM or AMP	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.
36	None	NA - No AEM or AMP	BWR / PWR	No	None	Copper alloy	Lubricating oil (no water pooling)	SP-7	Piping, piping components, and piping elements	I.
						Stainless steel	Lubricating oil (no water pooling)	SP-14	Piping, piping components, and piping elements	I.
						Steel	Lubricating oil (no water pooling)	SP-3	Piping, piping components, and piping elements	I.