## GALL-SLR AND SRP-SLR SUPPLEMENTAL STAFF GUIDANCE

### INTRODUCTION

This document provides supplemental guidance to the draft NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," Volumes I and II and draft NUREG-2192, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants" (SRP-SLR). These changes were developed subsequent to the release of NUREG-2191 and NUREG-2192 for public comment in a Federal Register Notice published at 80 FR 79956 (December 23, 2015). This supplement is being released for public comment. Comments received on the changes proposed in this document will be addressed along with comments received on the draft versions of NUREG-2191 and NUREG-2192. The changes will be then incorporated into the final versions of NUREG-2191 and NUREG-2192.

### DISCUSSION

The topical areas addressed in this supplement to the draft GALL-SLR Report and SRP-SLR are as follows:

A. Selective leaching of ductile iron

B. Cracking due to stress corrosion cracking and intergranular stress corrosion cracking

C. Changes to further evaluation (FE) sections of the SRP-SLR, aging management program (AMP) XI.M29, "Aboveground Metallic Tanks," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," and aging management review (AMR) line items to address cracking and loss of material for aluminum and stainless steel components

D. A new title for AMP XI.M29

E. Issuance of LR-ISG-2015-01, "Changes to Buried and Underground Piping and Tank Recommendations"

F. Minor technical and editorial changes to AMR line items and AMPs

G. Response to certain initial feedback from the industry as presented at a public meeting on January 21, 2016

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### A) Selective Leaching of Ductile Iron

#### i) Background

The GALL Report, Revision 2, and SRP-LR, Revision 2, addressed loss of material due to selective leaching for gray cast iron and copper alloys (except for inhibited brass) that contain greater than 15 percent zinc or 8 percent aluminum. During the Electric Power Research Institute (EPRI) Buried Pipe Integrity Group (BPIG) July 2015 meeting, a licensee presented results showing evidence of selective leaching, also commonly referred to as graphitic corrosion or graphitization, of ductile iron components.

The staff conducted further research in the months following the EPRI BPIG meeting and presented its findings at the quarterly meeting with the Nuclear Energy Institute (NEI) to discuss current and subsequent license renewal topics on September 10, 2015 (ADAMS Accession No. ML15253A217). The staff presentation showed that ductile iron is less susceptible, not immune, to selective leaching based on microstructural differences between gray cast iron and ductile iron as summarized below:

- Gray cast iron has a continuous network of graphite flakes surrounded by iron as opposed to ductile iron where the graphite exists as discrete nodules/spheres embedded in iron. This results in a smaller cathode (graphite)/anode (iron) ratio for ductile iron and lower susceptibility to corrosion.
- Selective leaching, which is characterized by the component retaining its shape with an associated loss in strength, requires a network to be able to retain or 'hold-on' to corrosion products. Ductile iron consists of discrete graphite phase that is less likely to be able to 'hold-on' to the corrosion products to prevent dimensional changes.

Given the lower susceptibility of ductile iron, the staff presented the following as alternative approaches to perform inspections of ductile iron:

- Use gray cast iron as a leading indicator for susceptibility to graphitic corrosion in a similar environment. Ductile iron would be inspected only if graphitic corrosion is identified for gray cast iron in a similar environment.
- Create a separate population for ductile iron with a reduced sample size when compared to gray cast iron.

In the weeks following the NEI quarterly meeting, the staff concluded that the alternative approaches listed above were not suitable to perform inspections of ductile iron, and that ductile iron should be inspected as a separate population and to the same extent as gray cast iron based on the following:

- During its literature review, the staff could not determine that gray cast iron components would show signs of selective leaching before ductile iron in a similar environment. Therefore, the leading indicator approach would not be appropriate.
- Although ductile iron is less susceptible to selective leaching when compared to gray cast iron, the staff could not quantitatively determine the degree of susceptibility (e.g. 50 percent less susceptible when compared to gray cast iron). Therefore, it would be difficult to provide technical justification for a reduced sample size when compared to gray cast iron.

**ii) Operating Experience, Literature, and Regulatory Examples**

a) The staff's review of the Institute of Nuclear Power Operation's (INPO) compiled industry operating experience (OE) showed that a licensee identified graphitic corrosion (dealloying) on buried ductile iron piping in August 2014.

b) Subsequent research following the EPRI BPIG July 2015 meeting has shown that while there is universal agreement that gray cast iron has a microstructure susceptible to selective leaching, consensus has not been reached regarding the susceptibility of ductile iron. However, given the numerous sources that state that graphitic corrosion is an applicable aging mechanism for ductile iron, the NRC has concluded that this is an applicable aging effect. Below are literature examples supporting the susceptibility of ductile iron to graphitic corrosion. It is not intended to be an exhaustive list:

- NACE International [formerly known as the National Association of Corrosion Engineers] paper number #2477, *Corrosion and Corrosion Control for Buried*

*Cast- and Ductile-Iron Pipe*, states “[a] form of corrosion unique to cast and ductile-iron pipe is referred to as graphitic corrosion.”

- *Uhlig’s Corrosion Handbook*, Third Edition, states “[b]uried water lines made from nodular (ductile) cast iron piping have been in use for several decades, and many utilities are reporting dealloying of this metal, which was once considered to be immune to dealloying.”
- ASCE (American Society of Civil Engineers) International Conference on Pipeline Engineering and Construction, July 13-16, 2003, *Evaluating Ductile Iron Pipe Corrosion*, states “[d]uctile iron pipe typically corrodes by two mechanisms, graphitization and pitting corrosion.”
- NACE International 57th Annual Appalachian Underground Corrosion Short Course, May 15, 2012, *Corrosion Control Considerations for Ductile Iron Pipe - A Consultant’s Perspective*, states “[t]his process is known as graphitic corrosion or graphitization and is a common form of corrosion on buried cast iron pipe and to a lesser degree on ductile iron.”
- United States Environmental Protection Agency (EPA) State of Technology Review Report, *Condition Assessment of Ferrous Water Transmission and Distribution Systems* (EPA/600/R-09/055), states “[g]eneral corrosion can occur in ductile iron in the form of graphitization” and “[t]he relative merits of the different metallurgical forms of grey cast iron and ductile iron and their resistance to graphitization have been an area of some disagreement among researchers.”
- National Research Council Canada Report, *Failure Modes and Mechanisms in Gray Cast Iron Pipes* (NRCC-44218), references graphitic corrosion of ductile iron pipe in the cities of Toronto and Ottawa and states “[w]hile graphitisation is less common in ductile iron pipes than in gray iron pipes, it is clearly still a possibility.”

c) The United States Department of Transportation (DOT) recognizes the susceptibility of ductile iron to graphitic corrosion in 49 CFR 192.489. The section describes remedial measures to be performed when graphitic corrosion is identified in gray cast iron or ductile iron pipe.

**iii) Proposed Changes**

a) Addition of “ductile iron” to AMP XI.M33, “Selective Leaching.”

b) Revised SRP-LR Table 1 AMR line items and the GALL Report AMR line items.

c) Addition of “ductile iron” and modification of “steel” in Chapter IX of the GALL-SLR Report.

**B) Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking**

**i) Background**

a) The staff noted that the further evaluations sections associated with cracking due to stress corrosion cracking (SCC) and intergranular stress corrosion cracking (IGSCC) for stainless steel and nickel alloy components exposed to treated water (i.e., 3.2.2.2.9, 3.3.2.2.9) cite: (a) a limit of greater than or equal to 4 inches nominal pipe size (NPS); (b) components that were not associated with the scope of components in the particular set of systems (e.g., spent fuel racks are not addressed in SRP-SLR

Section 3.2); and (c) exposure to reactor coolant. The size limits were not stated in the corresponding AMR line items. The size limits are appropriate because the further evaluations sections cite AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry." AMP XI.M7 is applicable to 4 NPS or larger.

b) The staff also noted that there were no boiling water reactor (BWR) AMR line items for stainless steel and nickel alloy components exposed to treated water less than 4 NPS. The staff concluded it is possible that there could be in-scope piping and piping components less than 4 NPS. The staff concluded that the water chemistry controls recommended by AMP XI.M2 would mitigate the potential for SCC or IGSCC to occur. The staff also concluded that the inspections of AMP XI.M32 would be sufficient to verify the effectiveness of the water chemistry controls.

**ii) Changes Incorporated Into the Draft GALL-SLR Report and SRP-SLR**

a) AMR line item 3.3.1-54 and the corresponding GALL-SLR line item, V.D2.E-37, were editorially revised to include a reference to pipe size and include nickel alloy as an applicable material.

b) Further evaluation Sections 3.2.2.2.9 and 3.2.3.2.9 were edited to remove references to nozzle safe ends and associated welds and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds. The aging effects associated with these components are addressed in SRP-SLR Section 3.1 and GALL-SLR Report Chapter IV. In addition, the environment was corrected to cite treated water >60°C (>140°F). Components in the engineered safety feature systems would be exposed to treated water, not reactor coolant.

c) AMR line item 3.3.1-110 and the corresponding GALL-SLR line item, VII.E4.A-61, were editorially revised to include a reference to pipe size and include nickel alloy as an applicable material.

d) Further evaluation sections 3.3.2.2.9 and 3.3.3.2.9 were edited to remove references to nozzle safe ends and associated welds and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds. The aging effects associated with these components are addressed in SRP-SLR Section 3.1 and GALL-SLR Report Chapter IV. In addition, the environment was corrected to cite treated water >60°C (>140°F). Components in the auxiliary systems would be exposed to treated water, not reactor coolant.

e) New AMR line items were added to SRP-SLR Sections 3.2 and 3.3 and the corresponding portions of GALL-SLR Chapters V and VII.

**C) Changes to Further Evaluation (FE), AMP XI.M29, AMP XI.M36, and AMR Line Items to Address Cracking and Loss of Material for Aluminum and Stainless Steel Components**

**i) Background**

a) **Loss of material and SCC of stainless steel components**: the GALL Report, Revision 2, and SRP-LR, Revision 2, addressed loss of material due to pitting and crevice corrosion and cracking due to SCC of stainless steel components as further evaluation AMR line items in SRP-LR Sections 3.2.2.2.3, 3.2.2.2.6, 3.3.2.2.3, 3.3.2.2.5, 3.4.2.2.2, and 3.4.2.2.3. The potential for loss of material or SCC to occur was assessed based on the component's proximity to outdoor air with the potential for halogens to be present (e.g., component located within approximately 5 miles of a saltwater coastline or one-half mile of a highway which is treated with salt in the wintertime). An applicant could demonstrate that managing loss of material or SCC was not applicable by demonstrating that the presence of halides was unlikely. During its development of the SRP-SLR, the staff concluded that these criteria may not account for all relevant factors. For example, depending on prevailing winds, the effects of coastal saltwater could be impactful beyond 5 miles.

b) **Loss of material and SCC of aluminum alloy components**: the GALL Report, Revision 2, recommended managing loss of material due to pitting or crevice corrosion of aluminum components by citing AMP XI.M29, "Aboveground Metallic Tanks," AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," and AMP XI.M41, "Buried and Underground Piping and Tanks," for the air-outdoor, air-indoor uncontrolled (underground components only), or condensation environments. For the air-dry, air-indoor controlled, air-indoor uncontrolled (aboveground components only), and gas environments, the GALL Report indicated that there was no aging effect requiring management and no recommended AMP. The GALL Report, Revision 2, was revised by LR-ISG-2012-02, "Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation," to address cracking of aluminum tanks and insulated components.

**ii) Changes Incorporated Into the Draft GALL-SLR Report and SRP-SLR**

a) **Loss of material and SCC of stainless steel components**: as stated above, loss of material due to pitting or crevice corrosion, and cracking due to SCC of stainless steel components were addressed in GALL Report, Revision 2. The recommendations in the further evaluation sections were revised, and new AMR line items were developed for SRP-SLR Section 3.1, to address specific environments and additional AMPs in the draft GALL-SLR Report and SRP-SLR.

b) **Loss of material for aluminum alloy components**: during the development of the GALL-SLR Report and SRP-SLR, the staff concluded that it may not be necessary to conduct periodic inspections of aluminum components in order to manage potential loss of material due to pitting and crevice corrosion. Based on its review of Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that loss of material can occur with relatively minor moisture levels in the air. Sources of moisture include humidity, rain, or leakage from mechanical connections such as bolted flanges and valve packing. Loss of material due to pitting or crevice corrosion can occur on aluminum surfaces due to the presence of minor amounts of moisture. This moisture interacts with second phase particles at local anode and cathode regions; resulting in corrosion due to the passive layer being interrupted. As a result, rather than loss of material being limited to environments encompassing the air-outdoor, air-indoor uncontrolled (underground components only), or condensation environments, as cited in GALL Report, Revision 2, any air environment could have sufficient moisture to enable the aging effect. In addition, loss of material can occur in water environments that could potentially contain deleterious materials (i.e., raw water, waste water).

The staff noted that one-time inspections, as described by AMP XI.M32, "One-Time Inspection," for the subsequent license renewal period would occur after no less than 50 years of operation. The staff concluded that a one-time inspection of aluminum components prior to entry in the subsequent period of extended operation coupled with a search of plant-specific OE related to loss of material of aluminum components would provide sufficient input to determine whether periodic inspections should be conducted.

The staff addressed the potential for loss of material on the internal surfaces of the aluminum alloy components exposed to air. The staff concluded that if a search of plant-specific OE and the applicable external surfaces of aluminum components do not exhibit loss of material, it is unlikely that loss of material would be occurring on the internal surfaces of the components. Therefore, loss of material would not need to be age managed for the internal surfaces. The staff developed further evaluation sections (i.e., 3.2.2.2.13, 3.3.2.2.13, 3.4.2.2.10) to address loss of material due to pitting and crevice corrosion.

c) **SCC of aluminum alloy components**: during the development of the GALL-SLR Report and SRP-SLR, the staff concluded that cracking of aluminum components should be addressed through a further evaluation section. Based on its review of "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys," B.F. Brown, Naval Research Laboratory, 1972; and Corrosion of Aluminum and Aluminum Alloys, J.R. Davis, ASM International, 1999, the staff noted that certain alloy compositions and tempers are not susceptible to SCC. In addition, the staff noted that certain environments such as dry gas would not promote SCC because there is insufficient moisture to accumulate the halogens on the surface of the component that would cause SCC. The staff further noted that barrier coatings could isolate aluminum components from an aggressive environment.

The staff developed further evaluation AMR line items to address cracking of aluminum components due to SCC. The further evaluation sections (i.e., 3.2.2.2.10, 3.3.2.2.10, 3.4.2.2.7) allow an applicant to document that SCC is not applicable due to the type of material or environment. If the material is susceptible to SCC and the environment promotes SCC, the further evaluation recommends that cracking be managed by a periodic condition monitoring program (e.g., AMP XI.M36, AMP XI.M41). As an alternative, if a barrier coating is utilized to isolate the aluminum component from the environment, the applicant can choose to manage loss of coating integrity with AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," in lieu of conducting inspections for SCC.

### iii) Proposed Changes to the Draft GALL-SLR Report and SRP-SLR

During the final stages of refining the content of the GALL-SLR Report and SRP-SLR, the staff concluded that accounting for all the relevant factors that influence a plant-specific environment, as it relates to the loss of material and SCC of stainless steel and aluminum alloys, was not practical. Likewise, the staff concluded that establishing material-specific threshold levels for halides was also not practical. Ultimately, the staff determined that the most accurate and practical method for determining the susceptibly of these materials to the plant-specific environments was by reviewing the available plant-specific OE and conducting a one-time inspection. As a result, the staff has proposed the following changes to the draft GALL-SLR Report and SRP-SLR:

a) **Loss of material and SCC for stainless steel components**: the staff concluded that the SRP-LR further evaluation screening may not account for all relevant factors. A one-time inspection of stainless steel components prior to entry in the subsequent period of extended operation coupled with a search of plant-specific OE related to loss of material and SCC of stainless steel components would provide sufficient input to determine if periodic inspections should be conducted. The staff revised the existing further evaluation sections associated with loss of material and SCC of stainless steel components to reflect these changes.

b) **Loss of material for aluminum alloy components**: the staff provided an alternative to conducting inspections for loss of material of aluminum alloy components. The alternative consists of verifying that loss of coating integrity of a barrier coating is not occurring by conducting inspections in accordance with AMP XI.M42. The staff concluded that this alternative would be equally effective as a preventive strategy for loss of material in aluminum alloys. In addition, the staff addressed loss of material due to pitting and crevice corrosion for components exposed to raw water or waste water.

c) **SCC of aluminum alloy components**: the only change to the further evaluation sections addressing SCC of aluminum alloy components was to address the potential for leakage from flanged connections or valve packing through insulation that contains sufficient levels of halides to promote SCC. As a result, the staff concluded these further evaluation sections should be addressed in all air environments.

d) **Changes to AMP XI.M29 and AMP XI.M36:** The AMPs were revised as follows:

- The GALL-SLR Report AMP XI.M29, Table XI.M29, "Tanks Inspection Recommendations," was revised to reference the further evaluation sections for loss of material and SCC of stainless steel and aluminum tank surfaces exposed to air, and aluminum tanks exposed to raw water and waste water. The outcome of the OE search and one-time inspection, recommended in the further evaluation sections, will provide the basis for determining whether periodic inspections based on AMP XI.M29 will be conducted for these material, environment, and aging effect (MEA) combinations. Given that the tank internals for the tanks within the scope of AMP XI.M29 will typically be exposed at least in part to air, Table XI.M29 was updated to reflect internal inspections for these MEA combinations. The new recommended internal inspections also reference the further evaluation sections. The staff also revised the detection of aging effects program element of AMP XI.M29 to reflect that the recommended periodic inspections might not be applicable based on the outcome of the OE search and one-time inspection.

  The staff also revised Table XI.M29-1 to include managing SCC on the external surfaces of tanks exposed to soil or concrete. For aluminum tanks, the table cites the further evaluation sections associated with SCC of aluminum components. For stainless steel tanks, inspections for loss of material and SCC and aluminum tank inspections for loss of material are conducted every 10 years. However, as stated in footnote 13 to the table, a one-time inspection can be conducted in lieu of periodic inspections if either the soil is demonstrated not to be corrosive or effective cathodic protection has been provided. The staff confirmed that cathodic protection mitigates SCC for stainless steel components. Chapter 1.5.5 of "Principles and Prevention of Corrosion," Denny A. Jones, second edition, states, "hydrogen induced cracking is accelerated by cathodic protection, whereas SCC and corrosion fatigue cracking are suppressed." Cathodic protection limits related to hydrogen induced cracking is addressed in the "preventive actions" program element of AMP XI.M41.

- The GALL-SLR Report AMP XI.M36 was revised to reflect that the recommended periodic inspections of aluminum and stainless steel for loss of material and SCC might not be applicable based on the outcome of the OE search and one-time inspection of the referenced further evaluation sections.

e) **Changes to AMR line items:** the associated AMR line items were revised to reflect the above discussion. This was accomplished principally by:

- Consistently revising the environment to "any air environment, condensation" instead of further descriptive terms such as air-outdoor, air-indoor uncontrolled, etc., for all stainless steel and aluminum AMR line items associated with air with an aging effect of loss of material or SCC.
- Creating new line items or editing existing line items as necessary to address the internal and external surfaces of piping, piping components, tanks, and tanks within the scope of AMP XI.M29; external surfaces of insulated and underground piping, piping components and tanks; and buried piping, piping components and tanks.
- For AMR line items citing the further evaluation sections, the recommended AMP was revised to cite a plant-specific AMP in lieu of a specific AMP. This change was made because the results of the plant-specific OE search and one-time inspection for stainless steel components and loss of material line items for aluminum will determine whether one-time or periodic inspections will be conducted. When managing SCC for aluminum components, the results of the evaluation of the susceptibility of the material and environment, or whether a barrier to the environment has been used will determine whether periodic inspections are conducted.
- The further evaluation sections were not referenced for buried stainless steel and aluminum components. The direct visual examinations of buried components inspect for damage to the coatings. If no coatings are present or the coatings have been damaged, the component's surface is inspected for loss of material and SCC, when applicable.
- The environments for underground components were consistently changed to cite any air environment, raw water (because some applicants consider in-leakage of rain water or ground water to be raw water), condensation, or ground water.
- Some AMR line items included stainless steel or aluminum with steel and copper components. Stainless steel and aluminum were removed from these line items so that steel and copper components would not be subject to the further evaluation section. When stainless steel or aluminum was deleted, the staff confirmed that this material, environment, and aging effect was cited in another line item or a new line item was created.
- Creating new line items or editing existing line items as necessary to address the internal and external surfaces of piping, piping components, tanks, and tanks within the scope of AMP XI.M29; and buried piping, piping components and tanks.

**D) New title for AMP XI.M29**

The changes incorporated into the GALL Report and SRP-LR by LR-ISG-2012-02 revised the scope of AMP XI.M29 to include indoor large volume storage tanks that are designed to internal pressures approximating atmospheric pressure and exposed internally to water.

During the development of LR-ISG-2012-02, the staff recognized that the existing title of AMP XI.M29 did not adequately describe the scope of the program. However, changing the title at that time would have resulted in numerous editorial changes to the GALL Report and SRP-LR. With the limited number of plants remaining to submit license renewal applications for the first period of extended operation, the staff decided to defer changing the title until issuance of the SLR documents. The title of AMP XI.M29 will be changed to “Outdoor and Large Atmospheric Metallic Storage Tanks.” The changes to the GALL-SLR Report and SRP-SLR will be incorporated with the final issuance of these documents.

**E) Issuance of LR-ISG-2015-01**

AMP XI.M41, “Buried and Underground Piping and Tanks,” was recently revised by LR-ISG-2015-01, which was issued as final on February 4, 2016. The changes to AMP XI.M41 identified in LR-ISG-2015-01 will be incorporated into the GALL-SLR Report as-is.

**F) Minor technical and editorial changes to AMR line items and AMPs**

The staff conducted a review of the draft NUREG-2191 and draft NUREG-2192 subsequent to the compilation of all the proposed changes. This review continued past the date when changes were locked down in order to proceed through final concurrence reviews and technical editing. The staff developed several minor technical and editorial changes as a result of this review. Most of these changes are documented in Appendix F, “Minor Technical and Editorial Changes to AMR Line Items and AMPs.” A few changes are documented in Appendix A, “Markup Showing Changes to the SRP-SLR,” because the changes resulted in addition of new SRP-SLR AMR line items versus a change to an as-published AMR line item. These changes include addition of line items to address:

i) Loss of material due to wear for seals, piping, and piping components in the Engineered Safety Features and Steam and Power Conversion systems.

ii) Loss of material due to wear for polyvinyl chloride (PVC) piping, piping components, and tanks exposed to soil in the Steam and Power Conversion systems.

iii) The fact that there are no aging effects requiring management and no recommended AMPs associated with PVC piping, piping components, and tanks exposed to concrete in the Steam and Power Conversion systems.

iv) The fact that there are no aging effects requiring management and no recommended AMP associated with aluminum piping and piping components exposed to air with borated water leakage.

**G) Response to certain initial feedback from the industry as presented at a public meeting on January 21, 2016**

On January 21, 2016, the staff conducted a public meeting to discuss significant changes as published in draft NUREG-2191 and NUREG-2192. During this meeting, NEI provided the staff with initial feedback. The staff agreed with some of the feedback and needed no further details from the industry to incorporate changes into the draft documents. The staff addressed these feedback items as follows. The staff is waiting for final comments on the draft documents to address the remainder of the feedback provided at the meeting.

i) NEI feedback: Table XI.M27-1, the column for NFPA-25 sections includes sections that address the calibration of gauges used during flow testing. A footnote should be added to explain that gauges and their calibration are not part of this AMP.

The staff agrees with this feedback. Calibration of gauges is conducted by plant-specific programs. Calibration of measuring and test equipment is not addressed in the program elements in the GALL-SLR Report AMPs. The staff added a new note to Table XI.M27-1, "Fire Water System Inspection and Testing Recommendations," to address this change. See Appendix E, "Markup Showing Changes to GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components."

ii) NEI feedback: Inspections described in NFPA-25 as "annual" should be described in this AMP as "every refueling cycle" based on LRAs that have taken exception to this.

The staff agrees with this feedback. NFPA 25 was written for a broad range of facilities, including those with a limited number of fire water system components (e.g., a small manufacturing facility with only a dozen sprinklers) and those with numerous sprinklers (as is typical for power plants). The staff has approved exceptions for the interval of sprinkler inspections for virtually all of the applicant's programs that have been reviewed since the issuance of LR-ISG-2012-02. The staff based its acceptance on: (a) a sufficient number of sprinklers installed in commercial nuclear power plants to establish an adverse performance trend; and (b) plant-specific OE that demonstrates that no loss of intended function has occurred due to the longer interval between inspections. As a result, the staff revised all the Table XI.M27-1 tests or inspections that are recommended to be conducted annually to add a footnote that states that the tests or inspections can be conducted on a refueling outage interval if plant-specific OE has shown no loss of intended function of the in-scope system, structure or component (SSC). See Appendix E.

iii) NEI feedback: Element 4b, delete last sentence "When fouling is identified deposits are removed…"

The staff agrees with this feedback. It is likely that there will be many fixed deposits in fire water systems after years of service. This is particularly the case with fire water systems that use raw water versus treated water. Loose deposits are a concern because of their potential to clog small openings (e.g., sprinkler heads, nozzles). Although fixed deposits create additional pressure drops, condition monitoring tests (e.g., underground and exposed piping flow tests, main drain tests) are capable of trending performance in this regard. The sentence was deleted. However, deposits can provide evidence that the base material of the piping, piping component, heat exchanger, or tank is experiencing loss of material. The staff added a recommendation to the corrective actions program element that an evaluation be conducted to determine if deposits need to be removed to determine if loss of material has occurred. This allows the engineering organization to make the appropriate determination on the need to remove deposits. See Appendix E.

iv) NEI feedback: Element 6, Acceptance Criteria, Section c) states "no fouling exists". This is overly stringent. Our view is that the acceptance criteria provided in 6.a) "the water-based fire protection system is able to maintain required pressure and flow rates" should be adequate and 6.c) should be deleted.

The staff agrees with this feedback in part. See the above section for a discussion on why "no fouling exists" is overly stringent. However, evidence of loose particles in the system should be corrected. See U.S. Nuclear Regulatory Commission (NRC) Information Notice (IN) 2013-06, "Corrosion in Fire Protection Piping Due to Air and Water Interaction" (ADAMS Accession No. ML13031A618). The staff revised the recommendation accordingly. See Appendix E.

v) NEI feedback: Recommend deleting long term loss of material aging effect. It would be difficult to satisfy the XI.M32 element 1 (M32-1 line 24) recommendation for representative samples conducted every 5 years up to at least the 50th year of operation. In addition, aging effects for raw water and waste water environments are more effectively managed by other AMPs.

The staff agrees with this feedback in part. As shown in Appendix E, the staff has revised the recommendation to state that one representative sample (in lieu of periodic samples) conducted between the $50^{th}$ year and $60^{th}$ year of operation is sufficient to satisfy the recommendation in AMP XI.M32. See Appendix E. Although the aging effects associated with raw water systems and waste water systems are managed by other programs (e.g., AMP XI.M20, "Open-Cycle Cooling Water System," AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"), neither of these programs recommend that a representative volumetric wall thickness examination be conducted. AMP XI.M20 states that qualitative inspections are conducted for loss of material and volumetric wall thickness examinations are only conducted as a followup. AMP XI.M38 states that visual inspections are conducted to detect surface condition or wall thickness measurements are taken. The recommendation could be met by conducting only visual examinations. It is the staff's intent that after 50 to 60 years of operation, wall thickness measurements should be conducted to confirm that the original design requirements are still satisfied.

vi) NEI feedback: Clarify element 4 (M33-3 line 42) to read: "Dependent on plant-specific operating experience and implementation of preventive actions, the exclusions for external surface coatings of buried components may no longer apply and the inspection population is adjusted as follows:"

The staff agrees with this feedback. The revised wording more clearly represents the staff's intent. See Appendix E.

vii) NEI feedback: XI.M42, Element 4, page XI.M42-3, Line 8, see suggested markup below: <u>If a baseline has not been previously established,</u> baseline coating/lining inspections occur in the 10-year period prior to the subsequent period of extended operation. Subsequent inspections are based on an evaluation of the effect of a coating/lining failure on the in-scope component's intended function, potential problems identified during prior inspections, and known service life history.

The staff agrees with this feedback with one minor change. The baseline inspections should be conducted between the $50^{th}$ and $60^{th}$ year of operation to provide an effective baseline for entering a subsequent period of extended operation. See Appendix E.

viii) NEI feedback: Delete AMR lines for loss of material for causes other than selective leaching for gray cast iron in various environments. The lines are redundant to steel AMR lines in the same environments that are managed by the same AMPs

The staff agrees with this feedback. Loss of material due to general, pitting, or crevice corrosion, or MIC (raw water, waste water, and treated water environments only) would be managed for gray cast iron components in conjunction with steel components. AMR line items 3.3.1-164 and 3.3.1-165 will be deleted. See Appendix E.

**ACTIONS**

The staff is issuing these proposed changes for public comment. The staff's changes as a result of public comments will be published in the issuance of final NUREG-2191 and

NUREG-2192. The response to public comments will be incorporated with those issued as a result of the public comments on the draft NUREG-2191 and draft NUREG-2192.

**NEWLY IDENTIFIED SYSTEMS, STRUCTURES, AND COMPONENTS UNDER 10 CFR 54.37(b)**

The NRC is not proposing to treat the revised recommendations for these aging effects as "newly identified" SSCs under 10 CFR 54.37(b).

**BACKFITTING AND ISSUE FINALITY**

This Supplement contains guidance on one acceptable approach for managing the associated aging effects during the period of extended operation (PEO) for components within the scope of subsequent license renewal. The staff's discussion on compliance with the requirements of the Backfit Rule, 10 CFR 50.109 is presented below:

Compliance with the Backfit Rule and Issue Finality

Issuance of this supplement does not constitute backfitting as defined in 10 CFR 50.109(a)(1), and the NRC staff did not prepare a backfit analysis for issuing this Supplement. There are several rationales for this conclusion, depending on the status of the nuclear power plant licensee.

*Licensees currently in the subsequent license renewal process* – No applications for subsequent license renewal have been received to date.

*Licensees that already hold a renewed license* - This guidance, as proposed, is nonbinding and the Supplement would not require current holders of renewed licenses to take any action (i.e., programmatic or plant hardware changes for managing the associated aging effects for components within the scope of this Supplement). If the Supplement were finalized as written, then current holders of renewed licenses should treat this guidance as OE and take actions as appropriate to ensure that applicable aging management programs are, and will remain, effective. If, in the future, the NRC decides to take additional action and impose requirements for managing the associated aging effects for components within the scope of this Supplement, then the NRC would follow the requirements of the Backfit Rule.

*Current operating license or combined license holders that have not yet applied for subsequent license renewal* - The backfitting provisions in 10 CFR 50.109 do not protect any future applicant, as backfitting policy considerations are not applicable to a future applicant. Therefore, issuance of this Supplement does not constitute backfitting as defined in 10 CFR 50.109(a)(1). The issue finality provisions of 10 CFR Part 52 do not extend to the aging management matters covered by 10 CFR Part 54, as evidenced by the requirement in 10 CFR 52.107, "Application for Renewal," stating that applications for renewal of a combined license must be in accordance with 10 CFR Part 54.

**CONGRESSIONAL REVIEW ACT**

This Supplement is a rule as designated in the Congressional Review Act (Title 5 of the United States Code, Part I, Chapter 8 (5 USC, Sec. 801)). The changes described in this Supplement will be published in the issuance of the final NUREG-2191 and NUREG-2192. The Congressional Review Act review for the final NUREG-2191 and NUREG-2192 will determine whether the changes are a major rule as designated in the Congressional Review Act.

**APPENDICES**

Appendix A, Markup Showing Changes to the SRP-SLR Further Evaluation Sections

Appendix B, Markup Showing Changes to the SRP-SLR AMR Line Items and GALL-SLR Report Definitions

Appendix C, Markup Showing Changes to GALL-SLR Report AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks"

Appendix D, Markup Showing Changes to GALL-SLR Report AMP XI.M33, "Selective Leaching"

Appendix E, Markup Showing Changes to GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components

Appendix F, Minor Technical and Editorial Changes to AMR Line Items and AMPs

**Unless otherwise noted, substantive changes in Appendices A through F are shown as crossed out for deleted text and underlined for added text.**

**REFERENCES**

5 USC, Sec. 801, Congressional Review of Agency Rulemaking, Office of the Law Revision Counsel of the House of Representatives, 2012.

10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities, Office of the Federal Register, National Archives and Records Administration, 2013.

10 CFR Part 52, Licenses, Certifications, and Approvals for Nuclear Power Plants, Office of the Federal Register, National Archives and Records Administration, 2013.

10 CFR Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Office of the Federal Register, National Archives and Records Administration, 2013.

NEI 95-10, Industry Guidelines for Implementing The Requirements of 10 CFR 54 – The License Renewal Rule, Revision 6, ADAMS Accession No. ML051860406.

U.S. Nuclear Regulatory Commission. Regulatory Issue Summary (RIS) 2007-16, Revision 1, Implementation of the Requirements of 10 CFR 54.37(b) for Holders of Renewed Licenses.

U.S. Nuclear Regulatory Commission. Draft NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," Volumes I and II, December 2015.

U.S. Nuclear Regulatory Commission. Draft NUREG-2192, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants," December 2015.

## APPENDIX A

## MARK-UP SHOWING CHANGES TO THE SRP-SLR FURTHER EVALUATION SECTIONS

### 3.1.2.2.20 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel Alloys

Loss of material due to pitting and crevice corrosion could occur for indoor or outdoor SS piping, piping components, and tanks exposed any air environment when the component is: (a) uninsulated; (b) insulated; or (c) in the vicinity of insulated components. Loss of material due to pitting and crevice corrosion is known to occur in environments containing sufficient halides (e.g., chlorides) and in which moisture is possible.

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

The plant-specific OE and condition of SS components are evaluated to determine if the plant-specific air environments are aggressive enough to result in pitting and crevice corrosion after prolonged exposure. The aging effect of loss of material due to pitting and crevice corrosion in SS components is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of pitting or crevice corrosion; and (b) a one-time inspection demonstrates that the aging effect is not occurring or that loss of material due to pitting or crevice corrosion is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the LRA.

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

The GALL-SLR Report recommends the further evaluation of SS piping and piping components exposed to an air environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is an acceptable method to demonstrate that the aging effect of loss of material due to pitting and crevice corrosion is not occurring at a rate that affects the intended function of the components. If loss of material due to pitting or crevice corrosion has occurred and is sufficient to potentially affect the intended function of a SS SSC, GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components” is an acceptable method to manage loss of material due to pitting or crevice corrosion.

The applicant may establish that loss of material due to pitting and crevice corrosion is not expected to occur by demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier coating. An acceptable barrier includes coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

## APPENDIX A

## MARK-UP SHOWING CHANGES TO THE SRP-SLR FURTHER EVALUATION SECTIONS

### 3.2.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel Alloys

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

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

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

The plant-specific OE and condition of SS components are evaluated to determine if the plant-specific air environments are aggressive enough to result in pitting and crevice corrosion after prolonged exposure. The aging effect of loss of material due to pitting and crevice corrosion in SS components is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of pitting or crevice corrosion and (b) a one-time inspection demonstrates that the aging effect is not occurring or that loss of material due to pitting or crevice corrosion is occurring so slowly that it will not affect the intended function of the components during the subsequent period of extended operation. The applicant documents the results of the plant-specific OE review in the LRA.

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

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

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

- For outdoor uninsulated components, describing the outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected.
- For underground components, the applicant may demonstrate that loss of material due to pitting or crevice corrosion due to exposure to in-leakage to the vault as a result of external precipitation or groundwater is not expected.
- For insulated components, determining that the insulation does not contain sufficient contaminants to cause loss of material due to pitting or crevice corrosion. One acceptable means to demonstrate this is provided by Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel."
- For indoor components, determining that there are no liquid-filled systems with threaded or bolted connections (e.g., flanges, valve packing) that could leak onto the component.

Ffor all components, by demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier coatingto prevent loss of material due to pitting or crevice corrosion. An acceptable barrier includes coatings that have been demonstrated to be impermeable to aqueous solutions and atmospheric air that contain halides. If a barrier coating is credited for isolating a component from a potentially aggressive environment, then the barrier coating is evaluated to verify that it is impervious to the plant-specific environment. GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks," is an acceptable method to manage the integrity of a barrier coating for internal or external coatings.

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

3.2.2.2.5 **Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys**

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

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

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

The plant-specific OE and condition of SS components are evaluated to determine if the plant-specific air environment is aggressive enough to result in SCC after prolonged exposure. The aging effect of SCC in SS components is not applicable and does not require management if: (a) the plant-specific OE does not reveal a history of SCC and (b) a one-time inspection demonstrates that the aging effect is not occurring.

The internal surfaces of SS components do not need to be inspected if: (a) the review of plant-specific OE does not reveal a history of SCC; and (b) inspection results for external surfaces demonstrate that the aging effect is not applicable. Inspection results associated with the periodic introduction of either moisture or halides from secondary sources may be treated as a separate population of components. In the environment of air-indoor controlled, SCC is only expected to occur as the result of secondary source of moisture or halides. Inspections focus on the most susceptible locations. The applicant documents the results of the plant-specific OE review in the LRA.

The GALL-SLR Report recommends the further evaluation of SS piping, piping components, and tanks exposed to an air environment to determine whether an AMP is needed to manage the aging effect of SCC. GALL-SLR Report AMP XI.M32, “One-Time Inspection,” is an acceptable method to demonstrate that the aging effect of SCC is not occurring. If SCC is applicable, the following AMPs are acceptable methods to manage loss of material due to SCC: (a) GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” for tanks; (b) GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” for external surfaces of piping and piping components; (c) GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” for underground piping, piping components and tanks; and (d) GALL-SLR Report Chapter XI.M38, “nspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” for internal surfaces of components that are not included in other AMPs.

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

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

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

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

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

Cracking due to SCC and intergranular stress corrosion cracking (IGSCC) could occur in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches nominal pipe size (NPS)~~; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs~~ that are exposed to ~~reactor coolant~~ treated water >60°C (>140°F). The GALL-SLR Report recommends GALL-SLR Report AMP XI.M2, "Water Chemistry," to mitigate SCC and IGSCC and augmented inspection activities in accordance with GALL-SLR Report AMP XI.M7, "BWR Stress Corrosion Cracking," for condition monitoring. However, these programs may need to be augmented to manage the effects of cracking in dead-legs and other piping locations with stagnant flow where localized environmental conditions could exacerbate the mechanisms of SCC and IGSCC. The GALL-SLR Report recommends further evaluation to identify any such locations and to evaluate the adequacy of the applicant's proposed AMPs on a case-by-case basis to ensure that the intended functions of components in these locations will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

### 3.2.2.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

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

~~The susceptibility of the material is to be established prior to evaluating the environment.~~ This further evaluation item is applicable unless it is demonstrated by the applicant that one of the two necessary conditions discussed below is absent.

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

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

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

Aggressive Environment [this paragraph was editorially placed in front of the following paragraph]: If the environment that an aluminum alloy is exposed to is not aggressive, such as dry gas~~, controlled indoor air,~~ or treated water, then cracking due to SCC will not occur and the aging effect is not applicable. Aggressive environments that are known to result in cracking of susceptible aluminum alloys due to SCC are aqueous solutions and atmospheric air that contain halides (e.g., chloride). Halide concentrations should generally be considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and atmospheric air, such as outdoor air, raw water, waste water, and condensation, unless demonstrated otherwise. Additionally, in a controlled or uncontrolled indoor air environment, sufficient halide concentrations to cause SCC could be present due to leakage from nearby components (e.g., leakage from insulated flanged connections or valve packing). If an aluminum component is encapsulated in a secondary material, such as insulation or concrete, the composition of the encapsulating material is evaluated for halides. The environment that the aluminum alloy is exposed to is evaluated to verify that it is either controlled or treated and free of halides.

GALL-SLR Report AMP XI.M29, “Outdoor and Large Atmospheric Metallic Storage Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in tanks. GALL-SLR Report AMP XI.M36, “External Surfaces Monitoring of Mechanical Components,” is an acceptable method to manage cracking of aluminum due to SCC in piping and piping components. GALL-SLR Report AMP XI.M41, “Buried and Underground Piping and Tanks,” is an acceptable method to manage cracking of aluminum due to SCC in piping and tanks which are buried or underground. GALL-SLR Report AMP XI.M38, “Inspection of Internal Surfaces in

Miscellaneous Piping and Ducting Components" is an acceptable method to manage cracking of aluminum due to SCC in components that are not included in other AMPs. ~~Additional acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR)~~.

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

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

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

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

The GALL-SLR Report recommends the further evaluation of aluminum piping, piping components, and tanks exposed to an air environment to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion. GALL-SLR

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

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

### 3.1.3.2.20 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel Alloys

The GALL-SLR Report recommends further evaluation to manage loss of material due to pitting and crevice corrosion of SS piping and piping components exposed to any air environment when the component is: (a) uninsulated; (b) insulated; or (c) in the vicinity of insulated components where the presence of sufficient halides (e.g., chlorides) and moisture is possible.

The reviewer independently verifies the sufficiency of the applicant’s evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in stainless steel alloys, the reviewer determines whether an adequate program is credited to manage the aging effect. If there is no related plant-specific OE, the reviewer verifies that AMP XI.M32, “One-Time Inspection,” is cited for all applicable AMR line items.

An applicant may refine its OE search, and subsequent one-time inspections, by binning plant-specific environments into subcategories. For example, the applicant could categorize the indoor air locations as those where leakage could impinge on the SS component’s surface (e.g., leakage from mechanical connections) and those where there is not potential for leakage. When the applicant chooses to conduct its OE search in this manner, the reviewer is to also confirm that the applicant has adequately addressed the potential for the periodic introduction of either moisture or halides from secondary sources. Secondary sources of moisture or halides should be considered for all air environments including indoor conditioned air. Typical secondary sources of moisture or halides include: leakage from mechanical connections, leakage into vaults, and insulation containing halides. Grouping of air environments consistent with that described in the detection of aging effects program element of GALL-SLR AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components,” is appropriate.

### 3.2.3.2.2 Loss of Material Due to Pitting and Crevice Corrosion in Stainless Steel Alloys

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

~~If the applicant claims that neither the environment nor composition of the insulation will result in loss of material due to pitting and crevice corrosion, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks.~~ The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals loss of material due to pitting or crevice corrosion in stainless steel alloys, the reviewer ~~If the applicant elects to manage loss of material due to pitting or crevice corrosion, the reviewer should~~ determines whether an adequate program is credited to manage the aging effect. ~~based on the applicable environmental conditions.~~ If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

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

### 3.2.3.2.5 Cracking Due to Stress Corrosion Cracking in Stainless Steel Alloys

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

~~If the applicant claims that neither the environment nor composition of insulation will result in stress corrosion cracking, the reviewer should evaluate the applicant's data to verify that sufficient halides will not be present on the surface of the SS piping, piping components, or tanks.~~ The reviewer independently verifies the sufficiency of the applicant's evaluation of plant-specific OE. If the review of plant-specific OE reveals SCC in stainless steel alloys, the reviewer ~~If the applicant elects to manage stress corrosion cracking, the reviewer should~~ determines whether an adequate program is credited to manage the aging effect ~~based on the~~

~~applicable environmental conditions~~. If the review of plant-specific OE reveals that SCC is not applicable, the reviewer verifies that AMP XI.M32, "One-Time Inspection," is cited for all applicable AMR line items.

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

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

The GALL-SLR Report recommends review of plant-specific AMPs for managing cracking due to SCC and IGSCC in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches NPS~~; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs~~ that are exposed to ~~reactor coolant~~ treated water >60°C (>140°F). Components in dead-legs and other piping locations with stagnant flow may be subject to localized environmental conditions that could exacerbate the mechanisms of SCC and IGSCC. The reviewer ensures that the applicant has identified any such locations and provided justification for the AMPs credited for managing this aging effect. The reviewer reviews the applicant's justification and proposed AMPs on a case-by-case basis to ensure that the effects of aging will be adequately managed.

### 3.2.3.2.10 Cracking Due to Stress Corrosion Cracking in Aluminum Alloys

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

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

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

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

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

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

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

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

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

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

The GALL-SLR Report recommends a further evaluation to determine whether an AMP is needed to manage the aging effect of loss of material due to pitting and crevice corrosion of aluminum piping, piping components, and tanks exposed to an air ~~environment~~or non-treated water environment. ~~If the applicant claims that a search of 10 years of plant-specific did not reveal any instances of loss of material due to pitting and crevice corrosion exposed to air environments, the staff conducts an independent review of plant-specific OEoperating experience during the AMP audit.~~ The reviewer is to verify that the applicant's evaluation of its plant-specific OE includes the most recent ten years of operation for all air and non-treated water environments. The reviewer is to conduct an independent assessment of plant-specific OE during the AMP audit to confirm that the applicant's evaluation of its OE is adequate.

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

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

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

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

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

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**The identical changes will be implemented for the following SRP-SLR Sections**

| Stainless Steel | | Aluminum | |
|---|---|---|---|
| **Loss of Material Due to Pitting and Crevice Corrosion** | **Cracking Due to Stress Corrosion Cracking** | **Loss of Material Due to Pitting and Crevice Corrosion** | **Cracking Due to Stress Corrosion Cracking** |
| 3.3.2.2.4 | 3.3.2.2.3 | 3.3.2.2.13 | 3.3.2.2.10 |
| 3.3.3.2.4 | 3.3.3.2.3 | 3.3.3.2.13 | 3.3.3.2.10 |
| 3.4.2.2.3 | 3.4.2.2.2 | 3.4.2.2.10 | 3.4.2.2.7 |
| 3.4.3.2.3 | 3.4.3.2.2 | 3.4.3.2.10 | 3.4.3.2.7 |

*3.3.2.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking*

Cracking due to SCC and ~~intergranular stress corrosion cracking (~~IGSCC~~)~~ could occur in BWR SS and nickel alloy piping, piping components greater than or equal to 4 inches NPS ~~nominal pipe size; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs~~ that are exposed to ~~reactor coolant~~ treated water >60°C (>140°F). The GALL-SLR Report recommends GALL-SLR Report AMP XI.M2, "Water Chemistry," to mitigate

SCC and IGSCC and augmented inspection activities in accordance with GALL-SLR Report AMP XI.M7, "BWR Stress Corrosion Cracking," for condition monitoring. However, these programs may need to be augmented to manage the effects of cracking in dead-legs and other piping locations with stagnant flow where localized environmental conditions could exacerbate the mechanisms of SCC and IGSCC. The GALL-SLR Report recommends further evaluation to identify any such locations and to evaluate the adequacy of the applicant's proposed AMPs on a case-by-case basis to ensure that the intended functions of components in these locations will be maintained during the subsequent period of extended operation. Acceptance criteria are described in BTP RLSB-1 (Appendix A.1 of this SRP-SLR Report).

*3.3.3.2.9 Cracking Due to Stress Corrosion Cracking and Intergranular Stress Corrosion Cracking*

The GALL-SLR Report recommends review of plant-specific AMPs for managing cracking due to SCC and IGSCC in BWR SS and nickel alloy piping and piping components greater than or equal to 4 inches NPS ~~nominal pipe size; nozzle safe ends and associated welds; and control rod drive return line nozzle caps and the associated cap-to-nozzle welds or cap-to-safe end welds in BWR-3, BWR-4, BWR-5, and BWR-6 designs~~ that are exposed to ~~reactor coolant~~ treated water >60°C (>140°F). Components in dead-legs and other piping locations with stagnant flow may be subject to localized environmental conditions that could exacerbate the mechanisms of SCC and IGSCC. The reviewer ensures that the applicant has identified any such locations and provided justification for the AMPs credited for managing this aging effect. The reviewer reviews the applicant's justification and proposed AMPs on a case-by-case basis to ensure that the effects of aging will be adequately managed.

# APPENDIX B

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

**AMR line item changes are only shown as modified or new draft SRP-SLR Table 1 entries. Subsequent to issuance of the final NUREG-2191 Volume I and final NUREG-2192, the changes will be incorporated into revised GALL-SLR Tables and Table 1s in the SRP-SLR.**

# APPENDIX B

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 122 | BWR/PWR | Steel, ~~stainless steel,~~nickel alloy, copper alloy Non-ASME Code Class 1 piping, piping components exposed to air – indoor, condensation | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical" | No | IV.C1.R-429<br>IV.C2.R-429 |
| N | 124 | BWR/PWR | Steel, ~~stainless steel,~~nickel alloy, copper alloy piping, piping components exposed to condensation | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical" | No | IV.C1.R-431<br>IV.C2.R-431 |
| N | NNN | BWR/PWR | Stainless steel Non-ASME Code Class 1 piping, piping components exposed to any air environment (except air-dry internal), condensation | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.1.2.2.20) | IV.C1.R-NNN<br>IV.C2.R-NNN |
| N | NNN | BWR/PWR | Stainless steel piping, piping components exposed to any air environment (except air-dry internal), condensation | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.1.2.2.20) | IV.C1.R-NNN<br>IV.C2.R-NNN |

# APPENDIX B

# MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 4 | BWR/PWR | Stainless steel piping, piping components exposed to any air environment (except air-dry internal), condensation—outdoor | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.2) | V.B.EP-107<br>V.C.EP-107<br>V.D1.EP-107<br>V.D2.EP-107 |
| | 7 | BWR/PWR | Stainless steel piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation (internal/external)– outdoor | Cracking due to stress corrosion cracking SCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.5) | V.B.EP-103<br>V.C.EP-103<br>V.D1.EP-103<br>V.D2.EP-103 |
| M | 36 | PWR | Gray cast iron, ductile iron piping, piping components exposed to closed-cycle cooling water, treated water | Loss of material due to selective leaching | AMP XI.M33, “Selective Leaching” | No | V.D1.EP-52 |
| M | 37 | BWR/PWR | Gray cast iron, ductile iron piping, piping components exposed to soil, ground water | Loss of material due to selective leaching | AMP XI.M33, "Selective Leaching" | No | V.B.EP-54<br>V.D1.EP-54<br>V.D2.EP-54 |
| M | 42 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation – outdoor(external) | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | No Yes (SRP-SLR Section 3.2.2.2.13) | V.E.EP-114 |
| M | 48 | BWR/PWR | Stainless steel piping, piping components (internal surfaces), tanks exposed to any air environment (except air-dry internal), condensation (internal) | Loss of material due to pitting, crevice corrosion | AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” Plant-specific aging management program | No Yes (SRP-SLR Section 3.2.2.2.2) | V.A.EP-81<br>V.D1.EP-81<br>V.D2.EP-61 |

## APPENDIX B

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 53 | BWR/PWR | Stainless steel, nickel alloy piping, piping components, tanks exposed to soil, concrete | Loss of material due to pitting, crevice corrosion, MIC (soil environment only) | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | V.D1.EP-72<br>V.D2.EP-72 |
| M | 54 | BWR | Stainless steel, nickel alloy piping, piping components greater than or equal to 4 NPS exposed to treated water >60°C (>140°F) | Cracking due to stress corrosion crackingSCC, intergranular stress corrosion cracking IGSCC | AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry" | Yes (SRP-SLR Section 3.2.2.2.9) | V.D2.E-37 |
| M | 56 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation – indoor uncontrolled (internal) | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.13) | V.F.EP-3 |
| M | 63 | BWR/PWR | Stainless steel piping, piping components exposed to air – indoor uncontrolled (external),air with borated water leakage, gas, air – indoor uncontrolled (internal) | None | None | No | V.F.EP-18<br>V.F.EP-19<br>V.F.EP-22<br>V.F.EP-82 |
| M | 67 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, ground water, concrete | Cracking due to stress corrosion crackingSCC | AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks" | No | V.D1.E-405<br>V.D2.E-405 |

**APPENDIX B**

**MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS**

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 103 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to ~~air – outdoor, air – indoor uncontrolled, air – indoor controlled, moist air,~~ any air environment (except air-dry internal), condensation | Cracking due to ~~stress corrosion cracking~~SCC | Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.5) | V.D1.E-446<br>V.D2.E-446 |
| M | 69 | BWR/PWR | Insulated steel, copper alloy, ~~aluminum~~piping, piping components, tanks exposed to condensation, air – outdoor | Loss of material due to general~~steel, copper alloy only)~~, pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | V.E.E-403 |
| N | NN | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment, condensation | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.13) | V.E.E-403 |
| M | 74 | BWR/PWR | Gray cast iron, ductile iron piping, piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, or treated water | Loss of material due to selective leaching | AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks" | No | V.A.E-415<br>V.B.E-415<br>V.C.E-415<br>V.D1.E-415<br>V.D2.E-415 |
| N | 80 | BWR/PWR | Stainless steel underground piping, piping components, tanks exposed to any air environment, raw water, condensation, ground water | Cracking due to ~~stress corrosion cracking~~SCC | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.5) | V.B.E-423<br>V.C.E-423<br>V.D1.E-423<br>V.D2.E-423 |

## APPENDIX B

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 89 | BWR/PWR | Steel, ~~stainless steel~~nickel alloy, copper alloy, ~~aluminum~~ piping, piping components exposed to condensation | Loss of material due to general ~~(steel, copper alloy only)~~, pitting, crevice corrosion | AMP XI.M36, “External Surfaces Monitoring of Mechanical Components” | No | V.E.E-433 |
| N | 99 | BWR/PWR | Stainless steel tanks exposed to any air environment~~– outdoor~~, condensation | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M29, "Aboveground Metallic Tanks"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.2) | V.E.E-442 |
| N | 100 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal) ~~– outdoor~~, raw water, waste water, condensation (internal) | Cracking due to ~~stress corrosion cracking~~SCC | ~~AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.10) | V.A.E-443<br>V.B.E-443<br>V.D1.E-443<br>V.D2.E-443 |
| N | 101 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal)~~– outdoor~~, raw water, waste water, condensation (external) | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M36, "External Surfaces monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.10) | V.E.E-444 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 102 | BWR/PWR | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to the following external environments: soil, ground water, concrete, any air environment, – outdoor, air – indoor uncontrolled, air – indoor controlled, condensation, raw water, waste water | Cracking due to stress corrosion crackingSCC | AMP XI.M29, "Aboveground Metallic Tanks" Plant-specific aging management program | Yes (SRP Section 3.2.2.2.10) | V.D1.E-445<br>V.D2.E-445 |
| N | 105 | BWR/PWR | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment, condensation (internal/external) | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.13) | V.D1.E-448<br>V.D2.E-448 |
| N | 106 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment – indoor uncontrolled, moist air, condensation, air – outdoor (internal/external) | Loss of material due to pitting, crevice corrosion | AMP XI.M29, "Aboveground Metallic Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.2) | V.D1.E-449<br>V.D2.E-449 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 107 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.2) | V.E.E-450 |
| N | 108 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, condensation, air – outdoor | Cracking due to stress corrosion crackingSCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.5) | V.E.E-451 |
| N | 109 | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment, condensation, air – outdoor | Cracking due to stress corrosion crackingSCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.10) | V.E.E-452 |
| N | 110 | BWR/PWR | Aluminum underground piping, piping components, tanks exposed to any air environment – outdoor, raw water, condensation, ground water | Cracking due to stress corrosion crackingSCC | AMP XI.M41, "Buried and Underground Piping and Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.10) | V.B.E-453<br>V.C.E-453<br>V.D1.E-453<br>V.D2.E-453 |
| N | 111 | BWR/PWR | Aluminum underground piping, piping components, tanks exposed to any air (external) environment, raw water, condensation, ground water | Loss of material due to pitting, crevice corrosion | AMP XI.M41, "Buried and Underground Piping and Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.13) | V.E.E-454 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 112 | BWR/PWR | Stainless steel underground piping, piping components, tanks exposed to any air environment, raw water, condensation, ground water | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~<br>Plant-specific aging management program | ~~No~~ Yes (SR-SLR Section 3.2.2.2.2) | V.E.E-455 |
| ~~N~~ | ~~113~~ | ~~BWR/PWR~~ | ~~Stainless steel underground piping, piping components exposed to air – indoor uncontrolled, condensation, air – outdoor~~ | ~~Loss of material due to pitting, crevice corrosion~~ | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~ | ~~Yes (SRP-SLR Section 3.2.2.2.2)~~ | ~~V.E.E-456~~ |
| N | NN | BWR | Stainless steel, nickel alloy piping, piping components less than 4 NPS exposed to treated water >60°C (>140°F) | Cracking due to SCC, ~~intergranular stress corrosion cracking~~ IGSCC | AMP XI.M2, "Water Chemistry" and XI.M32, "One-Time Inspection" | No | V.B.E-NN<br>V.C.E-NN<br>V.D2.E-NN |
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to soil, concrete | Loss of material due to pitting, crevice corrosion | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | V.E.E-NNN |
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to raw water, waste water | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.2.2.2.13) | V.E.E-NNN |
| N | NN | BWR/PWR | Elastomer seals, piping, piping components exposed to air (external) | Loss of material due to wear | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | V.E.E-NNN |
| N | NN | BWR/PWR | Elastomer seals, piping, piping components exposed to air (internal) | Loss of material due to wear | AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" | No | V.A.E-NNN<br>V.B.E-NNN<br>V.C.E-NNN<br>V.D1.E-NNN<br>V.D2.E-NNN |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

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

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to air with borated water leakage | None | None | No | V.F.E-NNN |

# MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 4 | BWR/PWR | Stainless steel piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation air – outdoor (internal/external) | Cracking due to stress corrosion cracking SCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.3) | VII.C1.AP-209<br>VII.C2.AP-209<br>VII.C3.AP-209<br>VII.D.AP-209<br>VII.E1.AP-209<br>VII.E4.AP-209<br>VII.F1.AP-209<br>VII.F2.AP-209<br>VII.F4.AP-209<br>VII.G.AP-209<br>VII.H1.AP-209<br>VII.H2.AP-209 |
| M | 6 | BWR/PWR | Stainless steel piping, piping components exposed to any air environment (except air-dry internal), condensation outdoor(internal/external) | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.C1.AP-221<br>VII.C2.AP-221<br>VII.C3.AP-221<br>VII.D.AP-221<br>VII.E1.AP-221<br>VII.E4.AP-221<br>VII.F1.AP-221<br>VII.F2.AP-221<br>VII.F4.AP-221<br>VII.G.AP-221<br>VII.H1.AP-221<br>VII.H2.AP-221 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 16 | BWR | Stainless steel piping, piping components, outboard the second containment isolation valves with a diameter ≥4 inches nominal pipe size exposed to treated water > 9360°C (> 140200°F) | Cracking due to stress corrosion cracking, intergranular stress corrosion cracking | AMP XI.M2, "Water Chemistry," and AMP XI.M25, "BWR Reactor Water Cleanup System" | No | VII.E3.AP-283 |
| M | 72 | BWR/PWR | Gray cast iron, ductile iron, copper alloy (>15% Zn or >8% Al) piping, piping components, heat | Loss of material due to selective leaching | AMP XI.M33, “Selective Leaching” | No | VII.A3.AP-31<br>VII.A3.AP-43<br>VII.A4.AP-31<br>VII.A4.AP-32 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| | | | exchanger components exposed to treated water, closed-cycle cooling water, soil, raw water, waste water, ground water | | | VII.F1.AP-31<br>VII.F1.AP-43<br>VII.F1.AP-65<br>VII.F2.AP-31<br>VII.F2.AP-43<br>VII.F3.A-50<br>VII.F3.AP-43<br>VII.F3.AP-65<br>VII.F4.AP-31<br>VII.F4.AP-43<br>VII.G.A-02<br>VII.G.A-47<br>VII.G.A-51<br>VII.G.AP-31<br>VII.H1.A-02<br>VII.H1.AP-43<br>VII.H2.A-02<br>VII.H2.A-47<br>VII.H2.A-51<br>VII.H2.AP-43 | VII.A4.AP-43<br>VII.C1.A-02<br>VII.C1.A-47<br>VII.C1.A-51<br>VII.C1.A-66<br>VII.C2.A-50<br>VII.C2.AP-31<br>VII.C2.AP-32<br>VII.C2.AP-43<br>VII.C3.A-02<br>VII.C3.A-47<br>VII.C3.A-51<br>VII.E1.AP-31<br>VII.E1.AP-43<br>VII.E1.AP-65<br>VII.E3.AP-31<br>VII.E3.AP-32<br>VII.E3.AP-43<br>VII.E4.AP-31<br>VII.E4.AP-32<br>VII.E4.AP-43<br>VII.E5.A-547<br>VII.E5.A-724 |
| M | 81 | BWR/PWR | Copper alloy~~, aluminum~~ piping, piping components, and piping elements exposed to air – outdoor (external), air – outdoor | Loss of material due to general~~(copper alloy only)~~ pitting, crevice corrosion | AMP XI.M36, “External Surfaces Monitoring of Mechanical Components” | No | VII.I.AP-159<br>~~VII.I.AP-256~~ |

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| ~~M~~ | ~~92~~ | ~~BWR/PWR~~ | ~~Aluminum piping, piping components exposed to condensation (internal)~~ | ~~Loss of material due to pitting, crevice corrosion~~ | ~~AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"~~ | ~~No~~ | ~~VII.F1.AP-142~~<br>~~VII.F2.AP-142~~<br>~~VII.F3.AP-142~~<br>~~VII.F4.AP-142~~ |
| M | 94 | BWR/PWR | Stainless steel ducting and components exposed to condensation | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"~~ Plant-specific aging management program | ~~No~~ Yes (SRP-SLR Section 3.3.2.2.4) | VII.F1.AP-99<br>VII.F2.AP-99<br>VII.F3.AP-99 |
| M | 95 | BWR/PWR | Copper alloy, ~~stainless steel, aluminum,~~ nickel alloy, steel piping, piping components heat exchanger components, ~~piping, piping components,~~ tanks exposed to waste water, condensation (internal) | Loss of material due to general (steel and copper alloy only), pitting, crevice corrosion, MIC (steel, ~~stainless steel,~~ nickel alloy, and copper alloy in waste water environments only) | AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" | No | VII.E5.AP-272<br>~~VII.E5.AP-273~~<br>VII.E5.AP-274<br>~~VII.E5.AP-275~~<br>VII.E5.AP-276<br>~~VII.E5.AP-278~~<br>VII.E5.AP-279<br>VII.E5.AP-280 |
| N | NNN | BWR/PWR | Aluminum heat exchanger components exposed to waste water, condensation | Loss of material due to pitting and crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.E5.A-NNN |
| N | NNN | BWR/PWR | Stainless steel heat exchanger components exposed to condensation | Loss of material due to pitting and crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.E5.A-NNN |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 96.4 | BWR/PWR | Steel, ~~aluminum ,~~copper alloy, ~~stainless steel~~heat exchanger components exposed to condensation (for components not covered by NRC GL 89-13) | Loss of material due to general ~~(steel and copper alloy only)~~, pitting, crevice corrosion; fouling that leads to corrosion | AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” | No | VII.C1.A-417<br>~~VII.C1.A-418~~<br>VII.F1.A-417<br>~~VII.F1.A-418~~<br>VII.F2.A-417<br>~~VII.F2.A-418~~<br>VII.F3.A-417<br>~~VII.F3.A-418~~<br>VII.F4.A-417<br>~~VII.F4.A-418~~ |
| N | NNN | BWR/PWR | Aluminum heat exchanger components exposed to condensation (for components not covered by NRC GL 89-13) | Loss of material due to pitting, crevice corrosion; fouling that leads to corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.C1.A-NNN<br>VII.F1.A-NNN<br>VII.F2.A-NNN<br>VII.F3.A-NNN<br>VII.F4.A-NNN |
| N | NNN | BWR/PWR | Stainless steel heat exchanger components exposed to condensation (for components not covered by NRC GL 89-13) | Loss of material due to pitting, crevice corrosion; fouling that leads to corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.C1.A-NNN<br>VII.F1.A-NNN<br>VII.F2.A-NNN<br>VII.F3.A-NNN<br>VII.F4.A-NNN |
| M | 108 | BWR/PWR | Titanium, super austenitic, aluminum, copper alloy, stainless steel, nickel alloy piping, piping components, tanks, bolting exposed to soil, concrete | Loss of material due to pitting, crevice corrosion, MIC (soil environment only) | AMP XI.M41, “Buried and Underground Piping and Tanks” | No | VII.C1.AP-171<br>VII.C1.AP-172<br>VII.C1.AP-173<br>VII.C1.AP-174<br>VII.I.AP-243 |

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 109a | BWR/PWR | Copper alloy, ~~stainless steel,~~nickel alloy, steel underground piping, piping components exposed to air – indoor uncontrolled, condensation, air – outdoor (external) | Loss of material due to general (copper alloy, steel only), pitting, crevice corrosion | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | VII.I.AP-284 |
| M | 110 | BWR | Stainless steel, nickel alloy piping, piping components greater than or equal to 4 NPS exposed to treated water >60°C (>140°F) | Cracking due to ~~stress corrosion cracking~~ SCC, ~~intergranular stress corrosion cracking~~ IGSCC | AMP XI.M7, "BWR Stress Corrosion Cracking," and AMP XI.M2, "Water Chemistry" | Yes (SRP-SLR Section 3.3.2.2.9) | VII.E4.A-61 |
| N | NNN | BWR | Stainless steel, nickel alloy piping, piping components less than 4 NPS exposed to treated water >60°C (>140°F) | Cracking due to ~~stress corrosion cracking~~ SCC, ~~intergranular stress corrosion cracking~~ IGSCC | AMP XI.M2, "Water Chemistry" and XI.M32, "One-Time Inspection" | No | VII.E3.A-NN<br>VII.E4.A-NN |
| M | 120 | BWR/PWR | Stainless steel piping, piping components exposed ~~to air – indoor uncontrolled (internal/external), air – indoor uncontrolled (external),~~ air with borated water leakage, concrete, ~~air – dry,~~ gas | None | None | No | ~~VII.J.AP-123~~<br>~~VII.J.AP-17~~<br>VII.J.AP-18<br>VII.J.AP-19<br>~~VII.J.AP-20~~<br>VII.J.AP-22 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 132` | BWR/PWR | Insulated steel, copper alloy, copper alloy (> 15% Zn), ~~aluminum~~ piping, piping components, tanks exposed to condensation, any air environment – ~~outdoor~~ | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to ~~stress corrosion cracking~~ SCC (copper alloy (>15% Zn) only) | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | VII.I.A-405 |
| M | 140 | BWR/PWR | Gray cast iron, ductile iron piping, piping components with internal coatings/linings exposed to closed cycle cooling water, raw water, treated water, waste water | Loss of material due to selective leaching | AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks" | No | VII.C1.A-415<br>VII.C2.A-415<br>VII.C3.A-415<br>VII.D.A-415<br>VII.E1.A-415<br>VII.E2.A-415<br>VII.E3.A-415<br>VII.E4.A-415<br>VII.E5.A-415<br>VII.F1.A-415<br>VII.F2.A-415<br>VII.F3.A-415<br>VII.F4.A-415<br>VII.G.A-415<br>VII.H1.A-415<br>VII.H2.A-415 |
| N | 144 | BWR/PWR | Stainless steel, aluminum piping, piping components, tanks exposed to soil, concrete | Cracking due to ~~stress corrosion cracking~~ SCC | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | VII.C1.A-425<br>VII.C3.A-425<br>VII.E5.A-425<br>VII.G.A-425<br>VII.H1.A-425<br>VII.H2.A-425 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| | 146 | BWR/PWR | Stainless steel underground piping, piping components, tanks exposed to any air environment~~– outdoor~~, raw water, condensation, ground water | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~<br>Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.3) | VII.C1.A-714<br>VII.C2.A-714<br>VII.C3.A-714<br>VII.D.A-714<br>VII.E1.A-714<br>VII.E4.A-714<br>VII.F1.A-714<br>VII.F2.A-714<br>VII.F4.A-714<br>VII.G.A-714<br>VII.H1.A-714<br>VII.H2.A-714 |
| ~~M~~ | ~~165~~ | ~~BWR/PWR~~ | ~~Gray cast iron, ductile iron piping, piping components exposed to air – indoor uncontrolled, air – outdoor, moist air, condensation, raw water, treated water, waste water (internal)~~ | ~~Loss of material due to general, pitting, crevice corrosion, MIC (raw water, waste water, and treated water environments only)~~ | ~~AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"~~ | ~~No~~ | ~~VII.C1.A-456~~<br>~~VII.C3.A-456~~<br>~~VII.E5.A-456~~<br>~~VII.G.A-456~~<br>~~VII.H1.A-456~~ |
| N | 181 | BWR/PWR | Nickel alloy, ~~aluminum,~~ titanium piping, piping components, exposed to condensation (External) | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | ~~VII.I.A-700~~<br>VII.I.A-701<br>VII.I.A-702<br>~~VII.I.A-703~~ |

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# MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 186 | BWR/PW | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment, air – outdoor, air – indoor controlled, air – indoor uncontrolled, raw water, waste water, condensation, soil, concrete (internal/external) | Cracking due to stress corrosion cracking SCC | AMP XI.M29, "Aboveground Metallic Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | VII.C3.A-482<br>VII.E5.A-482<br>VII.H1.A-482 |
| N | 187 | BWR/PW | Insulated aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air- outdoor, air – indoor controlled, air – indoor uncontrolled, condensation | Cracking due to stress corrosion cracking | AMP XI.M29, "Aboveground Metallic Tanks" | Yes (SRP-SLR Section 3.3.2.2.10) | VII.G.A-654<br>VII.H1.A-654 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 189 | BWR/PWR | Aluminum tanks, piping, piping components exposed to any air environment (except air-dry internal), – outdoor, raw water, waste water, condensation (internal) | Cracking due to stress corrosion cracking SCC | AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | VII.A2.A-429<br>VII.A3.A-429<br>VII.A4.A-429<br>VII.C1.A-451<br>VII.C2.A-451<br>VII.C3.A-451<br>VII.D.A-451<br>VII.E1.A-451<br>VII.E2.A-451<br>VII.E3.A-451<br>VII.E4.A-451<br>VII.E5.A-451<br>VII.F1.A-451<br>VII.F2.A-451<br>VII.F3.A-451<br>VII.F4.A-451<br>VII.G.A-451<br>VII.H1.A-451<br>VII.H2.A-451 |
| N | 190 | BWR/PWR | Aluminum piping, piping components, tanks exposed to raw water, waste water, condensation (external) | Cracking due to stress corrosion cracking | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | Yes (SRP-SLR Section 3.3.2.2.10) | VII.I.A-452 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 192 | BWR/PWR | Aluminum underground piping, piping components, tanks exposed to any air environment, ~~– outdoor,~~ raw water, condensation, groundwater | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | VII.I.A-706 |
| N | 205 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, ~~– indoor uncontrolled, air – indoor controlled,~~ condensation~~, air – outdoor~~ | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.3) | VII.I.A-734 |
| N | 221 | BWR/PWR | Aluminum piping, piping components exposed to ~~air – outdoor~~ any air environment (except air-dry internal), condensation | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | ~~VII.C1.A-750~~ ~~VII.C2.A-750~~ ~~VII.C3.A-750~~ ~~VII.D.A-750~~ ~~VII.E1.A-750~~ ~~VII.E4.A-750~~ ~~VII.F1.A-750~~ ~~VII.F2.A-750~~ ~~VII.F4.A-750~~ ~~VII.G.A-750~~ ~~VII.H1.A-750~~ ~~VII.H2.A-750~~ VII.I.A-750 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 222 | BWR/PWR | Stainless steel tanks exposed to any air environment, condensation ~~– outdoor~~ (internal/external) | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M29, "Aboveground Metallic Tanks"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.I.A-751 |
| N | 223 | BWR/PWR | Aluminum underground piping, piping components, tanks exposed to any air environment, raw water, condensation, groundwater ~~(external)~~ | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.I.A-752 |
| ~~N~~ | ~~224~~ | ~~BWR/PWR~~ | ~~Aluminum piping, piping components exposed to air – outdoor (external)~~ | ~~Cracking due to stress corrosion cracking~~ | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ | ~~Yes (SRP-SLR Section 3.3.2.2.10)~~ | ~~VII.I.A-753~~ |
| N | 225 | BWR/PWR | Aluminum tanks exposed to ~~air – outdoor~~any air environment, condensation | Cracking due to ~~stress corrosion cracking~~, SCC | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | VII.I.A-762 |
| N | 227 | BWR/PWR | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment, condensation (internal/external) | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.C3.A-756<br>VII.E5.A-756<br>VII.H1.A-756 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 228 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment, – outdoor, air – indoor uncontrolled, moist air, raw water, condensation (internal/external) | Loss of material due to pitting, crevice corrosion, MIC (raw water environment only) | AMP XI.M29, "Aboveground Metallic TanksPlant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.C3.A-757<br>VII.E5.A-757<br>VII.H1.A-757 |
| N | 231 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to any air environment, – outdoor, air – indoor uncontrolled, air – indoor controlled, condensation (internal/external) | Cracking due to stress corrosion cracking SCC | AMP XI.M29, "Aboveground Metallic Tanks"Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.3) | VII.C3.A-760<br>VII.E5.A-760<br>VII.H1.A-760 |
| N | 232 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, condensation, air – outdoor | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.I.A-761 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | NNN | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment, condensation | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.I.A-NNN |
| N | 233 | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment, condensation, air – outdoor | Cracking due to stress corrosion cracking SCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.10) | VII.I.A-762 |
| N | 234 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal) – dry, air – indoor uncontrolled, air – indoor controlled, condensation (internal/external) | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13 | VII.J.A-763 |
| N | NNN | BWR/PWR | Stainless steel underground piping, piping components, tanks exposed to any air environment, raw water, condensation, ground water | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.4) | VII.I.A-NNN |

| Table 3.3-1 Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report | | | | | | | |
|---|---|---|---|---|---|---|---|
| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to raw water, waste water | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.3.2.2.13) | VII.E.A-NNN |
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to air with borated water leakage | None | None | No | VII.J.A-NNN |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 2 | BWR/PWR | Stainless steel piping, piping components exposed to ~~air – outdoor~~ any air environment (except air-dry internal), condensation (internal/external) | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.A.SP-118<br>VIII.B1.SP-118<br>VIII.B2.SP-118<br>VIII.C.SP-118<br>VIII.D1.SP-118<br>VIII.D2.SP-118<br>VIII.E.SP-118<br>VIII.F.SP-118<br>VIII.G.SP-118 |
| M | 3 | BWR/PWR | Stainless steel piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation ~~air – outdoor~~ (internal/external) | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.3) | VIII.A.SP-127<br>VIII.B1.SP-127<br>VIII.B2.SP-127<br>VIII.C.SP-127<br>VIII.D1.SP-127<br>VIII.D2.SP-127<br>VIII.E.SP-127<br>VIII.F.SP-127<br>VIII.G.SP-127 |
| M | 32 | BWR/PWR | Gray cast iron, ductile iron piping, piping components exposed to soil, ground water | Loss of material due to selective leaching | AMP XI.M33, "Selective Leaching" | No | VIII.E.SP-26<br>VIII.G.SP-26 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 33 | BWR/PWR | Gray cast iron, ductile iron, copper alloy (>15% Zn or >8% Al) piping, piping components exposed to treated water, raw water, closed-cycle cooling water, soil, ground water | Loss of material due to selective leaching | AMP XI.M33, "Selective Leaching" | No | VIII.A.SP-27<br>VIII.A.SP-28<br>VIII.A.SP-30<br>VIII.E.S-440<br>VIII.E.SP-27<br>VIII.E.SP-29<br>VIII.E.SP-30<br>VIII.E.SP-55<br>VIII.F.S-440<br>VIII.F.SP-27<br>VIII.F.SP-29<br>VIII.F.SP-30<br>VIII.F.SP-55<br>VIII.G.S-440<br>VIII.G.SP-27<br>VIII.G.SP-28<br>VIII.G.SP-29<br>VIII.G.SP-30<br>VIII.G.SP-55 |
| M | 35 | BWR/PWR | Aluminum piping, piping components, tanks exposed to ~~air – outdoor~~ any air environment (except air-dry internal), condensation (internal/external) | Loss of material due to pitting, crevice corrosion | ~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~ Plant-specific aging management program | ~~No~~ Yes (SRP Section 3.4.2.2.10) | VIII.H.SP-147 |
| ~~M~~ | ~~39~~ | ~~BWR/PWR~~ | ~~Stainless steel piping, piping components, and piping elements exposed to condensation (internal)~~ | ~~Loss of material due to pitting, crevice corrosion~~ | ~~AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components"~~ | ~~No~~ | ~~VIII.B1.SP-110~~<br>~~VIII.B2.SP-110~~ |

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# MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 47 | BWR/PWR | Steel (with coating or wrapping), stainless steel, nickel-alloy piping, piping components, and piping elements, tanks exposed to soil, concrete | Loss of material due to general (steel only), pitting, crevice corrosion, MIC (soil environment only) | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | VIII.E.SP-145 |
| ~~M~~ | ~~49~~ | ~~BWR/PWR~~ | ~~Stainless steel, nickel alloy piping, piping components exposed to soil, concrete~~ | ~~Loss of material due to pitting, crevice corrosion, MIC (soil environment only)~~ | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~ | ~~No~~ | ~~VIII.E.SP-94~~ ~~VIII.G.SP-94~~ |
| N | NNN | BWR/PWR | Aluminum piping, piping components, tanks exposed to soil, concrete | Loss of material due to pitting, crevice corrosion | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | VIII.E.S-NNN VIII.G.S-NNN |
| N | NNN | BWR/PWR | Aluminum tanks exposed to soil, concrete | Cracking due to ~~stress corrosion cracking~~SCC | AMP XI.M41, "Buried and Underground Piping and Tanks" | No | VIII.E.S-NNN VIII.G.S-NNN |
| M | 63 | BWR/PWR | Insulated steel, copper alloy, copper alloy (> 15% Zn), ~~aluminum~~piping, piping components, tanks exposed to condensation, air – outdoor | Loss of material due to general, pitting, crevice corrosion; cracking due to ~~stress corrosion cracking~~SCC (copper alloy (>15% Zn) only) | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | VIII.H.S-402 |
| N | NNN | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment, condensation | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.10) | VIII.H.S-NNN |

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| M | 68 | BWR/PWR | Gray cast iron, ductile iron piping, piping components with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, waste water | Loss of material due to selective leaching | AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks” | No | VIII.A.S-415<br>VIII.B1.S-415<br>VIII.B2.S-415<br>VIII.C.S-415<br>VIII.D1.S-415<br>VIII.D2.S-415<br>VIII.E.S-415<br>VIII.F.S-415<br>VIII.G.S-415 |
| N | 74 | BWR/PWR | Underground stainless steel piping, piping components, tanks exposed to ~~air – outdoor~~ any air environment, raw water, condensation, ground water | Cracking due to ~~stress corrosion cracking~~SCC | ~~AMP XI.M41, "Buried and Underground Piping and Tanks"~~Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.H.S-425 |
| N | 80 | BWR/PWR | ~~Stainless steel,~~Steel, nickel alloy, copper alloy, ~~aluminum~~ piping, piping components exposed to condensation | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion | AMP XI.M36, “External Surfaces Monitoring of Mechanical Components” | No | VIII.H.S-431 |
| N | 93 | BWR/PWR | Stainless steel tanks exposed to ~~air – outdoor~~ any air environment (except air-dry internal), condensation (internal/external) | Cracking due to ~~stress corrosion cracking~~ SCC | ~~AMP XI.M29, "Aboveground Metallic Tanks"~~Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.A.S-441<br>VIII.B1.S-441<br>VIII.B2.S-441<br>VIII.C.S-441<br>VIII.D1.S-441<br>VIII.D2.S-441<br>VIII.E.S-441<br>VIII.F.S-441<br>VIII.G.S-441 |

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 94 | BWR/PWR | Underground aluminum piping, piping components, tanks exposed to air (externa) any air environment, raw water, condensation, ground water | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.10) | VIII.H.S-442 |
| N | 95 | BWR/PWR | Underground stainless steel piping, piping components, tanks exposed to any air environment, raw water, air-indoor uncontrolled, condensation, ground water air-outdoor (external) | Loss of material due to pitting, crevice corrosion | AMP XI.M41, "Buried and Underground Piping and TanksPlant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.3) | VIII.H.S-443 |
| N | 97 | BWR/PWR | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air (external) any air environment, condensation (internal/external) | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.10) | VIII.E.S-445<br>VIII.G.S-445 |

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 98 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air, air – outdoor, air – indoor uncontrolled, moist air any air environment, condensation (internal, external) | Loss of material due to pitting, crevice corrosion | AMP XI.M29, "Aboveground Metallic Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.3) | VIII.E.S-446<br>VIII.G.S-446 |
| N | 100 | BWR/PWR | Stainless steel tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to air – outdoor, air – indoor uncontrolled, air – indoor controlled,any air environment, condensation (internal/external) | Cracking due to stress corrosion crackingSCC | AMP XI.M29, "Aboveground Metallic Tanks" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.E.S-448<br>VIII.G.S-448 |

| Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report | | | | | | | |
|---|---|---|---|---|---|---|---|
| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
| N | 102 | BWR/PWR | Aluminum tanks (within the scope of AMP XI.M29, "Outdoor and Large Atmospheric Metallic Storage Tanks") exposed to soil, concrete, air – outdoor, air – indoor uncontrolled, air – indoor controlled, raw water, waste water, any air environment, condensation (internal/external) | Cracking due to stress corrosion crackingSCC | AMP XI.M29, "Aboveground Metallic Tanks"Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.E.S-450<br>VIII.G.S-450 |
| N | 103 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, condensation, air – outdoor | Loss of material due to pitting, crevice corrosion | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.3) | VIII.H.S-451 |
| N | 104 | BWR/PWR | Insulated stainless steel piping, piping components, tanks exposed to any air environment, condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled | Cracking due to stress corrosion crackingSCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.H.S-452 |

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## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 105 | BWR/PWR | Insulated aluminum piping, piping components, tanks exposed to any air environment condensation, air – outdoor, air – indoor uncontrolled, air – indoor controlled | Cracking due to stress corrosion crackingSCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.H.S-453 |
| N | 106 | BWR/PWR | Steel, stainless steel, copper alloy, copper alloy (> 15% Zn), nickel alloy piping, piping components exposed to air – outdoor | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to stress corrosion crackingSCC (copper alloy (>15% Zn) only) | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | VIII.H.S-454 |
| N | 107 | BWR/PWR | Steel, stainless steel, copper alloy, copper alloy (> 15% Zn), nickel alloy tanks exposed to condensation | Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion; cracking due to stress corrosion crackingSCC (copper alloy (>15% Zn) only) | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | No | VIII.H.S-455 |
| N | 108 | BWR/PWR | Stainless steel piping, piping components, tanks exposed to condensation | Cracking due to stress corrosion cracking | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" | Yes (SRP-SLR Section 3.4.2.2.2) | VIII.H.S-456 |

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | 109 | BWR/PWR | Aluminum piping, piping components, tanks exposed to any air environment (except air-dry internal), condensation, raw water, waste water (external) | Cracking due to stress corrosion crackingSCC | AMP XI.M36, "External Surfaces Monitoring of Mechanical Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.H.S-457 |
| N | 110 | BWR/PWR | Aluminum piping, piping components exposed to air – outdoor, raw water, waste water, any air environment (except air-dry internal) condensation (internal) | Cracking due to stress corrosion crackingSCC | AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.D1.S-458<br>VIII.D2.S-458<br>VIII.E.S-458<br>VIII.F.S-458<br>VIII.G.S-458 |
| N | 111 | BWR/PWR | Aluminum tanks exposed to raw water, waste water, any air environment condensation (internal) | Cracking due to stress corrosion crackingSCC | AMP XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components" Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.D1.S-459<br>VIII.D2.S-459<br>VIII.E.S-459<br>VIII.F.S-459<br>VIII.G.S-459 |
| N | 112 | BWR/PWR | Underground aluminum piping, piping components, tanks exposed to air – outdoor any air environment, raw water, condensation, ground water | Cracking due to stress corrosion crackingSCC | AMP XI.M41, "Buried and Underground Piping and Tanks"Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.7) | VIII.H.S-460 |
| N | 113 | BWR/PWR | Aluminum piping, piping components exposed to air – indoor uncontrolled | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | Yes (SRP-SLR Section 3.4.2.2.10) | VIII.I.S-461 |

Table 3.4-1 Summary of Aging Management Programs for Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

| New (N), Modified (M), Deleted (D) Item | ID | Type | Component | Aging Effect/Mechanism | Aging Management Program (AMP)/TLAA | Further Evaluation Recommended | GALL-SLR Item |
|---|---|---|---|---|---|---|---|
| N | NN | BWR/PWR | Aluminum piping, piping components, tanks exposed to raw water, waste water | Loss of material due to pitting, crevice corrosion | Plant-specific aging management program | No Yes (SRP-SLR Section 3.4.2.2.10) | VIII.E.S-NNN |
| N | NN | BWR/PWR | Stainless steel tanks exposed to soil, concrete | Cracking due to ~~stress corrosion cracking~~SCC | AMP XI.M41, “Buried and Underground Piping and Tanks” | No | VIII.H.S-NNN |
| N | NN | BWR/PWR | Elastomer seals, piping, piping components exposed to air (external) | Loss of material due to wear | AMP XI.M36, “External Surfaces Monitoring of Mechanical Components” | No | VIII.h.E-NNN |
| N | NN | BWR/PWR | Elastomer seals, piping, piping components exposed to air (internal) | Loss of material due to wear | AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components” | No | V.D1.E-NNN<br>V.D2.E-NNN<br>V.E.E-NNN<br>V.G1.E-NNN |
| N | NN | BWR/PWR | PVC piping, piping components, tanks exposed to concrete | None | None | No | VIII.I.S-NNN |
| N | NN | BWR/PWR | PVC piping, piping components, tanks exposed to soil | Loss of material due to wear | AMP XI.M41, “Buried and Underground Piping and Tanks” | No | VIII.H.S-NNN |

# APPENDIX B

## MARK-UP SHOWING CHANGES TO THE SRP-LR AMR LINE ITEMS and GALL-SLR REPORT DEFINITIONS

| GALL Report Section | Term | Definition as used in this document |
|---|---|---|
| IX.C | Ductile Iron | Ductile iron, similar to gray cast iron, is an iron alloy made by adding larger amounts of carbon to molten iron than would be used to make steel. Most steel has less than about 1.2 percent by weight carbon, while cast irons typically have between 2.5 to 4 percent. Ductile iron contains spherical graphite nodules, as opposed to graphite flakes for gray cast iron, resulting in increased mechanical properties when compared to gray cast iron. Ductile iron is susceptible to selective leaching, resulting in a significant reduction of the material's strength due to the loss of iron from the microstructure, leaving a porous matrix of graphite. In some environments, ductile iron is categorized with the group "Steel." |
| IX.C | Steel | In some environments, carbon steel, alloy steel, ~~cast iron,~~ gray cast iron, ductile iron, malleable iron, and high-strength low-alloy steel are vulnerable to general, pitting, and crevice corrosion, even though the rates of aging may vary. Consequently, these metal types are generally grouped under the broad term "steel." Note that this does not include SS, which has its own category. However, gray cast iron and ductile iron are ~~also is~~ susceptible to selective leaching, and high-strength low-alloy steel is susceptible to SCC. Therefore, when these aging effects are being considered, these materials are specifically identified. Galvanized steel (Zn-coated carbon steel) is also included in the category of "steel" when exposed to moisture. Malleable iron is specifically called out in the phrase "Porcelain, Malleable iron, Al, galvanized steel, cement," which is used to define the high voltage insulators in GALL-SLR Chapter VI.<br><br>Examples of steel designations included in this category are ASTM A36, ASTM A285, ASTM A759, SA36, SA106-Gr. B, SA155-Gr. KCF70, SA193-Gr. B7, SA194 -Gr. 7, SA302-Gr B, SA320-Gr. L43 (AISI 4340), SA333-Gr. 6, SA336, SA508-64, class 2, SA508-Cl 2 or Cl 3, SA516-Gr. 70, SA533-Gr. B, SA540-Gr. B23/24, and SA582. [Ref. 4, 5] |

# APPENDIX C

# MARK-UP SHOWING CHANGES TO GALL REPORT AMP XI.M29, "OUTDOOR AND LARGE ATMOSPHERIC METALLIC TANKS"

## XI.M29 ~~ABOVEGROUND~~ OUTDOOR AND LARGE ATMOSPHERIC METALLIC STORAGE TANKS

***Parameters Monitored or Inspected**:* The program consists of periodic inspections of metallic tanks (with or without coatings) to manage the effects of corrosion and cracking on the intended function of these tanks. Inspections cover all surfaces of the tank (i.e., outside uninsulated surfaces, outside insulated surfaces, bottom, interior surfaces). The AMP uses periodic plant inspections to monitor degradation of coatings, sealants, and caulking because it is a condition directly related to the potential loss of material or cracking. Thickness measurements of the bottoms of the tanks are made periodically for the tanks monitored by this program as an additional way to ensure that loss of material is not occurring at locations inaccessible for inspection. Periodic internal visual inspections and surface examinations, as required to detect applicable aging effects, are performed to detect degradation that could be occurring on the inside of the tank. Where the exterior surface is insulated for outdoor tanks and indoor tanks operated below the dew point, a representative sample of the insulation is periodically removed or inspected to detect the potential for loss of material or cracking underneath the insulation, unless it is demonstrated that the aging effect (i.e., SCC, loss of material) is not applicable, see Table XI.M29-1, "Tank Inspection Recommendations."

***Detection of Aging Effects: [third paragraph only]***

If the exterior surface of an outdoor tank or indoor tank exposed to condensation (because the in-scope component being operated below the dew point) is insulated, sufficient insulation is removed to determine the condition of the exterior surface of the tank, unless it is demonstrated that the aging effect (i.e., SCC, loss of material) is not applicable, see Table XI.M29-1, "Tank Inspection Recommendations." When an aging effect is applicable, periodic inspections are conducted ~~A~~at a minimum, during each 10-year period of the subsequent period of extended operation, a minimum of either 25 1 square foot sections or 20 percent of the surface area of insulation is removed to permit inspection of the exterior surface of the tank. Aging effects associated with corrosion under insulation for outdoor tanks may be managed by GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components."

| **Table XI.M29-1. Tank Inspection Recommendations[1, 2] [revised rows only]** | | | | |
|---|---|---|---|---|
| **Inspections to Identify Degradation of Inside Surfaces of Tank Shell, Roof[4], and Bottom[5, 6]** | | | | |
| **Material** | **Environment** | **Aging Effect Required Aging Management (AERM)** | **Inspection Technique[3]** | **Inspection Frequency** |
| Stainless steel | Any air environment | Loss of Material | Visual | Each refueling outage interval, or one-time inspection. See SRP-SLR Sections 3.2.2.2.2, 3.3.2.2.4, or 3.4.2.2.3. |
| | | Cracking | Surface[11] | Each 10-year period starting 10 years before the subsequent period of extended operation, or one-time inspection. See SRP-SLR Sections 3.2.2.2.5, 3.3.2.2.3, or 3.4.2.2.2. |

# APPENDIX C

## MARK-UP SHOWING CHANGES TO GALL REPORT AMP XI.M29, "OUTDOOR AND LARGE ATMOSPHERIC METALLIC TANKS"

| **Table XI.M29-1. Tank Inspection Recommendations[1, 2] [revised rows only]** | | | | |
|---|---|---|---|---|
| Aluminum | Any air environment | Loss of Material | Visual | Each 10-year period starting 10 years before the subsequent period of extended operation, or one-time inspection. See SRP-SLR Sections 3.2.2.2.13, 3.3.2.2.13, or 3.4.2.2.10. |
| | | Cracking | Surface[11] | Each 10-year period starting 10 years before the subsequent period of extended operation, or demonstrate that SCC is not an applicable aging effect. See SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7. |
| | Raw water<br>Waste water | Loss of material | Visual | Each 10-year period starting 10 years before the subsequent period of extended operation, or one-time inspection. See SRP-SLR Sections 3.2.2.2.13, 3.3.2.2.13, or 3.4.2.2.10. |
| | | Cracking | Surface[11] | Each 10-year period starting 10 years before the subsequent period of extended operation, or demonstrate that SCC is not an applicable aging effect. Ssee SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7. |
| **Inspections to Identify Degradation of External Surfaces[9] of Tank Shell, Roof, and Bottom** | | | | |
| Stainless steel~~[14]~~ | ~~Any indoor air environment~~ | ~~Cracking~~ | ~~Surface [10, 11]~~ | ~~Each 10-year period starting 10 years before the subsequent period of extended operation or demonstrate that SCC is not an applicable aging effect, see SRP-SLR Sections 3.2.2.2.5, 3.3.2.2.3, or 3.4.2.2.2.~~ |
| | Any air ~~outdoor~~ environment, condensation | Loss of material | Visual from OS | Each refueling outage interval, or one-time inspection~~demonstrate that loss of material is not an applicable aging effect~~. See SRP-SLR Sections 3.2.2.2.2, 3.3.2.2.4, or 3.4.2.2.3. |
| | | Cracking | Surface~~[10,]~~ [11] | Each 10-year period starting 10 years before the subsequent period of extended operation, or one-time inspection ~~demonstrate that SCC is not an applicable aging effect~~. See SRP-SLR Sections 3.2.2.2.5, 3.3.2.2.3, or 3.4.2.2.2. |
| | Soil, ~~or~~concrete, ground water, raw water | Loss of material | Volumetric from IS[12] | Each 10-year period starting 10 years before the subsequent period of extended operation[13] |
| | | Cracking | Volumetric from IS[12] | Each 10-year period starting 10 years before the subsequent period of extended operation[13] |

# APPENDIX C

## MARK-UP SHOWING CHANGES TO GALL REPORT AMP XI.M29, "OUTDOOR AND LARGE ATMOSPHERIC METALLIC TANKS"

**Table XI.M29-1. Tank Inspection Recommendations[1, 2] [revised rows only]**

| | | | | |
|---|---|---|---|---|
| Aluminum | Any ~~indoor~~ air environment, condensation | Cracking | Surface[~~10,~~ 11] | Each 10-year period starting 10 years before the subsequent period of extended operation, or demonstrate that SCC is not an applicable aging effect. See SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7. |
| | | Loss of material | Visual from OS | Each 10-year period starting 10 years before the subsequent period of extended operation, or ~~O~~one-time inspection ~~conducted in accordance with AMP XI.M32 or demonstrate that loss of material is not an applicable aging effect~~. See SRP-SLR Sections 3.2.2.2.13, 3.3.2.2.13, or 3.4.2.2.10. |
| | Soil, ~~or~~ concrete, ground water, raw water | Loss of material | Volumetric from IS[12] | Each 10-year period starting 10 years before the subsequent period of extended operation[13] |
| | | Cracking | Volumetric from IS[12] | Each 10-year period starting 10 years before the subsequent period of extended operation,[13] or demonstrate that SCC is not an applicable aging effect. See SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7. |
| | ~~Air-outdoor~~ | ~~Loss of material~~ | ~~Visual from OS~~ | ~~Each refueling outage interval~~ |
| | | ~~Cracking[14]~~ | ~~Surface[10, 11]~~ | ~~Each 10-year period starting 10 years before the subsequent period of extended operation or demonstrate that SCC is not an applicable aging effect, see SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7.~~ |

Footnote:

~~10: A one-time inspection conducted in accordance with GALL-SLR Report AMP XI.M32 may be conducted in lieu of periodic inspections if an evaluation conducted before the subsequent period of extended operation and during each 10-year period during the subsequent period of extended operation demonstrates the absence of environmental impacts in the vicinity of the plant due to: (a) the plant being located within approximately 5 miles of a saltwater coastline, or within 1/2 mile of a highway that is treated with salt in the wintertime, or in areas in which the soil contains more than trace amounts of chlorides, (b) cooling towers where the water is treated with chlorine or chlorine compounds, and (c) chloride contamination from other agricultural or industrial sources. The evaluation includes soil sampling in the vicinity of the tank (because soil results indicate atmospheric fallout accumulating in the soil and potentially affecting tank surfaces) and sampling of residue on the top and sides of the tank to ensure that chlorides or other deleterious compounds are not present at sufficient levels to cause pitting corrosion, crevice corrosion, or cracking.~~

~~14: If the tank contents are greater than 60 °C [140 °F] , or the tank's surface could be greater than 60 °C [140 °F] due to exposure to the environment (e.g., direct sunlight on the surfaces of the tank), stress corrosion cracking is an applicable aging effect and surface examinations are conducted to detect potential cracking.  Reference footnote 11 for the extent of inspections.~~

## APPENDIX D

## MARK-UP SHOWING CHANGES TO GALL REPORT AMP XI.M33, "SELECTIVE LEACHING"

### XI.M33 SELECTIVE LEACHING

### Program Description

The program for selective leaching (dealloying) of materials ensures the integrity of the components made of gray cast iron, ductile iron, and copper alloys (except for inhibited brass) that contain greater than 15 percent zinc (> 15 percent Zn) or 8 percent aluminum (>8 percent Al) exposed to a raw water, closed-cycle cooling water (CCCW), treated water, waste water, soil, or ground water environment. Depending on the environment, the aging management program (AMP) includes one-time, or opportunistic or periodic visual inspections of selected components that are susceptible to selective leaching, coupled with mechanical examination techniques (e.g., chipping, scraping). Destructive examinations of components to determine the presence of and depth of dealloying through wall thickness are also conducted. These techniques can determine whether loss of material due to selective leaching is occurring and whether selective leaching will affect the ability of the components to perform their intended function for the subsequent period of extended operation.

The selective leaching process involves the preferential removal of one of the alloying components from the material. Dezincification (loss of zinc from brass) and graphitization (removal of iron from gray cast iron and ductile iron) are examples of such a process. Susceptible materials exposed to high operating temperatures, stagnant-flow conditions, and a corrosive environment (e.g., acidic solutions for brasses with high zinc content and dissolved oxygen) are conducive to selective leaching.

### Evaluation and Technical Basis

1. ***Scope of Program****:* Components include piping, valve bodies and bonnets, pump casings, and heat exchanger components that are susceptible to selective leaching. The materials of construction for these components may include gray cast iron, ductile iron, and uninhibited brass containing greater than 15 percent zinc or greater than 8 percent aluminum. These components may be exposed to raw water, CCCW, treated water, waste water, soil, or ground water.

   Dependent on plant-specific OE and implementation of preventive actions, certain components may be excluded from the scope of this program in each 10-year inspection interval as follows:

   - The internal surfaces of internally-coated components for which loss of coating integrity is managed by GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"
   - The external surfaces of buried components that are externally-coated in accordance with Table XI.M41-1, of GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," and where direct visual examinations of buried piping in the scope of license renewal have not revealed any coating damage
   - The external surfaces of buried gray cast iron and ductile iron components that have been cathodically protected since installation and meet the criteria for Preventive Actions Category C in Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP XI.M41, Table XI.M41-2, "Inspections of Buried Pipe"

- The external surfaces of buried copper alloy components that meet the above cathodic protection recommendations, if technical justification is submitted with the subsequent license renewal application (SLRA) that demonstrates the effectiveness of cathodic protection in the prevention of selective leaching for those alloys.

2. ***Preventive Actions**:* Although the program does not provide guidance on preventive actions, water chemistry control consistent with GALL-SLR Report AMP XI.M2, "Water Chemistry," or GALL-SLR Report AMP XI.M21A, "Closed Treated Water Systems," to control pH and concentration of corrosive contaminants, and treatment to minimize dissolved oxygen can be effective in minimizing selective leaching.

3. ***Parameters Monitored or Inspected**:* This program monitors visual appearance (e.g., color, porosity, abnormal surface conditions), surface conditions through mechanical examination techniques (e.g., chipping, scraping), and the presence of and depth of dealloying through wall thickness through destructive examinations

4. ***Detection of Aging Effects**:* Inspections and examinations consist of the following:

- Visual inspections of all accessible surfaces. In certain copper-based alloys selective leaching can be detected by visual inspection through a change in color from a normal yellow color to a reddish copper color or green copper oxide. Graphitized cast iron cannot be reliably identified through visual examination, as the appearance of the graphite surface layer created by selective leaching does not always differ appreciably from uncorroded cast iron.

- Mechanical examination techniques, such as chipping and scraping, augment visual inspections for gray cast iron <u>and ductile iron </u>components.

- Destructive examinations are used to determine the presence of and depth of dealloying through wall thickness of components.

One-time and periodic inspections are conducted of a representative sample of each population. A population is defined as the same material and environment combination. Opportunistic inspections are conducted whenever components are opened, or buried or submerged surfaces are exposed.

One-time inspections are only conducted for components exposed to CCCW or treated water when no plant-specific operating experience of selective leaching exists in these environments. In the 10-year period prior to a subsequent period of extended operation, a sample of 3 percent of the population or a maximum of 10 components per population at each unit are visually and mechanically (for gray cast iron <u>and ductile iron</u> components) inspected. Inspections, where possible, focus on the bounding or lead components most susceptible to aging based on time-in-service and severity of operating conditions for each population.

Opportunistic and periodic inspections are conducted for components exposed to raw water, waste water, soil, or ground water and for components in CCCW or treated water where plant-specific OE includes selective leaching in these environments. Opportunistic inspections are conducted whenever components are opened, or buried or submerged surfaces are exposed. Periodic inspections are conducted in the 10-year period prior to a subsequent period of extended operation and in each 10-year period during a period of extended operation. In these periodic inspections, a sample of 3 percent of the population or a maximum of 10 components per population are visually and mechanically (for gray cast iron and ductile iron components) inspected at each unit. When inspections are conducted on piping, a 1-foot axial length section is considered as one inspection. In addition, two destructive examinations are performed in each material and environment population in each 10-year period at each unit. The number of visual and mechanical inspections may be reduced by two for each component that is destructively examined beyond the minimum number of destructive examinations recommended in each 10-year interval. Inspections, where possible, focus on the bounding or lead components most susceptible to aging based on time-in-service and severity of operating conditions for each population. Opportunistic inspections may be credited as periodic inspections as long as the inspection locations selection criteria are met.

For multi-unit sites where the sample size is not based on the percentage of the population and the inspections are conducted periodically (not one-time inspections), it is acceptable to reduce the total number of inspections at the site as follows. For two unit sites, eight visual and mechanical inspections and two destructive examinations are conducted at each unit. For three unit sites, seven visual and mechanical and one destructive examination are conducted at each unit. In order to conduct the reduced number of inspections, the applicant states in the SLRA the basis for why the operating conditions at each unit are similar enough (e.g., flowrate, chemistry, temperature, excursions) to provide representative inspection results. The basis should include consideration of potential differences such as the following:

- Have power uprates been performed and if so, could more aging have occurred on one unit that has been in the uprate period for a longer time period?
- Are there any systems which have had an out-of-spec water chemistry condition for a longer period of time or out-of-spec conditions occurred more frequently?
- For raw water systems, is the water source from different sources where one or the other is more susceptible to microbiologically-induced corrosion or other aging effects?

For similar environments (i.e., soil and groundwater, or raw water and waste water), the populations may be combined as long as an evaluation is conducted to determine the more severe environment and the inspections and examinations are conducted on components in the most severe environment, with one inspection being conducted in the less severe environment.

Dependent on plant-specific OE and implementation of preventive actions, the number of inspections for certain components exposed to soil or groundwater may be adjusted as follows. When minor through-wall coating damage has been identified in plant-specific OE, but the components are coated in accordance with Table XI.M41-1 of GALL-SLR Report AMP XI.M41, the inspection sample size may be reduced by 50 percent of that recommended in the "detection of aging effects" program element of this AMP if the following conditions are met:

- There were no more than two instances of coating damage identified in each 10-year period of the prior operating period

- An analysis demonstrates that, if the pipe surface area affected by the coating damage is assumed to have been a through-wall hole, the pipe could be shown to meet unreinforced opening criteria of the applicable piping code

Inspections follow site procedures that include inspection parameters such as lighting, distance offset, surface coverage, presence of protective coatings, and cleaning processes that ensure an adequate examination.

5. ***Monitoring and Trending**:* Trending of destructive examination results to indicate the progression of dealloying is performed. The extent of degradation (e.g., dealloyed wall thickness, percent dealloying) is projected until the next inspection period or end of the subsequent period of extended operation to confirm the component's intended functions will be maintained.

6. ***Acceptance Criteria**:* The acceptance criteria are: (a) for copper-based alloys, no noticeable change in color from the normal yellow color to the reddish copper color or green copper oxide; (b) for gray cast iron and ductile iron, the absence of a surface layer that can be easily removed by chipping or scraping or identified in the destructive examinations; and (c) components meet system design requirements such as minimum wall thickness, extended to the end of the subsequent period of extended operation.

7. ***Corrective Actions**:* Results that do not meet the acceptance criteria are addressed ~~as conditions adverse to quality or significant conditions adverse to quality~~in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the corrective actions element of this AMP for both safety-related and nonsafety-related structures and component (SCs) within the scope of this program.

   When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the subsequent period of extended operation, additional inspections are performed. The number of additional inspections is equal to the number of failed inspections for each material and environment population with a minimum of five additional visual and mechanical inspections when visual and mechanical inspections(s) did not meet acceptance criteria and a minimum of one additional destructive examination when destruction examination(s) did not meet acceptance criteria. If any of the additional inspections do not meet the acceptance criteria, the number of additional inspections continues as described above until in the last set of inspections all of the components meet the acceptance criteria.

   The program includes a process to evaluate difficult-to-access surfaces (e.g., heat exchanger shell interiors, exterior of heat exchanger tubes) if unacceptable inspection findings occur within the same material and environment population.

8. ***Confirmation Process**:* The confirmation process is addressed through those specific portions of the QA program that are used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the confirmation process element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

9. ***Administrative Controls**:* Administrative controls are addressed through the QA program that is used to meet the requirements of 10 CFR Part 50, Appendix B, associated with managing the effects of aging. Appendix A of the GALL-SLR Report describes how an applicant may apply its 10 CFR Part 50, Appendix B, QA program to fulfill the administrative controls element of this AMP for both safety-related and nonsafety-related SCs within the scope of this program.

10. ***Operating Experience**:* OE shows that selective leaching has been detected in components constructed from cast iron, brass, bronze, and aluminum bronze. The following OE may be of significance to an applicant's program:

    a. In March 2013, a licensee submitted an American Society of Mechanical Engineers (ASME) Code Section XI relief request because it had detected weeping through aluminum bronze (susceptible to dealloying) valve bodies exposed to sea water. The degraded area was characterized by corrosion debris or wetness that returned following cleaning and drying of the surface. (ADAMS Accession Numbers ML13091A038 and ML14182A634).

    b. During a one-time inspection for selective leaching, a licensee identified degradation in four gray cast iron valve bodies in the service water system exposed to raw water. The mechanical test used by the licensee to identify the graphitization was tapping and scraping of the surface. The licensee sand blasted two of the valve bodies and, after all of the graphite was removed, the licensee determined that the leaching progressed to a depth of approximately 3/32 inch. Based on the estimated corrosion rate, the licensee determined that the valve bodies had adequate wall thickness for at least 20 years of additional service. (ADAMS Accession Number ML14017A289).

    c. Based on visual inspections conducted as part of implementing a one-time inspection for selective leaching, a licensee identified selective leaching in a gray cast iron drain plug of an auxiliary feedwater (AFW) pump outboard bearing cooler. Possible selective leaching was also found on multimatic valves on the underside of the clapper. As a result, the licensee incorporated quarterly inspections of the components in its preventive surveillance and periodic maintenance program. (ADAMS Accession Number ML13122A009).

    d. In September 2008, a licensee identified the dealloying of an aluminum bronze strainer drum exposed to brackish water. This was identified after an unexpected material failure occurred, during a planned maintenance evolution at an offsite repair facility. The maintenance evolution involved rigging the strainer drum into position for a machining operation. During the rigging, the strainer drum material failed at the rigging attachment point to the strainer. This failure of the strainer drum exposed the inner portion of the drum material where dealloying of the drum was visually observed during an inspection. (ADAMS Accession Number ML092400531).

    e. A licensee has reported occurrences of selective leaching of aluminum bronze components for an extensive number of years. The licensee is evaluating changes to its current approach to managing selective leaching in order to address the aging effect during the period of extended operation (e.g., enhanced testing, metallurgical analyses of degraded components to trend material properties). (ADAMS Accession Number ML13045A356).

f. U.S. Nuclear Regulatory Commission (NRC) Information Notice (IN) 84-71, Graphitic Corrosion of Cast Iron in Salt Water, September 06, 1984.

g. NRC IN 94-59, Accelerated Dealloying of Cast Aluminum-Bronze Valves Caused by Microbiologically Induced Corrosion, August 17, 1994.

h. The staff's review of INPO-compiled industry OE, in August 2014, noted that a licensee identified graphitic corrosion on buried ductile iron piping. This was identified when the equipment operator noted that the potable water storage level tank was less than 50 percent and trending down. The failure of the ductile iron piping was caused by localized external corrosion and graphitic corrosion. The leak was repaired using a Mueller clamp and a modification is currently being considered to improve long-term reliability.

The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry OE, as discussed in Appendix B of the GALL-SLR Report.

**References**

10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

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# APPENDIX E
# MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS

## XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS

***Program Description [second paragraph only]***

Reduced thermal insulation resistance due to moisture intrusion, associated with insulation that is jacketed, is managed by visual inspection of the condition of the jacketing when the insulation has an intended function to reduce heat transfer from the insulated components. Outdoor insulated components, and indoor components exposed to condensation, have portions of the insulation inspected or removed, when applicable, to determine whether the exterior surface of the component is degrading or has the potential to degrade. Loss of material due to boric acid corrosion is managed by the Boric Acid Corrosion program [Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report aging management program (AMP) XI.M10].

***Scope of Program: [first paragraph only]***

This program visually inspects the external surfaces of mechanical components for loss of material, hardening and loss of strength due to elastomer degradation, and reduction of heat transfer due to fouling and monitors the external surfaces of metallic components for leakage due to cracking. Visual inspections are conducted on insulation jacketing to ensure that the function of the thermal insulation is not impaired by moisture intrusion. Visual inspections, when applicable, are also conducted on outdoor insulated components, and indoor insulated components exposed to condensation (because the in-scope component is operated below the dew point) to determine whether the exterior surface of the component is degrading or has the potential to degrade. Cracking of SS and aluminum components exposed to aqueous solutions and air environments containing halides may also be managed by this program. Visual inspections or surface examinations are used to manage cracking. This program also visually inspects and monitors the external surfaces of elastomeric and polymeric components for changes in material properties (such as hardening and loss of strength), cracking, and loss of material due to wear. The program also inspects heat exchanger surfaces exposed to air for evidence of reduction of heat transfer due to fouling. Cementitious components are inspected for changes in material properties, cracking, and loss of material.

***Detection of Aging Effects: [third paragraph]***

Periodic visual inspections or surface examinations are conducted on SS and aluminum to manage cracking when applicable (see SRP-SLR Sections 3.2.2.2.5, 3.2.2.2.10, 3.3.2.2.3, 3.3.2.2.10, 3.4.2.2.2, and 3.4.2.2.7). Periodic visual inspections are conducted where it has been demonstrated that leakage or surface cracks can be detected prior to a crack challenging the structural integrity or intended function of the component. If visual inspections have not been demonstrated to effectively detect cracks prior to challenging the structural integrity or intended function of the component then a representative sample of surface examinations is conducted every 10 years during the period of extended operation. A minimum of 20 percent of the population (components having the same material, environment, and aging effect combination) or maximum of 25 components per population is inspected. The 20 percent minimum is surface area inspected unless the component is measured in linear feet, such as piping. Alternatively, any combination of 1-foot length sections and components can be used to meet the recommended extent of 25 inspections.

***Detection of Aging Effects: [fifth paragraph]***

Component surfaces that are insulated and exposed to condensation (because the in-scope component is operated below the dew point), and insulated outdoor components, (aging effects associated with corrosion under insulation for outdoor tanks may be managed by this AMP or GALL-SLR Report AMP XI.M29, "~~Aboveground Metallic Tanks~~Outdoor and Large Atmospheric

Metallic Storage Tanks") are periodically inspected every 10 years during the period of extended operation. For all outdoor components and any indoor components exposed to condensation (because the in-scope component is operated below the dew point), inspections are conducted of each material type (e.g., steel, SS, copper alloy, aluminum) and environment (e.g., air outdoor, moist air, air accompanied by leakage) where condensation or moisture on the surfaces of the component could occur routinely or seasonally. In some instances, significant moisture can accumulate under insulation during high humidity seasons, even in conditioned air. A minimum of 20 percent of the in-scope piping length, or 20 percent of the surface area for components whose configuration does not conform to a 1-foot axial length determination (e.g., valve, accumulator, tank) is inspected after the insulation is removed. Alternatively, any combination of a minimum of 25 1-foot axial length sections and components for each material type is inspected. Inspection locations should focus on the bounding or lead components most susceptible to aging because of time in service, severity of operating conditions (e.g., amount of time that condensate would be present on the external surfaces of the component), and lowest design margin. Inspections for cracking due to SCC in aluminum components need not be conducted if it has been demonstrated that SCC is not an applicable aging effect, see SRP-SLR Sections 3.2.2.2.10, 3.3.2.2.10, or 3.4.2.2.7. The following are alternatives to removing insulation after the initial inspection.

**APPENDIX E**
**MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS**

The following material represents a compiled listed of minor technical and editorial changes to draft NUREG-2191 and draft NUREG-2192. For ease of presenting the information, duplicate entries for changes to the SRP-SLR AMR line items and GALL-SLR Report AMR line items were not generated. Where a change is noted as affecting the SRP-SLR, the corresponding changes will be made for the GALL-SLR Report AMR line items and vice versa when the final NUREG-2191 and final NUREG-2192 are issued.

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.1.1-62 | Editorially revise R-10 to cite “high-strength alloy steel” in lieu of “steel (high-strength alloy steel).” |
| 3.1.1-133 | Delete the “reactor coolant” environment. |
| 3.1.1-134 | Delete the term “jacketed” and capitalize the “t” in “thermal.” Change “environment” to “any environment” and delete existing cited environments. |
| 3.2.2.2.3 | Add third sentence from the SRP-LR Section 3.2.2.2.4 to SRP-SLR Section 3.2.2.2.3. |
| 3.2.2.2.12<br>3.2.3.2.12 | Delete reference to steel with stainless steel cladding, spent fuel storage racks, sodium pentaborate, and the term “PWR” (in front of heat exchanger components. Two places each. |
| EP-113 | Delete “fouling that leads to corrosion,” add “flow blockage due to fouling.” |
| 3.2.1-1 | Delete all existing environments and add “any environment.” |
| 3.2.1-8 | Delete aluminum from the list of materials. Delete EP-101. |
| 3.2.1-12 | Editorially revise to cite “high-strength steel” in lieu of “steel, high-strength.” |
| 3.2.1-15 | Replace material and component wording with “Metallic bolting.”<br>Delete all existing environments except “Any environment.”<br>Delete EP-117, 118, 119, 120, 121, 122, 69 |
| 3.2.1-17 | Delete stainless steel and EP-73. Also delete, “MIC (stainless steel only).” |
| 3.2.1-18 | Add “treated borated water.”<br>In the Further Evaluation (FE) Recommended column state, “Yes (SRP-SLR Section 3.2.2.2.12).”<br>Change “AMP” to “Plant-specific aging management program.” |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.2.1-22 | Add treated water, heat exchanger components, and nickel alloy. Add V.D2.EP-73, V.A.E-428, V.D1.E-428, and V.D2.E-428.<br>In the FE Recommended column state, "Yes (SRP-SLR Section 3.2.2.2.12."<br>Change AMP to "Plant-specific aging management program." |
| 3.2-1-24 | Add "fouling that leads to corrosion." |
| 3.2.1-26 | Delete |
| 3.2.1-27 | Add V.D2.E-21 to list and change first column to "M." |
| 3.2.1-35 | Lower case "Treated" |
| 3.2.1-38 | Change environment to "air" and delete existing cited environment. |
| 3.2.1-39 | Modify to include stainless steel, nickel alloy, copper alloy, and aluminum alloy. Revise the AERM to add "(steel and copper alloy only)" after the term "general." |
| 3.2.1-40 | Add pitting and crevice corrosion to the AERM. |
| 3.2-1-41 | Add pitting and crevice corrosion to the AERM and change the first column to "M." |
| 3.2.1-43 | Change environment to "air" and delete existing cited environment. |
| 3.2.1-44 | Add the term "piping" in front of the first use of the term "component."<br>Add the term "ducting" in front of the second use of the term "component."<br>Add pitting and crevice corrosion to the AERM and change first column to "M." |
| 3.2.1-46 | Add the term "piping" in front of the term "component." |
| 3.2.1-52 | Add the term "(soil environment only)" after the term "MIC." |
| 3.2.1-54 | Change the FE Recommended column to state No and do not designate as "M." |
| 3.2.1-59 | Revise the term "components" to "piping components, ducting components." Delete the term "and." |
| 3.2.1-60 | Do not designate as "M." |
| 3.2.1-65 | Add the term "metallic" after the term "Any." |
| 3.2.1-66 | Change the FE Recommended column to cite 3.2.2.2.8 in lieu of 3.2.2.2.9. |

**APPENDIX E**
**MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS**

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.2.1-68 | Add the term “ground water” to the parenthetical associated with MIC for steel and stainless steel. |
| 3.2.1-74 | Add waste water to the list of environments. Waste water is already cited in E-415. The first column should be designated as “M.” |
| 3.2.1-75 | Delete, enveloped by changes stated for 3.2.1-15. |
| 3.2.1-81 | Change component to “heat exchanger tubes.” |
| 3.2.1-83 | Delete line item and all GALL line items. Overtaken by changes to 3.2.1-38. |
| 3.2.1-84 | Delete line item and all GALL line items. Overtaken by changes to 3.2.1-43. |
| 3.2.1-85 | Delete, as noted above, the GALL-SLR are moved to 3.2.1-22. |
| 3.2.1-89 | Delete steel from E-433. E-46 adequately covers steel. |
| 3.2.1-87 | Delete the term “jacketed” and capitalize the “t” in “thermal.” Change environment to “any environment” and delete existing cited environments. |
| 3.2.1-90 | Add treated borated water.<br>Add treated borated water to GALL-SLR Report E-434 line items: A, C, and D1.<br>Revise AMP XI.M32 as follows:<br>• Program Description, 3rd paragraph, add treated borated water in “i.e., statement.”<br>• Scope of Program, 1st paragraph, add treated borated water in “i.e., statement.” |
| 3.2.1-92 | Change component to “heat exchanger tubes.” |
| 3.2.1-95 | Change the term “≤ 8% Al” to “>8% Al.” |
| 3.2.1-96 | Add steel to description. Add steel to E-439, add stainless steel to E440. Add “general (steel only)” to AERM. Move E-440 to 3.2.1-96. |
| 3.2.1-97 | Delete |
| 3.3.2.2.12<br>3.3.3.2.12 | Delete the term “PWR” (in front of heat exchanger components. Two places. |
| 3.3.1-1 | Delete existing environments, cite environment as “any environment.” |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-2 | Delete existing environments, cite environment as "any environment." |
| 3.3.1-3 | Add, "and a plant-specific program" to the AMP column. |
| 3.3.1-9 | Delete aluminum and AP-1. |
| 3.3.1-10 | Add, "or any environment for cyclic loading." Editorially revise to cite high-strength steel" in lieu of "steel, high-strength." Delete the term "closure." Re-status the line item as "M." |
| 3.3.1-11 | Delete |
| 3.3.1-12 | Add VII.I.A-03. Add "pitting and crevice corrosion" to VII.I.A-03. Delete the term "closure." Show line item as "M." |
| 3.3.1-13 | Delete |
| 3.3.1-15 | Delete the term "stainless steel closure bolting." Replace all existing environments with "any environment." Delete AP-263 through 267. Revise AP-124 environment to "any environment." Delete the term "closure" from AP-124. |
| | |
| 3.3.1-20 | This line item only had a minor editorial change, deletion of the redundant term "stainless steel" and therefore it should be designated as "E." |
| 3.3.1-25 | Add PWR to the Type column. Add an AP-130 line item to tables C2 and H2. Add "piping components." |
| 3.3.1-28 | Add nickel alloy. Add ">60°C (>140°F)" to the environment. The temperature limit exists in the GALL-SLR Report line item, inadvertently deleted from SRP-SLR. Delete "MIC." Revise AMP to cite XI.M2 and XI.M32. Revise FE Recommended column to cite "No." |
| 3.3.1-29 | Add nickel alloy. |
| 3.3.1-32.5 | Add the waste water environment. Link VII.E5.A-550 to this line item. |
| 3.3.1-35 | Delete this line item, move VII.H2.AP-193 to 3.3.1-34. |
| 3.3.1-36 | Delete this line item, move VII.C1.AP-196 to 3.3.1-34. |
| 3.3.1-39 | Delete this line item, move VII.C3.A-53 to 3.3.1-40. |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-41 | Delete this line item, move VII.H2.AP-55 to 3.3.1-40. |
| 3.3.1-46 | Add “MIC to AP-189. |
| 3.3.1-42 | Delete VII.G.AP-187 |
| 3.3.1-53 | Change environment to “air” and delete existing cited environments. |
| 3.3.1-57 | Change the environment to “air” and delete existing cited environments. Change AERM to “Hardening, loss of strength, shrinkage due to elastomer degradation.” Delete VII.G.A-20. |
| 3.3.1-58 | Add the following environments: “condensation,” and “air-moist.” |
| 3.3.1-59 | Change environment to “air” and delete existing cited environments. Delete VII.G.A-22. |
| 3.3.1-60 | Delete “Concrete” from the AERM column and designate as “E.” |
| 3.3.1-65 | Delete MIC, do not designate as “M.” |
| 3.3.1-67 | Do not designate as “M.” |
| 3.3.1-72 | A-02: add ductile iron.<br>AP-31: add ductile iron.<br>A-50: add ductile iron.<br>A-51: add ductile iron.<br>A-724: waste water should not have been deleted as an environment. |
| 3.3.1-76 | Change environment to “air” and delete existing cited environments. Add “ducting” and “ducting components.” |
| 3.3.1-77 | Change the AERM to “loss of material (spalling, scaling) and cracking due to freeze-thaw or aggressive chemical attack.” |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-78 | Change component description to "Steel piping, piping components, ducting, ducting components, ducting closure bolting." Cite "(external)" in relation to the environments.<br>Delete all associated GALL-SLR Report line items (i.e., A-10, A-78, A-80, A-81, and A-105) except for VII.I.A-77. Revise VII.I.A-77 as follows:<br>• Change component description to "Piping, piping components, ducting, ducting components, ducting closure bolting."<br>• Add "condensation" and "air-outdoor" to the environments. |
| 3.3.1-79 | Do not designate as "M." |
| 3.3.1-82 | Change environment to "air" and delete existing cited environments.<br>Add ducting and ducting components<br>Add fiberglass<br>Add the modified VII.I.A-719<br>Production tool shows this as new input and it therefore it was designated as "N". It should be designated as "M." |
| 3.3.1-88 | Delete "diesel engine exhaust." Do not delete "diesel exhaust" as an environment. |
| 3.3.1-89 | Delete "For fire water system components:" from the AMP column. Add "steel" and "moist air (internal)" to AP-143. Delete VII.G.A-23 |
| 3.3.1-90 | Add "ducting" in front of "components." Move "(for drip pans and drain lines)" to after MIC. Designate line item as "E." |
| 3.3.1-94 | Add "ducting" in front of "components." Designate line item as "E." |
| 3.3.1-95 | Delete second use of "piping, piping components."<br>Delete AP-278. However, create a new Table 1 entry for this MEAP absent citing aluminum as an applicable material. |
| 3.3.1-96 | Change environment to "air" and delete existing cited environment. |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-96.2 | Remove, "(for components not covered by NRC GL 89-13)."<br>Add "internal to components" to the component description just after the term "tubes."<br>Revise environment to "air, condensation (external)."<br>Add titanium. |
| 3.3.1-96.4 | Remove, "(for components not covered by NRC GL 89-13)."<br>Add air (external) as an environment.<br>Change AMP from XI.M38 to XI.M36.<br>Create a new Table 1 entry:<br>• Stainless steel, steel, aluminum, copper alloy heat exchanger components internal to components exposed to air (external), condensation being managed for loss of material due to general (steel and copper alloy only), pitting, crevice corrosion; fouling that leads to corrosion.<br>• Cite AMP XI.M38.<br>• In the Further Evaluation Recommended column state, "No".<br>• Cite GALL Report AMR line items for the same system tables as in 96.4. |
| 3.3.1-97 | Change component to "Steel piping, piping components," (i.e., remove "reactor coolant pump oil collection system: tanks, reactor coolant pump oil collection system: piping, tubing, valve bodies").<br>Delete VII.G.AP-127<br>Create a new Table 1 entry:<br>• Steel reactor coolant pump oil collection system tanks, piping, piping components exposed to lubricating oil, being managed for loss of material due to general, pitting, crevice corrosion, MIC.<br>• Cite AMP XI.M32.<br>• In the Further Evaluation Recommended column state, "No".<br>• Transfer VII.G.AP-116 and VII.G.AP-117 to this new SRP-SLR entry and delete XI.M39 from these line items<br>• Change VII.G.AP-117 to delete citing tubing and valves, cite piping, piping components instead. |
| 3.3.1-99 | Delete "aluminum" from VII.G.AP-133.<br>Add a new line item VII.G.AP-162 and make it look just like VII.H2.AP-162. |

| **SRP-SLR AMR Line Item and Minor FE Section Changes** | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-105 | Remove “corrosion of rebar due to exposure of rebar” from AP-237. Do not delete from the SRP-SLR Table 1 line item. |
| 3.3.1-106 | Add “(soil environment only)” to MIC. |
| 3.3.1-108 | Add “general (copper alloy only).”<br>Revise MIC as shown underlined (all materials, except aluminum and titanium, in the soil environment only. |
| 3.3.1-109a | Add “copper alloy” to the general corrosion statement. |
| 3.3.1-119 | Change “potable water” to “raw water (potable).” Revise line item entry to “E.” |
| 3.3.1-125 | Add nickel alloy to GALL Report line items associated with piping, piping components, and heat exchangers. |
| 3.3.1-130 | Reinsert “(where applicable)” after general corrosion.<br>Remover “only” after aluminum in the AERM column. |
| 3.3.1-137 | Add “(steel and stainless steel only)” after the term “MIC.” |
| 3.3.1-139 | Add fuel oil as an environment. |
| 3.3.1-141 | Delete this line item as well as VII.I.A-421, VII.I.A-422. Changes to 3.3.1-15 made these line items not necessary. |
| 3.3.1-147 | Delete closed cycle cooling water >60°C (>140°F) environment. |
| 3.3.1-148 | Delete line item. Enveloped by changes to 3.3.1-76. |
| 3.3.1-151 | Change “heat exchanger components” to heat exchanger tubes.” |
| 3.3.1-153 | Delete line item. Enveloped by changes to 3.3.1-76. |
| 3.3.1-154 | Delete line item; however, do not delete VII.I.A-719. Modify VII.I.A-719 as follows: (a) delete the term “elastomer;” and (b) link A-719 to 3.3.1-82. |
| 3.3.1-156 | Add VII.G.A-729. |
| 3.3.1-158 | Delete VII.C2.A-454, retain VII.C1.A-454. |
| 3.3.1-159 | Add “ducting” in front of the second use of “components.” |

**APPENDIX E**
**MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS**

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-164 | Delete line item. Redundant to inspections that would be conducted for steel piping. |
| 3.3.1-165 | Delete line item. Redundant to inspections that would be conducted for steel piping. |
| 3.3.1-162 | Delete line item and corresponding GALL line item. Duplicative of 3.3.1-131. |
| 3.3.1-173 | Delete line item and all related GALL Report line items A-457, A-477, A-498, A 548, A-641 A-667, and A-749. Enveloped by 3.3..1-32.5, 3.3.1-86 & 3.3.1-156. |
| 3.3.1-174 | Delete line item and VII.C1.A-459. VII.E5.A-550 was relinked to 3.3.1-32.5. |
| 3.3.1-179 | Change air environment to “air” and delete existing cited environments. |
| 3.3.1-182 | Delete the term “jacketed” and capitalize the “t” in “thermal.” Change environment to “any environment” and delete existing cited environments. |
| 3.3.1-191 | Delete “piping, piping components” and add “stainless steel.” Piping and piping components covered by 3.3.1-144. |
| 3.3.1-193 | VII.E4.A-532, delete raw water environment from this line item only.<br>VII.C1.A-469, change environment to “raw water” in lieu of “waste water.” |
| 3.3.1-194 | Delete concrete environment. |
| 3.3.1-197 | Delete “MIC.”<br>Change environment to “Any external environment except soil and concrete.” |
| 3.3.1-198 | Revise “MIC” to “MIC (in liquid and soil environments only; except for aluminum).” |
| 3.3.1-199 | Change environment to “air” and delete existing cited environments. |
| 3.3.1-200 | Change environment to “air” and delete existing cited environments. |
| 3.3.1-203 | Add nickel alloy to GALL Report line items associated with piping, piping components, and heat exchangers. |
| 3.3.1-206 | Change the term “≤ 8% Al” to “>8% Al.” |

| **SRP-SLR AMR Line Item and Minor FE Section Changes** | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.3.1-209 | Delete line item. Duplicative of 3.3-1, 175. |
| 3.3.1-214 | Insert comma after soil. |
| 3.3.1-215 | Change “air-indoor uncontrolled” to “air-indoor.” Delete “condensation, moist air.” |
| 3.3.1-218 | Change “air-indoor uncontrolled” to “air-indoor.” Delete “condensation, moist air.” |
| 3.3.1-220 | Add copper alloy to VII.H2.A-23. |
| 3.4.2.2.9<br>3.4.3.2.9 | Delete the term “spent fuel storage racks” and “PWR” (in front of heat exchanger components. Two places each. |
| 3.4.1-1 | Change environment to “any environment” and delete existing cited environments. |
| 3.4.1-6 | Change environment to “any environment” and delete existing cited environments. |
| 3.4.1-10 | Delete steel and stainless, delete SP-151 and SP-83. Delete all environments except for “any environment.” Steel and stainless steel are enveloped by change to 3.4.1-6. |
| 3.4.1-12 | Delete term “(steel only).” |
| 3.4.1-13 | Add “BWR.” |
| 3.4.1-14 | Delete “piping and piping components,” “BWR,” and “treated water.” |
| 3.4.1-18 | Delete copper alloy, Move VIII.E.SP-100 and VIII.G.SP-100 to 3.4.1-17. |
| 3.4.1-22 | Remove “heat exchanger components.” |
| 3.4.1-28 | Delete the term “components and.” |
| 3.4.1-29 | Delete Line item. Enveloped by 3.4.1-30. |
| 3.4.1-33 | Delete the soil and ground water environments and delete S-440. Line item is no longer designated as an “M.” Soil and ground water environments enveloped by 3.4.1.-32 |
| 3.4.1-38 | Change AMP from XI.M38 to XI.M20. |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.4.1-43 | Add MIC as an aging mechanism. |
| 3.4.1-47 | Add "(soil environment only)" following MIC. Delete stainless steel and nickel alloy material, enveloped by 3.4.1-49. |
| 3.4.1-49 | Add tanks. |
| 3.4.1-50x | Delete second comma after "nickel alloy." |
| 3.4.1-55 | Delete "air-outdoor" and "air-indoor uncontrolled environments." Leave in the air and air with borated water leakage environments. Delete SP-108 and SP-9. |
| 3.4.1-58 | Delete all environments except gas. |
| 3.4.1-62 | Add "(steel and stainless steel only)" after the term "MIC." |
| 3.4.1-64 | Delete the term "jacketed" and capitalize the "t" in "thermal." Change environment to "any environment" and delete existing cited environments. |
| 3.4.1-69 | Delete line item. Enveloped by 3.4.1-6. |
| 3.3.1-72 | Add GALL-SLR Report AMR line items for copper alloy (>15% Zn or >8% Al) exposed to soil, ground water for Tables C1, C3, G, H1, AND H2. |
| 3.4.1-75 | Change the term "components" to "tubes." Add the condensation environment. |
| 3.4.1-80 | Delete steel, enveloped by 3.4.1-34.<br>Delete stainless steel and aluminum. Covered in other AMR line items associated with a further evaluation. See Appendix A, Table 3.4-1. |
| 3.4.1-83 | Delete "general (steel only)." Add nickel alloy. |
| 3.4.1-85 | Add nickel alloy.<br>Editorially correct the Further Evaluation Recommendation to cite the "SRP-SLR" in lieu of the "SRP-LR." |
| 3.4.1-86 | Change "heat exchanger components" to "heat exchanger tubes." |
| 3.4.1-88 | Change the term "≤ 8% Al" to ">8% Al." |
| 3.4.1-90 | Replace "heat exchanger components" with "heat exchanger tubes." |
| 3.4.1-93 | Delete line item. Enveloped by 3.3.1-100. |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| 3.4.1-106 | Delete steel enveloped 3.4.1-34. Stainless steel was deleted as shown in Appendix A, Table 3.4-1. |
| 3.4.1-107 | Delete steel, enveloped 3.4.1-34. Stainless steel was deleted as shown in Appendix A, Table 3.4-1. |
| 3.5.1-79 | Editorially change the environment from “ground water/soil” to soil, ground water. |
| 3.5.1-89 | Delete aluminum from GALL-SLR TP-3 AMR line items. |
| Generic | Delete the existing environments for all underground AMR line items and change to “any air environment, condensation, raw water. |
| Generic | Inclusive of SRP-SLR Tables 3.2-1, 3.3-1, and 3.4-1:<br>• Change “groundwater/soil” to “soil, groundwater.”<br>• Change “soil, concrete” to “soil, groundwater, concrete.”<br>• Change “soil” to “soil, groundwater.”<br>When these changes are incorporated, the line item will be designated as “M.” |
| Generic | The following types of changes will be designated as editorial (E) in lieu of being designated as modified (M).<br>• Detail from FE recommended column was removed after verifying that it was in the FE section.<br>• Renumbered FEs.<br>• Aging effects changed from “and” to “or.”<br>• Minor edits to component descriptions, examples: (a) deleting “elastomer” from “elastomer, elastomer seals;” (b) adding “piping” or “ducting” in front of “component.”<br>As a result, the following:<br>3.2-1 AMR line items will be designated as “E”: 1, 4, 5, 7, 43, 66.<br>3.3-1 AMR line items will be designated as “E”: 85, 127, 134.<br>3.4-1 AMR line items will be designated as “E”: 6. |

| SRP-SLR AMR Line Item and Minor FE Section Changes | |
|---|---|
| **Reference** | **Proposed Change** |
| Generic | When the only change to an AMR line item was to delete "piping elements" from the component description because the material was not glass, the line item will be designated as "E."<br>As a result, the following:<br>3.2-1 AMR line items will be designated as "E": 8, 10, 11, 20, 28, 32, 42, 48, 57, 61, 62, 64.<br>3.3-1 AMR line items will be designated as "E": 18, 26, 30, 30.2, 31, 33, 43, 48, 54, 56, 66, 69, 70, 71, 73, 74, 75, 79, 80, 83, 91, 92, 100, 103, 104, 105, 114, 116, 117, 118, 121, 122, 124, 126.<br>3.4-1 AMR line items will be designated as "E": 2, 3, 5, 11, 23, 36, 37, 39, 42, 44, 54, 56, 57, 59. |

| GALL-SLR Table Introduction Changes: | |
|---|---|
| **Page** | **Change** |
| IV C1-1 | Pump and valve internals perform their intended functions with moving parts or with a change in configuration~~, or are subject to replacement based on qualified life or specified time period~~. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review (AMR). |
| Page IV C2-1 | Page IV C2-1: Pump and valve internals perform their intended functions with moving parts or with a change in configuration~~, or are subject to replacement based on qualified life or specified time period~~. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review 18 (AMR). |
| V E-1 | Delete the "s" from bolting in the second line of the SSC paragraph. |

## APPENDIX E
## MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS

| GALL-SLR Chapter IX Changes | |
|---|---|
| **Section** | **Change** |
| IX.B | Piping element: change as follows<br>The category of "piping elements" is a subcategory of piping, piping components, and piping elements that in the GALL-SLR Report, applies only to components or portions of components made of glass (e.g., the glass portion of sight glasses and level indicators~~, etc.~~) In the GALL-SLR Report, Chapters V, VII, and VIII, piping elements are thus called out separately. |
| IX.C | Cu alloy (≤15% Zn and ≤8% Al): delete "(≤15% Zn and ≤8% Al)" from the term.<br>Copper alloy (≤ 15% Zn and ≤ 8% Al): the term should be "Copper alloy;" the term "below" should be "less;" add period at end of sentence.<br>Copper alloy (>15% Zn or >8% Al): the term "(except for inhibited brass)" should be inserted after right the term "leaching" in the third row. Insert "selective" prior to the term "leaching." |
| IX.C | Various organic polymers: remove the underline format for the term "applications." |
| IX.E | Hardening and loss of strength: delete the term "piping element." |
| IX.F | Cladding degradation: delete the term "piping elements." |

| GALL-SLR Table XI-01 Changes | |
|---|---|
| **AMP** | **Change** |
| XI.M29 | The external surfaces of insulated tanks are periodically sampling-based inspected. [The applicant can modify this sentence if it is demonstrated that any in-scope stainless steel or aluminum tanks are not susceptible to SCC or loss of material based on the results of SRP-SLR Sections 3.1.2.2.20, 3.2.2.2.5, 3.3.2.2.3, 3.4.2.2.2, 3.2.2.2.2, 3.3.2.2.4, 3.4.2.2.3, 3.2.2.2.10, 3.3.2.2.10, 3.4.2.2.7, 3.2.2.2.13, 3.3.2.2.13, and 3.4.2.2.10.] |
| XI.M36 | A sample of outdoor component surfaces that are insulated and a sample of indoor insulated components exposed to condensation (due to the in-scope component being operated below the dew point), are periodically inspected every 10 years during the period of extended operation. [The applicant can modify this sentence if it is demonstrated that any in-scope stainless steel or aluminum components are not susceptible to SCC or loss of material based on the results of SRP-SLR Sections 3.1.2.2.20, 3.2.2.2.5, 3.3.2.2.3, 3.4.2.2.2, 3.2.2.2.2, 3.3.2.2.4, 3.4.2.2.3, 3.2.2.2.10, 3.3.2.2.10, 3.4.2.2.7, 3.2.2.2.13, 3.3.2.2.13, and 3.4.2.2.10.] |

# APPENDIX E
# MARKUP SHOWING CHANGES TO XI.M36 EXTERNAL SURFACES MONITORING OF MECHANICAL COMPONENTS

| GALL-SLR Table XI-01 Changes | |
|---|---|
| **AMP** | **Change** |
| XI.M42 | This program is a condition monitoring program that manages degradation of coatings/linings that can lead to loss of material of base materials ~~and~~or downstream effects such as reduction in flow, reduction in pressure or reduction in heat transfer when coatings/linings become debris |

| GALL-SLR AMP Changes | | |
|---|---|---|
| **AMP** | **Program Element** | **Change** |
| XI.M27 | Table XI.M27-1 | Foam Water Sprinkler Systems: Strainers (~~refueling outage interval and~~ after each system actuation) |
| XI.M27 | Table XI.M27-1 | Add a new footnote that applies to all of Table XI.M27-1, “Calibration of measuring and test equipment is conducted in accordance with plant-specific procedures in lieu of NFPA 25 requirements.” |
| XI.M27 | Table XI.M27-1 | Add a new footnote to the following lines in Table XI.M27-1: 5.2.1.1, 7.3.2, 8.3.3.7, 9.2.5.5, 13.2.5, 13.4.3.2.2, 10.2.1.6, 10.2.1.7, 10.2.7, 10.3.4.3, and 11.3.2.6.<br>“Where NFPA 25 or this table cite annual testing or inspections, testing and inspections can be conducted on a refueling outage interval if plant-specific OE has shown no loss of intended function of the in-scope SSC.” |
| XI.M27 | Detection of aging effects | ~~“When fouling is identified, deposits are removed to determine if loss of material has occurred and to prevent further degradation in the system.~~ |
| XI.M27 | Acceptance Criteria | Revise bullet (c) as follows:<br>no loose fouling products exist~~s~~ in the sprinkler systems that could cause ~~corrosion or~~ flow blockage in the sprinklers |
| XI.M27 | Corrective Actions | Add: “An evaluation is conducted to determine if deposits need to be removed to determine if loss of material has occurred.” |

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| XI.M29 | Scope of Program | The third bullet under the alternatives for aging effects associated with coatings cites SRP-SLR Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems." The citation should be Table XI-01, "FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR." |
| XI.M32 | Program Description | Revise as follows:<br>In addition, for steel components exposed to water environments that do not include corrosion inhibitors as a preventive action (~~i.e.~~e.g., treated water, ~~reactor coolant,~~raw water, ~~or~~ waste water), this program verifies that long-term loss of material due to general corrosion will not cause a loss of intended function [e.g., pressure boundary, leakage boundary (spatial), structural integrity (attached)]. |
| XI.M32 | Scope of Program | Revise as follows:<br>Long-term loss of material due to general corrosion for steel components need not be managed if one of the following two conditions ~~are~~ is met: (i) the environment for the steel components includes corrosion inhibitors as a preventive action; ~~and~~ or (ii) ~~periodic~~ wall thickness measurements on a representative sample of each environment ~~have~~ will been conducted ~~every 5 years up to~~ ~~at least~~ between the 50th and 60th year of operation. Environments such as treated water~~,~~ ~~reactor coolant~~, raw water, and waste water do not typically include corrosion inhibitors. |
| XI.M33 | Detection of Aging Effects | Change as follows:<br>Dependent on plant-specific OE and implementation of preventive actions, ~~the number of inspections for certain components exposed to soil or groundwater may be~~the exclusions for external surface coatings of buried components may no longer apply and the inspection population is adjusted as follows. |
| XI.M33 | Operating Experience | Example c: As a result, the licensee incorporated quarterly inspections of the components in its periodic surveillance and preventive maintenance ~~preventive surveillance and periodic maintenance~~ program. (ADAMS Accession Number ML13122A009). |
| XI.M36 | Parameters Monitored or Inspected | Make the following change to the examples of inspection parameters for polymers: discoloration (evidence of a potential change in material properties that could be indicative of polymeric degradation). |

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| XI.M36 | Parameters Monitored or Inspected<br>Detection of Aging Effects | Revise the term “demonstrated” to “determined” in all locations. |
| M38 | Program Description | The program consists of inspections of the internal surfaces of metallic piping, piping components, and piping elements, ducting, heat exchanger components, polymeric and elastomeric components, and other components exposed to uncontrolled indoor air, outdoor air, air with borated water leakage, condensation, moist air, diesel exhaust, fuel oil, lubricating oil.~~,~~ ~~and any~~ The scope of this program also includes water systems other than open-cycle cooling water systems [~~age-managed by Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report aging management program (AMP) XI.M20~~], closed treated water systems, ~~(age-managed by GALL-SLR Report AMP XI.M21A),~~and fire water systems, ~~(age-managed by GALL-SLR Report AMP XI.M27)~~for which aging effects are managed by (AMP) XI.M20, AMP XI.M21A, and AMP XI.M27, respectively. |
| XI.M36 | Parameters Monitored or Inspected<br>Detection of Aging Effects | Add the following:<br>Examples of inspection parameters for cementitious materials include:<br>• Spalling<br>• Scaling<br>• Cracking<br>• Changes in material properties as evidenced by visual indications such as cracking, exfoliation, spalling, scaling, or residue or deposits from leaching of the concrete. |
| XI.M38 | Parameters Monitored or Inspected | Make the following change to the examples of inspection parameters for polymers: discoloration (evidence of a potential change in material properties that could be indicative of polymeric degradation). |
| XI.M38 | Parameters Monitored or Inspected | Indicators of ~~loss of material~~ aging effects for metallic components include the following: |
| XI.M38 | Parameters Monitored or Inspected | The line worded as follows, “Indicators of loss of material and changes in material properties of elastomeric and polymeric materials include the following:” should not be bulletized. It is |

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| | | a new heading just like the previous "Indicators of for metallic…" |
| XI.M38 | Parameters Monitored or Inspected<br>Detection of Aging Effects | Revise the term "demonstrated" to "determined" in all locations. |
| XI.M41 | Parameters Monitored or Inspected<br>Detection of Aging Effects | Revise the term "demonstrated" to "determined" in all locations. |
| XI.M42 | Program Description | Revise to read as follows: "Degradation of coatings/linings can lead to loss of material or cracking of base materials and downstream effects such as reduction in flow, reduction in pressure, or reduction in heat transfer when coatings/linings become debris." |
| XI.M42 | Scope of Program | The third bullet under the alternatives for aging effects associated with coatings cites SRP-SLR Table 3.0-1, "FSAR Supplement for Aging Management of Applicable Systems." The citation should be Table XI-01, "FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR." |
| XI.M42 | Detection of Aging Effects | Revise to read as follows: "If a baseline has not been previously established between the 50th and 60th year of operation, ~~B~~baseline coating/lining inspections occur in the 10-year period prior to the subsequent period of extended operation. Subsequent inspections…" |

| **SRP-SLR Appendix Changes** | |
|---|---|
| **Section** | **Change** |
| A.1.2.3.4, Item 4 | For a condition monitoring program, when sampling is used to represent a larger population of SCs, applicants provide the basis for the inspection population and sample size. The inspection population ~~should be~~is based on such aspects of the SCs as ~~a~~ similarity of materials of construction, fabrication, procurement, design, installation, ~~operating~~ environment, operating conditions, ~~or~~and aging effects. The sample size ~~should be~~is based on such aspects of the SCs as the specific aging effect, location, existing technical information, system and structure design, materials of construction, ~~service~~ environment, operating conditions, ~~or~~ and previous failure history. The samples ~~should be~~are biased |

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| | toward locations most susceptible to the specific aging effect of concern in the period of extended operation. For multi-unit sites, samples are conducted at all units. Provisions for expanding the sample size when degradation is detected in the initial sample are included. |