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Ms. Cindy K. Bladey
Office of Administration
Mail Stop: OWFN-12-H08
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Industry Feedback on Changes to GALL–SLR (Draft NUREG–2191) and SLR–SRP (Draft NUREG–2192); Federal Register Notice 80 FR 79956; Docket ID: NRC–2015–0251

Project Number: 689

Dear Ms. Bladey:

On behalf of the nuclear energy industry, the Nuclear Energy Institute (NEI)[1] is providing the attached comments on draft NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report," and draft NUREG-2192, "Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants (SRP-SLR)." Attachment 1 identifies an overarching concern where the inspection scope or the inspection frequency of aging management programs (AMPs) were changed without providing operating experience (OE) or technical information as supporting bases for the changes. The use of existing aging management programs (AMPs) that are consistent with previous versions of the GALL, have supported plant safety and efficient operation during the first license renewal period. Industry will continue to review lessons learned and OE and enhance AMPs as required to ensure program effectiveness in managing the effects of aging. Our focus should remain on activities that are supported by technical data, OE or research in an overall effort to sustain safe and efficient nuclear energy as a viable option for the country's future energy needs.

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

SUNSI Review Complete
Template = ADM – 013
E-RIDS= ADM-03
Add= B. Brady (bmb1)
S. Bloom (sdb1)

In addition to the concerns identified in Attachment 1, the following attachments contain additional industry comments on the draft documents:

- Attachment 2 – NUREG-2192 mechanical changes
- Attachment 3 – NUREG 2191 mechanical AMPs X.M1 through XI.M22
- Attachment 4 – NUREG 2191 mechanical AMPs XI.M1 through XI.M42 (with exception of AMP XI.M31)
- Attachment 5 – NUREG-2191 mechanical AMP XI.M31
- Attachment 6 – NUREG-2191 and NUREG-2192 structural comments
- Attachment 7 – NUREG-2191 and NUREG-2192 electrical comments.

We appreciate the opportunity to provide comments for your consideration, as well as the opportunity to continue the technical dialogue with the NRC staff. If you have any questions, please contact me.

Sincerely,

Jerud Hanson

Attachments

c: Mr. Christopher G. Miller, NRR/DLR, NRC
Mr. Steven D. Bloom, NRR/DLR/RSRG, NRC

Attachment 1
NUREG-2191 Significant Issues – Summary List

1. A plant specific program is required for PWR Vessel Internals. MRP-227 should be used as a starting point for aging management in the GALL-SLR AMP and associated AMRs. (XI.M16A)

2. Reactor vessel internals fluence monitoring is not required. MRP-227 and BWRVIP have analyzed bounding fluence thresholds for selected degradation mechanisms that will be re-evaluated as part of the industry programs. (X.M2)

3. Program scope of BWR Stress Corrosion Cracking Program revised the RCS temperature to 140F which is no longer consistent with GL 88-01. (XI.M7)

4. A baseline inspection of bottom mounted instrument nozzles using a qualified volumetric examination method is required. The existing program of regular visual exams is sufficient. (XI.M11A)

5. A baseline inspection using a qualified volumetric method or inner diameter surface inspection of all susceptible nickel alloy branch line connections and welds consistent with MRP-126 which is a 2004 document is required. The existing program of regular visual exams is sufficient. (XI.M11A)

6. Reactor vessel surveillance capsule fluence between 1 and 1.25 of the SLR peak fluence is required even though some plants have tested a capsule that has a higher fluence higher than 1.25 and no capsules remain. Consistent with existing requirements, capsule fluence between 1 and 2 of peak SLR fluence should be allowed. (XI.M31)

7. SLR & contingency reactor vessel surveillance capsules are required for plants that tested all capsules. (XI.M31)

8. Inspecting for surface discontinuities and imperfections, and clearances and physical displacement for signs of loose joints is overly prescriptive. Inspection for signs of leakage should be sufficient, especially for non-safety related bolting. (XI.M18)

9. When fouling is identified in Fire Water Systems, deposits are required to be removed regardless of flow test results or minimum wall exam results. In addition, Open Cycle Cooling Water System corrective actions require that fouling is also required to be removed. (XI.M27 and XI.M20)

10. Surface exams for aluminum and stainless cracking are not necessary. Cracking can be seen visually prior to loss of intended function. Additionally, surface exams for opportunistic inspections are overly burdensome. (XI.M38)

11. NUREG-0619 should be sunset and XI.M5, BWR Feedwater Nozzle retired. (XI.M5)

12. Perform UT of the containment shell or liner surfaces inaccessible from one side on a random and focused basis each 10 year interval. (XI.S1)

13. Perform surface examination of SS material and dissimilar welds of penetration sleeves and penetration and vent line bellows every 10 years regardless of cyclic loading, SCC, or whether CLB Fatigue analysis exists. (XI.S1)

14. Inspect additional 5 % IWF piping supports for class I, II, and III every 10 years. (XI.S3)

15. Visual inspection all IWF bolts; and volumetric of ASTM A325, A490, F1852, and F2280 bolts every 10 years. (XI.S3)

16. UT of high strength bolts every 5 years on Refueling Crane structural members. (M23)

17. Increased frequency inspection every 3 years (vs 5 years previously) for unbraced and unreinforced masonry walls. (XI.S5)

18. New requirement – seasonally perform through-wall leakage or groundwater infiltration quantification and chemistry analysis. (XI.S6) (XI.S7)

19. Perform focused inspections of below grade inaccessible concrete exposed to aggressive groundwater/soil every 5 years frequency. (XI.S6) (S7)

20. Testing of in scope inaccessible Non EQ instrumentation & control cables every 6 years. (XI.E3B)

21. Testing of in scope inaccessible low voltage (below 400v) every 6 years. (XI.E3C)

22. Increased metal enclosed bus bolted inspection testing from a 20% sampling to 100% every 10 years. (XI.E4)

23. Change non-EQ connection inspections from one time before PEO to every10 years. (XI.E6)

Attachment 2

NUREG-2191 and NUREG-2192 Mechanical Comments (Non-AMP)

And

NUREG-2191 and NUREG-2192 Markups

(Markups Follow the Comment Table)

Attachment 2

NUREG-2191 and NUREG-2192 Mechanical Comments (Non-AMP)

GALL / SRP comments			
#	**Location of Change**	**Description of Change**	**Justification For Change**
1	SRP FE 3.1.2.2.9 Table 3.1.1, 118 Table 3.1.1, 119 GALL IV.B2.R-423 IV.B2.R-424 IV.B3.R-423 IV.B3.R-424 IV.B4.R-423 IV.B4.R-424	The GALL XI.M16A program has been deleted and management of cracking and loss of fracture toughness for PWR reactor vessel internal components is recommended by a plant-specific program. Consider restoring the XI.M16A program to GALL with reference to the industry action to update to 80 years, and recommending the use of this program to manage aging of PWR reactor vessel internal components.	The XI.M16A program is based on implementation of the guidance in MRP-227-A, which has been reviewed and accepted by the NRC. By deleting XI.M16A now, the staff is effectively saying that there are no generic aging lessons learned for managing PWR vessel internals and that previous generic lessons learned are of no use for SLR. MRP-227-A has introduced methodologies and guidance that are of great benefit to aging management. NEI 03-08 mandates licensee implementation of MRP-227 into their aging management programs, and the industry has initiated a project to address the additional aging considerations for the 60- 80-year licensing period. The industry believes the best way to address management of reactor internal components is to continue use of the MRP-227-A methodology and guidance, and update it as new insights become available. To abandon this guidance and require a plant-specific AMP and basis for individual applicants would impose a substantial burden with no additional safety benefit. The aging effects being managed are not expected to be discontinuous after 60 years such that a complete break with MRP-227-A guidance is indicated. The MRP update is expected to be completed in 2020, and the first reactor could enter the second PEO in 2027. Identifying the need to update to the new MRP-227 within the XI.M16A program provides a link to ensure applicants continue to use the best available guidance, and incorporation of MRP updates can be confirmed through the 71003 inspection. Additionally, any issue that might prevent an approved update to MRP-227 could be addressed by a license renewal ISG, or by generic or even licensee-specific communications. This recommendation is expected to result in better aging

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			management of the reactor internals, and in greater GALL consistency and review efficiency, as use of a Table 2 note E and evaluation of differing AMP descriptions will not be required.
2	SRP Table 3.1.1-38 GALL IV.C1.R-08 IV.C2.R-08 SRP Table 3.1.1-50 GALL IV.C1.R-52, IV.C2.R-52	IV.C1(C2).R-08/3.1.1-38 no longer lists CASS pump casings with valve bodies as not requiring screening for thermal embrittlement susceptibility (e.g., acceptability of XI.M1 ISI as AMP). Similarly, IV.C1(C2).R-52 now includes CASS pump casings, and 3.1.1-50 text says "Cast austenitic stainless steel Class 1 piping, piping component (including pump casings and control rod drive pressure housings) exposed to reactor coolant >250 °F (>482 °C)," with management by the M12 CASS thermal embrittlement program. Restore pump casings to XI.M1 management rows, and remove pump casings from XI.M12 management rows.	Note that the May 19, 2000 Grimes letter provided screening exclusions that referenced Code case N-481, which has been annulled. By practice, ASME Section XI code cases are annulled when the appropriate provisions of the case have been incorporated into the Code and that edition / addenda of the code has been endorsed by NRC in 10CFR505.55a. Since N-481 has been annulled, the conclusion is the code committee incorporated the appropriate elements of the case into the code itself. Further, it was in an edition or addenda NRC has endorsed in 10CFR50.55a. Since ASME did not include the screening for susceptibility provisions of the code case in the code and since NRC did not condition the use of the code it is logical to conclude that the screening is not needed. As such, the use of the code case should be dropped from GALL-SLR and Section XI as written is adequate for use. Screening of CASS pump casings for thermal embrittlement susceptibility should not be needed, ASME code inspection requirements are sufficient.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
3	SRP Tables 3.1-1, 133 3.2-1, 90 3.3-1, 193 3.4-1, 81 GALL IV.A1.R-448 IV.C1.R-448 IV.C2.R-448 IV.D1.R-448 IV.D2.R-448 V.A.E-434 V.B.E-434 V.C.E-434 V.D1.E-434 V.D2.E-434 VII.A4.A-439 VII.C1.A-469 VII.E1.A-439 VII.E3.A-439 VII.E4.A-532 VII.E5.A-469 VII.G.A-651 VII.H2.A-651 VIII.A.S-432 VIII.B1.S-432 VIII.B2.S-432 VIII.C.S-432 VIII.D1.S-432 VIII.D2.S-432	SLR GALL includes 27 new rows for "Any" component/ Steel/ in Reactor coolant, Treated water, Raw water and Waste water environments/ for "Long-term loss of material due to general corrosion" / recommending only M32 (One-Time Inspection). Recommend deleting these newly added GALL / SRP rows, the definition in IX.F and the treatment in AMP XI.M32. SLR Supplement Related	The Statements of Consideration (SOC), (60 FR 22461 et al), page 22463 states that "(1) The intent of the license renewal review has been clarified to focus on the adverse effects of aging rather than identification of all aging mechanisms." It is not a requirement of the Rule to identify all "mechanisms" of aging, only the effects of aging. Adding this new term adds confusion, not clarity. "Long-term loss of material due to general corrosion" presents the same effect as "loss of material due to general corrosion"— i.e., dissolution of metallic material due to an electrochemical process involving the metal and water. There is no distinction between "aging" and "long-term aging." The new GALL has not identified any industry OE or issues that would present a different form of aging, nor aging effect, such as "long-term loss" as opposed to "aging-related loss"; so again there appears to be no justification for the addition of this term, nor for addition of any attendant AMR line items. Loss of material for steel (due to general corrosion, as well as other mechanisms) in treated water environments is already identified in other GALL rows as a potential aging effect, with recommendation for management with XI.M2 (Water Chemistry) and XI.M32 (One-Time Inspection). The XI.M32 program Table XI.M32-1 includes visual (e.g., VT-3) or volumetric examination recommendations that are capable of identifying loss of material due to general corrosion without the need for the additional Long-term loss of material row. The use of XI.M32 (One-Time Inspection) to confirm the absence of aging effects in raw water and waste water appears to be inadequate, as loss of material due to general corrosion (and other mechanisms) is expected in these environments. Existing GALL rows provide for management of loss of material due to general corrosion of steel in raw water and waste water environments with ongoing programs such as XI.M20 (Open-Cycle), XI.M27 (Fire Water) or XI.M38 (Inspection of Internal Surfaces). These programs provide for

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	VIII.E.S-432 VIII.F.S-432 VIII.G.S-432 GALL IX.F GALL XI.M32		inspections that are capable of identifying loss of material due to general corrosion.
4	SRP FE 3.2.2.2.10 3.3.2.2.10 3.4.2.2.7 SRP Tables 3.2-1, 102 3.3-1, 186 3.4-1, 102 GALL rows V.D1.E-445 V.D2.E-445 VII.C3.A-482 VII.E5.A-482 VII.H1.A-482 VIII.E.S-450 VIII.G.S-450	Multiple new GALL/SRP Table 1 rows address cracking of aluminum due to SCC. Recommendations: 1. Delete the FE text "The susceptibility of the material is to be established prior to evaluating the environment." 2. Revise FE "Aggressive Environment" text to clarify that indoor air is not expected to be aggressive provided condensation is not expected, and delete indoor air environments from the SRP Table component descriptions and from the associated GALL AMR lines 3. Provide None/ None aging effect/ AMP rows for Aluminum (where material is non-susceptible or the environment is not aggressive). See comment 5 for aluminum loss of material comment. 4. Delete the recommendation to use the XI.M42 coatings program to manage a coating barrier to aggressive environments. <u>SLR Supplement Related</u>	1. As explained in the FE text, absence of cracking is expected for either non-susceptible materials or non-aggressive environments. In some cases, determining a specific alloy may be very difficult, but the environment may be known to be non-aggressive. It's not necessary to establish the specific alloy to exclude the aging effect if the component is indoors and not subject to condensation (i.e., within an Air-indoor uncontrolled or Air-indoor controlled environment). 2. Indoor air is not expected to support cracking of aluminum unless condensation is expected. For components that operate below ambient temperature, the "Condensation" environment would result in the expectation of cracking for susceptible alloys. Absence of cracking in (non-wetted) indoor air is consistent with EPRI 1010639 (Mechanical Tools), which specifies that in addition to a susceptible alloy, cracking of aluminum is applicable when the external surface is buried or exposed to a concentration of contaminants, or is exposed to an aggressive environment in outdoor locations. A concentration of contaminants is considered to be present when "*prolonged or frequent wetting (e.g., from condensation, leakage, ponding/pooling) or alternate wetting and drying can concentrate contaminants from the atmosphere and they can thereby become aggressive species for metals. Infrequent or intermittent wetting (e.g., limited time periods with condensation) are not expected to concentrate contaminants sufficiently to become aggressive for metals.*" This conclusion is

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			also consistent with the further evaluation text at the end of the subject paragraph ("... *aqueous solutions and atmospheric air, such as outdoor air, raw water, waste water, and condensation,...*"), and with GALL AMR rows for aluminum piping and piping components other than the XI.M29 Tank rows (e.g., E-443, E-444, E-452, E-453, A-623, A-429, A-451, A-452, A-706, A-750, A-753, A-762, S-457, S-458, S-459, S-460). These rows roll up to these FE topics, but do not include indoor air as an applicable environment for cracking of susceptible alloys. 3. There are no GALL rows provided for None/None aging effects and programs, when neither cracking nor loss of material (see comment 5) is applicable. 4. It's unlikely that applicants would credit a coating to provide a barrier to an aggressive environment for these components. If an applicant chose to do so, it would require a note E for a different program either with or without this text. Additionally, the XI.M42 program scope is clearly defined to be internal coatings. Use of this program to manage external coatings may be interpreted as a program exception.
5	SRP FE 3.2.2.2.13 3.3.2.2.13 3.4.2.2.10 SRP Tables 3.2-1, 56 3.2-1, 105 3.2-1, 111 3.3-1, 223 3.3-1, 227 3.3-1, 234	Multiple new or revised GALL rows address loss of material for aluminum in air environments that include indoor air and specify a Plant-specific AMP. These rows roll up to Table 1 lines that recommend further evaluation. Recommendations: 1. Modify/add GALL/SRP rows for aluminum in air environments such that loss of material for aluminum is managed by an appropriate program (XI.M29	FE sections state that loss of material may be expected in the presence of halides and moisture. 1. The addition of line items to specify the various acceptable programs is recommended to provide GALL matches in the Table 2s such that note E does not need to be used for a program assignment that is recommended by the SRP. 2. Loss of material for aluminum is expected in outdoor environments and in indoor wetted environments (i.e., condensation). This susceptibility is identified in EPRI 1010639 (Mechanical Tools) which specifies that loss of material of aluminum is applicable when the surface is buried or exposed to a concentration of contaminants, or is exposed to an aggressive

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	3.4-1, 94 3.4-1, 97 3.4-1, 113 GALL AMR rows V.F.EP-3 V.D1.E-448 V.D2.E-448 V.E.E-454 VII.I.A-752 VII.C3.A-756 VII.E5.A-756 VII.H1.A-756 VII.J.A-763 VIII.H.S-442 VIII.E.S-445 VIII.G.S-445 VIII.I.S-461	Aboveground Metallic Tanks, XI.M36 External Surfaces, XI.M38 Inspection of Internal Surfaces or XI.M41 Buried and Underground Piping and Tanks). 2. Revise the FE sections to address a site-specific OE review to confirm that loss of material due to aging for aluminum components exposed to indoor air (other than condensation) has not been identified. If site OE indicates that aluminum exposed to indoor air (i.e., not condensation, not underground locations) has experienced loss of material due to aging, then one of the above AMPs should be assigned. Delete reference to a one-time inspection. 3. Restore None/None rows for Aluminum in air-indoor uncontrolled and air-indoor controlled to be used if the site OE review does not identify aging of aluminum exposed to air-indoor uncontrolled or air-indoor controlled. <u>SLR Supplement Related</u>	environment in outdoor locations. A concentration of contaminants is considered to be present when "*prolonged or frequent wetting (e.g., from condensation, leakage, ponding/pooling) or alternate wetting and drying can concentrate contaminants from the atmosphere and they can thereby become aggressive species for metals. Infrequent or intermittent wetting (e.g., limited time periods with condensation) are not expected to concentrate contaminants sufficiently to become aggressive for metals.*" Normal indoor air environments (Air-indoor uncontrolled, Air-indoor controlled) do not support wetting that would be expected to cause loss of material for aluminum, as confirmed by the GALL IX.F definition of these environments (wetting is not normally expected). If conditions may result in wetting, "Condensation" is specified and loss of material would be expected. The FE sections recommend that leakage of fluids from mechanical connections, such as bolted flanges and valve packing, through insulation onto a component in indoor controlled air is identified as a water source that should be considered. However, in accessible areas, leakage does not result in a long-term wetted environment to be evaluated for aging. Leakage is an event, and does not represent a long-term environment that causes aging. Identified leakage and its effects are addressed through the corrective action program. It is appropriate to consider underground environments as potentially aggressive. 3. In the absence of site specific OE that identifies degradation of aluminum in indoor air, a plant specific program to confirm the absence of aging effects in aluminum exposed to indoor air is not warranted. This recommendation is expected to result in better and more

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			consistent aging management and improved review efficiency, as evaluation of a plant-specific AMP as identified by a Table 2 note E will not be required.
6	SRP FE 3.2.2.2.2 3.2.2.2.5 3.3.2.2.3 3.3.2.2.4 3.4.2.2.2	New Further Evaluation topics for stainless steel address cracking in outdoor air, or in any air environment when the component is insulated or where the component is in the vicinity of insulated components, or in close proximity to intake vents. Recommendations: 1. Revise text describing the sources of aggressive environments as shown in the marked-up FE text. Address confirmation of the absence of cracking in indoor locations by plant OE review, similar to that of aluminum in indoor air. 2. Delete text describing leakage of threaded or bolted connections as a source of water that supports aging. 3. Delete text discussing use of a coating as a barrier to aggressive environments. Applicants have typically stated that coatings are not credited in this way, and the recommendation to monitor the coatings with the M42 coating program is not supported by the AMP text. 4. Delete the environment "Moist air" from the definitions in section IX.D, and replace with "Condensation" wherever it occurs in the tables. Condensation environment should be specified when air is moist.	1. Stainless steel is not susceptible to loss of material or cracking in indoor air environments in which wetting is not expected (i.e., other than a condensation environment). EPRI 1010639 (Mech Tools) specifies that stainless steel is potentially susceptible to cracking when the surface is buried or exposed to a concentration of contaminants, or is exposed to an aggressive environment in outdoor locations. A concentration of contaminants is considered to be present when "*prolonged or frequent wetting (e.g., from condensation, leakage, ponding/pooling) or alternate wetting and drying can concentrate contaminants from the atmosphere and they can thereby become aggressive species for metals. Infrequent or intermittent wetting (e.g., limited time periods with condensation) are not expected to concentrate contaminants sufficiently to become aggressive for metals.*" Further evaluation section 3.2.2.2.2 asserts that these aging effects are applicable in outdoor air, or in any air environment when the component is insulated or where the component is in the vicinity of insulated components, or in close proximity to intake vents. These are applicable aging effects in outdoor air, and in potentially wetted environments, but they are not expected within indoor locations for components at or above ambient temperature. Insulated or uninsulated components below indoor ambient temperature are assigned a condensation environment, and stainless steel exposed to condensation should be considered susceptible to pitting and crevice corrosion regardless of the presence of insulation, unless the absence of atmospheric contaminants can be demonstrated.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
		SLR Supplement Related	2. The FE sections recommend that leakage of fluids from mechanical connections, such as bolted flanges and valve packing, through insulation onto a component in indoor controlled air is identified as a water source that should be considered. However, in accessible areas, leakage does not result in a long-term wetted environment to be evaluated for aging. Leakage is an event, and does not represent a long-term environment that causes aging. Identified leakage and its effects are addressed through the corrective action program. It is appropriate to consider underground environments as potentially aggressive. 3. It's unlikely that applicants would credit a coating to provide a barrier to an aggressive environment for these components. If an applicant chose to do so, it would require a note E for a different program either with or without this text. Additionally, the XI.M42 program scope is clearly defined to be internal coatings. Use of this program to manage external coatings may be interpreted as a program exception. 4. Normal indoor air environments (Air-indoor uncontrolled, Air-indoor controlled) do not support wetting that would be expected to cause loss of cracking of stainless steel, as confirmed by the GALL IX.F definition of these environments (wetting is not normally expected). If conditions may result in wetting (e.g., moist air), "Condensation" should be specified and loss of material would be expected. The definition of Air-indoor uncontrolled in GALL section IX specifies that the equipment surfaces are normally dry. Similarly, the air-indoor controlled environment is expected to have a lower dewpoint than air-indoor uncontrolled, and surfaces that may be wetted would be assigned the condensation environment.
7	SRP FE 3.1.2.2.19	Numerous GALL rows for stainless steel and	Stainless steel in treated water has the potential for loss of material

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	3.2.2.2.12 3.3.2.2.12 3.4.2.2.9 SRP Tables 3.2-1, 85 3.3-1, 29 3.3-1, 125 3.3-1, 203 3.4-1, 83 3.4-1, 85 GALL AMR rows V.A.E-428 V.D1.E-428 V.D2.E-428 VII.A2.A-98 VII.A2.A-99 VII.A2.AP-79 VII.A3.AP-79 VII.A4.AP-110 VII.A4.AP-111 VII.E1.A-88 VII.E1.AP-79 VII.E3.AP-110 VII.E4.AP-110 VIII.B1.SP-87 VIII.C.SP-87 VIII.D1.SP-87 VIII.D2.SP-87	nickel in treated water environments specify "Plant specific aging management program," and link to Further Evaluation sections that describes which programs are acceptable for use. Use of these rows will require note E in Table 2s. There are 25 of these new rows in GALL. Chapter V.A, V.C, V.D1 and V.D2 contain 4 rows that recommend XI.M2 and XI.M32, and chapter VII.A4 contains one row pointing to these traditional programs. GALL chapter VIII has no rows that recommend use of the XI.M2 and XI.M32 programs for loss of material of stainless steel in treated water. Delete these Further Evaluation topics and revise/ restore rows for stainless steel and nickel alloy in various treated water environments to recommend management by XI.M2 (Water Chemistry) and XI.M32 (One-Time Inspection). This recommendation is expected to provide appropriate aging management while supporting more efficient LRA review, as note E will not need to be used.	when the halide or sulfate levels identified in these further evaluation topics are exceeded. However, these contaminant concentrations are not expected in treated water. The aging effects are managed by exclusion of these contaminants by use of the XI.M2 Water Chemistry program. For operation in the first PEO, the effectiveness of the Water Chemistry program was verified by the One-Time Inspection program. For material/environment combinations that were found to have aging effects present, corrective actions were taken or an ongoing aging management program would be required. For oxygen concentrations >100 ppb, pitting corrosion is not expected in the absence of chlorides, fluorides or sulfates. Crevice corrosion may occur, but is expected to progress very slowly such that unacceptable degradation will not occur and can be managed with the XI.M2 Water Chemistry and XI.M32 One-Time Inspection programs. Operating experience with the One-Time Inspection program confirms that loss of material for stainless steel in treated water environments is not expected to challenge component function, or corrective actions (with the potential for plant-specific programs) would have been initiated during the first PEO. Note that the intent of LR-ISG 2011-01 that addressed loss of material for stainless steel in oxygenated treated borated water (and which many of these new rows address) was that the effectiveness of XI.M2 Water Chemistry (previously recommended by itself) should be confirmed by use of the XI.M32 One-Time Inspection program, not that a different program be used. Similarly, water controlled by the XI.M2 Water Chemistry program is not expected to contain microbiological agents that could cause MIC. Unless identified by plant OE (including the completed One-Time Inspections), MIC is not expected to challenge the function of stainless steel components in treated water. For each of the potential aging mechanisms discussed in the Further Evaluations, the XI.M2 (Water Chemistry) and XI.M32 (One-Time

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	VIII.E.SP-162 VIII.E.SP-80 VIII.E.SP-81 VIII.E.SP-87 VIII.F.SP-81 VIII.F.SP-87 VIII.G.SP-162 VIII.G.SP-87		Inspection) program provide adequate aging management. Therefore, there is no need for further evaluation. Any degradation noted during the initial or second PEO by One-Time Inspection would drive evaluations for corrective action that could include an ongoing program. Note that 3.1.2.2.19 is associated with GALL chapter IV, but there are no SRP Table 3.1-1 rows that link to this FE, and there are no associated GALL IV AMR rows. This recommendation is expected to result in better and more consistent aging management and improved review efficiency, as evaluation of a plant-specific AMP as identified by a Table 2 note E will not be required.
8	SRP Tables 3.3-1, 164 3.3-1, 165 GALL AMR rows VII.C1.A-456 VII.C2.A-456 VII.C3.A-456 VII.D.A-456 VII.E5.A-456 VII.G.A-456 VII.H1.A-456 VII.H2.A-456 VII.I.A-455	Nine new rows were added to GALL section VII for management of loss of material due to causes other than selective leaching for gray cast iron in various environments. All of the new rows recommend either M36 or M38 programs. Consider deleting these rows.	The same aging effects for steel in treated water are managed by M2 and M32, for raw water by M20 (Open cycle) or M27 (Fire Water), for waste water by M36 or M38, and for air environments by various programs including M36 or M38. Non-SL aging of gray cast irons would be appropriately managed by these programs. As described in the IX.C definitions, and as established by past use, applicants may simply align the GCI components to GALL rows for steel to address these other loss of material mechanisms. These rows do not appear to provide any additional flexibility or different guidance, and are present only within GALL Chapter VII.
9	SRP FE 3.3.2.2.8 SRP Table 3.3-1, 172	Three new GALL rows address aging of PVC in "Sunlight" environment by use of a plant-specific program. Recommend: 1. Revise environment to "Air – outdoor"	1. This environment is not defined, and would apply only to this material. The addition of these rows is a benefit, as they provide recommendations for an aging effect that industry has previously identified, but was not previously addressed in GALL. However, sunlight is only expected in (some) outdoor environments, and

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	GALL AMR Rows VII.C1.A-458 VII.E5.A-458 VII.G.A-458	and 2. Recommend management by the XI.M36 "External Surfaces Monitoring" program. With this program assignment, the FE text may be deleted.	there is no GALL row that corresponds to an outdoor air environment that is shaded (e.g., in a manhole, or under some open-air structure) and does not exhibit aging effects. Without the addition of an air-outdoor line that does not support the aging effect, simply calling this environment air-outdoor is conservative, and fills a gap in the environments addressed for PVC. 2. The XI.M36 "External Surfaces Monitoring" program is normally recommended for external surfaces that aren't specifically addressed by another program. The naming of aging effects for polymers varies according to the references cited: EPRI 1010639 (Mechanical Tools) refers to "loss of strength," which corresponds to the XI.M36 "changes in material properties (such as hardening and loss of strength)" and to "reduction in impact strength." EPRI 1007933 (Aging Assessment Field Guide) identifies several types of UV degradation of elastomers and polymers. UV degradation that results in "reduced strength, spontaneous fracture" (corresponding to reduction in impact strength) is normally accompanied by visible indications of age related degradation, such as yellowing or other discoloration, chalking, and surface crazing. XI.M36 addresses aging of polymers and is an appropriate program for management of aging of PVC external surfaces. If this program is recommended, no further evaluation would be needed. This recommendation is expected to result in better and more consistent aging management and improved review efficiency, as evaluation of a plant-specific AMP as identified by a Table 2 note E will not be required.
10	SRP FE 3.1.2.2.15 SRP Table	New GALL rows address loss of material due to boric acid corrosion for steel with stainless steel or nickel alloy cladding SG heads exposed to reactor coolant. An associated	The OE referenced in FE 3.1.2.2.15 which forms the basis for these rows describes the consequences of a manufacturing defect, not an aging effect that is expected for steel with stainless or nickel alloy cladding.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	3.1-1, 127 GALL AMR rows IV.D1.R-436 IV.D2.R-440	Further Evaluation topic describes foreign OE about an area of missing cladding that allowed boric acid attack during shutdown. Recommend deleting these GALL rows, SRP row 3.1-1, 127, and FE 3.1.2.2.15.	Additionally, the potential for this degradation is adequately managed by AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and AMP XI.M2, "Water Chemistry" as recommended by IV.D1.RP-232 and IV.D2.RP-47, which address cracking of steel-with-stainless-steel-cladding SG primary components. Since these line items are intended to ensure the integrity of the stainless steel cladding (inspections for cracking), they are also sufficient to ensure that any areas of missing cladding are identified and corrected. With management by the XI.M1 program, no further evaluation is needed. A similar issue was identified at the Callaway plant where a cladding breach in the reactor vessel was identified during ASME Inservice Inspection of the reactor vessel. The Callaway license renewal SER (NUREG-2172 , ML15068A342) section 3.0.3.1.4 (Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components) addressed the cladding breach and the adequacy of the associated aging management. RAI B2.1.5-4, B2.1.5-4a and B2.1.5-4b were issued requesting that the applicant describe the inspection methods and frequency of the subsequent inspections of the cladding indications as defined in the applicant's program and describe the technical basis for why the inspection method and frequency are adequate to manage the degradation of cladding and reactor vessel. The applicant provided details of the inspections and stated that they were consistent with the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWB program. The staff reviewed the responses and found the applicant's response acceptable because the applicant clarified that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program will perform depth measurements of the indications using an examination method that is capable of measuring the depths, consistent with ASME Code Section XI.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			This OE confirms the expectation that implementation of the ASME code inspections per the XI.M1 program is adequate to identify cladding breaches and establish appropriate corrective actions. This recommendation is expected to result in better and more consistent aging management and improved review efficiency, as evaluation of a plant-specific AMP as identified by a Table 2 note E will not be required.
11	SRP Tables 3.1-1, 69 3.1-1, 125 GALL AMR rows IV.D1.R-47 IV.D1.R-48 IV.D1.R-437 IV.D2.R-47 IV.D2.R-48 IV.D2.R-442	New GALL rows address cracking of SG tubes at tube support plate locations due to flow-induced vibration or high-cycle fatigue. Recommend combining all cracking mechanisms (R47, R-48 and R-437/R-442) for the external surfaces of the SG tubes into one IV.D1 row and one IV.D2 row. See markup.	These rows are redundant, as the aging effect (cracking) is managed over the entire tube length with the same programs that are recommended by this row via R-47 & R-48. Citing multiple GALL rows for the same component, material, environment, aging effect, and programs does not add value, may result in a confusing Table 2 presentation, and may be difficult to implement with some LR databases.
12	SRP Tables 3.3-1, 156 3.3-1, 173 3.4-1, 33 3.4-1, 92 GALL AMR rows VII.H1.A-660 VII.H1.A-667 VIII.E.S-439 VIII.E.S-440 VIII.F.S-439 VIII.F.S-440	VII.H1.A-660 and VII.H1.A-667 are adjacent in table VII.H1 and appear to be redundant (exactly the same table entries, but with different SRP links). Similarly, S-439 and S-440 appear to be redundant, appearing in VIII.E, VII.F and VIII.G. Recommend deleting redundant rows.	Identical entries for A-660 (3.3-1, 156) and A-667 (3.3-1, 173), with minor differences in the Table 1 wording. The Table 1 items are used for multiple other GALL rows. Identical entries for S-439 (3.4-1, 92) and S-440 (3.4-1, 33) with differences in the Table 1 environments (both include the environments in S-439 and S-440). A-667 is used in VII.H2 without A-660, so deleting A-660 will eliminate duplicate entry without losing needed row in VII.H1. S-439 is used without S-440 in VIII.D1 and VIII.D2, so deleting S-440 will eliminate duplicates without losing needed rows in VIII.D1 and VIII.D2.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	VIII.G.S-439 VIII.G.S-440		
13	SRP Table 3.2-1, 73 3.3-1, 139 3.4-1, 67 GALL AMR rows V.A.E-414 V.B.E-414 V.C.E-414 V.D1.E-414 V.D2.E-414 VII.A2.A-414 VII.A3.A-414 VII.A4.A-414 VII.C1.A-414 VII.C2.A-414 VII.C3.A-414 VII.D.A-414 VII.E1.A-414 VII.E2.A-414 VII.E3.A-414 VII.E4.A-414 VII.E5.A-414 VII.F1.A-414 VII.F2.A-414 VII.F3.A-414 VII.F4.A-414 VII.G.A-414 VII.H1.A-414	Modified GALL rows for management of "Any material with an internal coating/lining" and a variety of fluid environments now list cracking due to stress corrosion cracking as an aging effect. Recommend deletion of cracking from these GALL rows.	Cracking was not previously listed as an aging effect for components with an internal coating. Cracking within internal fluid environments is not expected for metals other than stainless steel, and is not expected for stainless steel at temperatures below 140F. Most coatings/linings are made of a polymeric material, and would not normally be used in applications at higher temperatures. Therefore, it's very unlikely that an applicant will find cracking to be an applicable aging effect for internally coated components. With cracking listed in GALL as an aging effect for any material with an internal coating, and in many fluid environments, these rows have the potential to add confusion and review burden. Most applicants will probably not list cracking as an aging effect when citing these rows in AMR Table 2s. Reviewers may be compelled to question the absence of this aging effect when applicants claim consistency with these line items. This change is intended to reduce confusion and improve review efficiencies.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	VII.H2.A-414 VIII.A.S-414 VIII.B1.S-414 VIII.B2.S-414 VIII.C.S-414 VIII.D1.S-414 VIII.D2.S-414 VIII.E.S-414 VIII.F.S-414 VIII.G.S-414		
14	SRP FE 3.3.2.2.12 SRP Table 3.3-1, 28 GALL AMR row VII.E1.AP-82	This GALL row was added to GALL R2 by LR-ISG-2011-01 to address the potential for cracking of stainless steel in treated borated water when oxygen concentration is controlled. It links to SRP Table 1 item 3.3-1, 28, which was not previously associated with a Further Evaluation topic. The modified AMR row now recommends management with a plant-specific program, and links to Further Evaluation topic 3.3.2.2.12. Consider restoring the temperature regime ">60°C (>140°F)," changing the program recommendation to AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection," and deleting the SRP 3.3-1, 28 reference to FE 3.3.2.2.12.	This GALL row was added by LR-ISG-2011-01 to address the potential for cracking of stainless steel in treated borated water >140F with oxygen levels controlled, such that the potential for cracking could be managed by the XI.M2 "Water Chemistry" program alone (without use of XI.M32 "One-Time Inspection"). The revision in SLR GALL removed both the temperature and oxygen regimes specification and replaced the program recommendation with a plant-specific program. Cracking is not expected in stainless steel with internal fluid environments controlled by water chemistry unless the temperature is >140F. Management with the XI.M2 and XI.M32 programs has been effective, and is the preferred aging management recommendation for this material/environment/aging effect combination. Further Evaluation topic 3.3.2.2.12 was linked to SRP Table 1 item 3.3-1, 28, but does not address cracking, so it is not applicable to 3.3-1, 28. See also comment #7 for additional justification for specifying XI.M2 and XI.M32 in lieu of a plant-specific program. This recommendation is expected to result in better and more consistent aging management and improved review efficiency, as

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			evaluation of a plant-specific AMP as identified by a Table 2 note E will not be required.
15	SRP Table 3.4-1, 83 GALL AMR rows VIII.E.SP-162 VIII.G.SP-162	Rows are for stainless steel tanks. Delete "general (steel only)" from aging effect / mechanism column.	Rows are for stainless steel only. Steel (and general corrosion) are not applicable to these rows. Also see comment #7 for other recommendations associated with these lines (program recommendation, FE link).
16	SRP Table 3.1-1, 122 GALL AMR rows IV.C1.R-429 IV.C2.R-429	These two new rows group steel, stainless steel, nickel alloy and copper alloys together, in environments of air-indoor, uncontrolled, and condensation, with Loss of material due to general (steel, copper alloy only), pitting, crevice corrosion. Delete stainless steel, nickel alloy and copper alloy from the material list, delete "(steel, copper alloy only)" and delete condensation from the environment list.	This row may imply to reviewers that stainless steel in indoor air is expected to be susceptible to loss of material due to pitting and crevice corrosion. EPRI 1010639 (Mech Tools) specifies that copper alloys are not susceptible to general corrosion except in fluid environments, and stainless steel, nickel alloys and copper alloys are potentially susceptible to loss of material due to pitting and crevice corrosion when the surface is buried or exposed to a concentration of contaminants, or is exposed to an aggressive environment in outdoor locations. A concentration of contaminants is considered to be present when "*prolonged or frequent wetting (e.g., from condensation, leakage, ponding/pooling) or alternate wetting and drying can concentrate contaminants from the atmosphere and they can thereby become aggressive species for metals. Infrequent or intermittent wetting (e.g., limited time periods with condensation) are not expected to concentrate contaminants sufficiently to become aggressive for metals.*" This environment is not expected within indoor air for components not exposed to condensation. See comment #6 for similar issue. Only steel is susceptible to loss of material in air-indoor uncontrolled. GALL rows IV.C1.R-431 and IV.C2.R-431 (both linking to 3.1-1, 124) address loss of material for Steel; stainless steel, nickel alloy; copper alloy exposed to condensation. Therefore, these portions of IV.C1.R-429 and IV.C2.R-429 imply aging effects that are not applicable for

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			some M/E combinations, and may potentially cause confusion and additional review burden.
17	SRP Tables 3.2-1, 99 3.2-1, 106 V.D1.E-449, V.D2.E-449 V.E.E-442	Multiple GALL R2 rows for loss of material for tanks of various metals in outdoor air environments, managed with M29 (Aboveground tanks) were changed or deleted and replaced with new rows for stainless steel. Recommend adding aluminum material to the rows at left.	There are no longer any rows for tanks/ aluminum / outdoor air environments / loss of material / M29. See comment #5 for related issue.
18	SRP Tables 3.2-1, 99 3.3-1, 67 3.3-1, 129 3.3-1, 222 3.3-1, 225 3.4-1, 29 3.4-1, 93 GALL AMR rows V.E.E-442 VII.H1.A-402 VII.H1.A-95 VII.I.A-751 VII.I.A-754 VIII.A.S-441 VIII.B1.S-441 VIII.B2.S-441 VIII.C.S-441 VIII.D1.S-441 VIII.D2.S-441	Editorial: Most GALL/SRP rows that recommend the XI.M29 , "Aboveground Metallic Tanks" program list program applicability in the Structure and/or Component column (i.e., Tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks")). These rows do not specify program applicability to the tank components. Consider adding program applicability to component column.	Consistency with other GALL/SRP rows. Additionally, tanks that are not within the scope of the M29 program should not be assigned to it for aging management. Note that the converse is also applicable: numerous rows for which the component type is listed similar to 'Tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks")' do not specify the M29 program for management. Instead, these rows specify a plant-specific program. Incorporation of comment #5 should address these items.

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#	Location of Change	Description of Change	Justification For Change
	VIII.E.S-31 VIII.E.S-441 VIII.F.S-441 VIII.G.S-31 VIII.G.S-441		
19	SRP Table 3.3-1, 39 GALL AMR rows IV.C1.RP-230 IV.C2.RP-235 GALL XI XI.M35	Editorial: SRP and GALL AMR rows refer to the XI.M35 program as ""One-Time Inspection of ASME Code Class 1 Small-bore Piping," while the program title/description in GALL XI is "ASME Code Class 1 Small-Bore Piping." Consider making SRP and AMR line titles match the Chapter XI program title.	Titles don't match. Program now includes an ongoing portion based on plant OE, so it is not always a One-Time program.
20	New SRP row New GALL rows	Consider addition of new GALL rows for the following titanium MEAs: HX tubes / Titanium / Treated water / Reduction of heat transfer / XI.M2 & XI.M32 Piping components, HX components other than tubes / Titanium (ASTM Grades 1, 2, 7, 11, or 12) / Treated water / None / None HX tubes / Titanium / Closed cycle cooling water / Reduction of heat transfer / XI.M2 & XI.M32 Piping components, HX components other than tubes / Titanium (ASTM Grades 1, 2, 7, 11, or 12) / Closed cycle cooling water / None / None	SLR GALL addresses titanium in some environments, but does not include some other environments in which titanium is used. Reduction of heat transfer due to fouling for titanium tubes is identified as a potential aging effect in EPRI 1010639 (Mechanical Tools) appendix H for titanium tubes in treated water. The Mechanical Tools does not identify reduction of heat transfer for titanium tubes in Closed-cycle cooling water, but assumes that corrosion inhibitors and biocides are employed in CCCW to preclude fouling. The GALL Closed-cycle cooling water environment definition does not assume these additives, so it was compared to the Mechanical Tools' Treated water environment for this evaluation. Absence of aging effects for other piping and HX components in these environments is identified in EPRI 1010639 (Mechanical Tools) appendix A. Loss of material due to crevice corrosion is not expected at temperatures below 160F (and requires the presence of oxygen and other contaminants above 160F), which is not present in the Treated water (as opposed to Treated water >140F) environment, or in the

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			Closed cycle cooling water environment. Cracking is not expected in ASTM grades 1, 2, 7, 11, or 12 Titanium (and requires the presence of chlorides and other alloying constituents in other alloys). No other potential aging effects are identified in Treated water environments in the Mechanical Tools.
21	SRP sections 1.1.5, 2.1.5, 2.2.5, 2.3.5, 2.4.5, 2.5.5, 3.1.5, 3.2.5, 3.3.5, 3.4.5, 3.5.5, 3.6.5, 4.1.5, 4.2.5, 4.3.5, 4.4.5, 4.5.5, 4.6.5, 4.7.5	SRP text allows for the proposal of acceptable alternative methods to those described in the GALL/SRP, but no guidance is provided for the determination of acceptability. Consider adding the following statement to the "Implementation" sections identified: "Alternatives should be considered acceptable if: 1. They provide reasonable assurance that component intended functions will be maintained, or 2. If consistency with GALL/SRP recommendations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."	The first criterion (reasonable assurance that component intended functions will be maintained) is consistent with the discussion of aging management reviews in SRP Appendix A, section A1.1: "The subsequent license renewal (SLR) process is not intended to demonstrate absolute assurance that SCs will not fail, but rather that there is reasonable assurance that they will perform such that the intended functions are maintained consistent with the CLB during the subsequent period of extended operation." The second criterion is similar to that provided in 10 CFR 50.55a(z)(2) for acceptable alternatives to code requirements.
22	SRP FE 3.1.2.2.12	Section 3.1.2.2.12 (Cracking Due to Irradiation-Assisted Stress Corrosion Cracking) of the draft SRP-SLR includes 1) – IASCC of BWR Internals Although not described in Section XI.M9, this	(1) In the case of internals components subject to substantial neutron fluence, there is a robust existing database that can be used to characterize irradiated material performance. BWRVIP guidance for reactor internals subject to significant fluence include NRC-accepted evaluation standards that can be used to manage BWR reactor

GALL / SRP comments			
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		SRP-SLR section contains a "further evaluation" item associated with IASCC of BWR reactor internals. The concern expressed is that "increases in neutron fluence during the SLR term may need to be assessed for supplemental inspections of BWR vessel internals to adequately manage cracking due to IASCC" However, this further evaluation discussion appears to be applied to many BWR internals, a significant number of which are exposed to fluences well below accepted thresholds for onset of irradiation effects in austenitic materials. The discussion also indicates that supplemental inspections may be needed. However, technical bases for recommending supplemental inspections are not included and there are no criteria that can be used by an applicant to ensure that the intent of this review item is satisfied. Recommend deletion of this FE topic, or identification of specific guidance. 2) - SRP-SLR Section 3.1.2.2.12 (2) – IASCC of BWR Access Hole Covers (AHCs) Similar to the discussion in Section 3.1.2.2.12 (1), this SRP section describes the need for further evaluation to address IASCC of BWR AHCs. IASCC of AHCs should be eliminated.	internals through the end of an SLR period. For example, BWRVIP-76 Rev. 1-A, BWRVIP-99-A, and BWRVIP-100-A include guidance for management of core shroud welds for EOL fluences as high as 1E22 n/cm2, $E \geq 1.0$ MeV. This fluence value bounds U.S. designed BWR through an 80-year service life. (2) The fluence at the AHC is insignificant, at least an order of magnitude below the threshold for onset of irradiation effects in austenitic materials.
23	SRP FE 3.1.2.2.14	Core Plate Holddown Bolts	This discussion implies that, regardless of analytical results, enhanced

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		SPR-SLR Section 3.1.2.2.14 addresses loss of preload in core plate holddown bolts due to stress relaxation: For SLRAs that apply to BWRs with core plate rim holddown bolts, the NRC staff recommends that an enhanced augmented inspection basis for the bolts be proposed and justified, with a supporting loss of preload analysis. If an existing NRC-approved analysis for the bolts exists in the CLB and conforms to the definition of a TLAA, the applicant should identify the analysis as a TLAA for the LRA and demonstrate how the analysis is acceptable in accordance with either 10 CFR 54.21(c)(1)(i), (ii), or (iii). Comment: This discussion implies that, regardless of analytical results, enhanced inspections of core plate holddown bolts are required for SLR. The content should be clarified to indicate that inspections are only required if there is not an adequate technical basis to justify continuation of the inspection exemption.	inspections of core plate holddown bolts are required for SLR. The content should be clarified to indicate that inspections are only required if there is not an adequate technical basis to justify continuation of the inspection exemption.
24	SRP FE 3.1.2.2.17	Section 3.1.2.2.17 of the draft SRP-SLR includes discussion related to further evaluation of management of IGSCC by XI.M7, BWR SCC, in the case of stagnant piping sections: "...these programs may need to be	It is true that hydrogen water chemistry technologies are not effective for some stagnant locations. However, BWRVIP-75-A includes the following language that was added to the applicable sections of BWRVIP-75-A as agreed by the BWRVIP and NRC and documented in the NRC SE for BWRVIP-75: "In addition, locations having attributes that would promote IGSCC

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#	Location of Change	Description of Change	Justification For Change
		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. Further evaluation is recommended 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." **Comment:** On the basis that the NRC review of BWRVIP-62 Revision 1 did not identify concerns with this guidance for dead legs, the BWRVIP maintains that the further evaluation recommendation in Section 3.1.2.2.17 of the SRP-SLR is not needed.	should have higher priority for inspection. The attributes that may be considered include: high carbon or low ferrite content, crevice or stagnant flow condition, evidence of weld repair, surface cold work, and high fit-up, residual and operating stresses." Additionally, Section 4.5 of BWRVIP-62 Revision 1 provides specific guidance for demonstrating mitigation in dead legs. BWRVIP-62 Revision 1 has been reviewed by NRC. None of the RAIs relate to the BWRVIP treatment of mitigation effectiveness demonstration for dead legs. Thus, existing guidance is available for use in determining the mitigation status for welds located in dead leg locations.
25	SRP-SLR, Administrative Information, Page 1.1-1, Lines 23 and 24	Starting on line 23 of the referenced section, there is a statement, "However, if the NRC staff approves the aging management activities provided in the renewal application before the NRC makes a final determination on the SLRA, the approved applicant may conduct aging management activities during the timely renewal period using the aging management programs (AMPs) included in the SLRA." Include clarification that staff approval is indicated by publication of the SER (if that is	Clarify how staff approval is to be determined by the applicant, when SLRA has not been approved.

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#	Location of Change	Description of Change	Justification For Change
		the intent of the text).	
26	SRP-SLR, Administrative Information, sub-section 1.1.2.2, Page 1.1-2, Lines 8-10	Recommend deleting the last eight words from the sentence as follows: In accordance with 10 CFR 2.109(b), a license renewal application is timely if it is submitted at least 5 years before the expiration of the current operating license (unless an exemption is granted) ~~and if it is determined to be sufficient~~.	Determination of timeliness is separate from determination of sufficiency, as defined in 10 CFR 2.109(b).
27	SRP-SLR, Administrative Information, Table 1.1-1, Section I.2.B.b Page 1.1-5	Recommend eliminating the need to provide 13 copies of application.	10 CFR 50.4 doesn't currently require 13 copies of application. Many CD copies are provided to the Project Manager for the staff's use.
28	SRP Sub-Section A.1.2, page A.1-7, lines 1-4	The sentence beginning on line 1, with "Corrective action is taken, such as piping replacement, ..." does not make sense. Suggested text is "Corrective action is taken, such as piping replacement, ~~before deadweight, seismic, and other loads, and this acceptance criterion must be appropriate~~ to ensure that the thinned piping would be able to carry ~~these~~ its CLB design loads."	Editorial – sentence garbled.
29	SRP-SLR Page xxxiii, Line 8	Change the first sentence on Line 8 as follows: The ~~appendices~~ Appendix A to the SRP-SLR lists branch technical positions and provides review guidance related to use of operating experience for aging management programs.	There is only one Appendix (Appendix A), and the guidance provided relative to Operating Experience for Aging Management Programs is not a branch technical position; rather, it is an insert from LR-ISG-2011-05.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
30	GALL section XI, page XI-5	After the section GUIDANCE ON USE OF LATER EDITIONS/REVISIONS OF VARIOUS INDUSTRY DOCUMENTS, add: <u>GUIDANCE ON THE USE OF PAST PRECEDENCE TO EVALUATE EXCEPTIONS TO AGING MANAGEMENT PROGRAMS</u> <u>To aid applicants in the evaluation of aging management program exceptions, an applicant may justify the exception by identifying that the exception was previously approved for the plant under review. To take this approach, the applicant is to confirm that the exception was previously approved and the applicant's exception and associated justification is consistent with the review in the applicant's initial License Renewal Safety Evaluation. An applicant may also use past precedence from another plant to justify the exception. To take this approach, the applicant is to confirm that the exception was previously approved and the applicant's exception and associated justification is consistent with the review in the reference plant's License Renewal Safety Evaluation.</u>	Provide guidance to aid in acceptance review of previously approved exceptions.
31	SRP section 3.0.1, page 3.0-4, lines 25-28	Lines 25-28 should be revised as follows: If a GALL-SLR Report AMP is selected to manage aging, the applicant may take one or more exceptions to specific GALL-SLR Report AMP program elements. <u>Exceptions are</u>	Provide guidance to aid in acceptance review of previously approved exceptions.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
		portions of the GALL-SLR Report AMP that the applicant does not intend to implement. ~~However, any~~ Any deviation or exception to the GALL-SLR Report AMP should be described and justified. The applicant may identify that the exception was previously approved for the plant under review. In this instance the reviewer is to confirm that the exception was previously approved and the applicant's exception and associated justification is consistent with the review in the applicant's initial License Renewal Safety Evaluation. The applicant may also use past precedence from another plant to justify their exception. In this instance, the reviewer is to confirm that the exception was previously approved and the applicant's exception and associated justification is consistent with the review in the reference plant's License Renewal Safety Evaluation.	
32	GALL VII.A2, page VII.A2-1	Change first sentence to read: "This section discusses those structures and components (SCs) used for spent fuel storage and includes ~~stainless steel (SS)~~ spent fuel storage racks (typically made of stainless steel) and neutron-absorbing materials (e.g., Boraflex, Boral®, or boron-steel sheets, if used) submerged in chemically treated oxygenated boiling water reactor (BWR) or borated pressurized water reactor (PWR) water."	Some racks utilize varying types of aluminum as the structural materials instead of stainless steel. Stainless steel is typical, but is not used exclusively.

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
33	GALL VII.A2 Page VII.A2-1, line 7	Revise second sentence to read: "~~Boraflex~~ Neutron absorber sheets fastened to the storage cells provide for neutron absorption and help maintain subcriticality of spent fuel assemblies in the spent fuel pool (SFP).	Sentence should apply to all types of neutron absorbers.
34	GALL VII.A2 Page VII.A2-1, line 12, 13	Revise sentence to read: "In some plants, the Boraflex has been replaced by ~~Boral® or boron steel~~ metallic based absorber materials.	The majority of modern Boraflex replacements have been made by using Boralcan or Metamic. The reference to BORAL and boron steel (1 plant) may not represent the typical configuration.
35	SRP-SLR section 3.1.3.2.3, page 3.1-16, lines 41-42	Why is the safety evaluation for MRP-227, Revision 0 (i.e., no SLR) being referenced herein? Recommend deleting the MRP-227 Revision 0 reference. Furthermore, the Applicant/Licensee Action Item (A/LAI) being referenced in this sentence appears to be A/LAI 8, parts 3, 4, and 5.	These A/LAI parts are only required for applicants who submit applications for (first) license renewal after the issuance of the MRP-227 Rev 0, safety evaluation. There is no allowance in A/LAI 8 for second license renewal (SLR) in relation to the aforementioned safety evaluation.
36	SRP-SLR section 4.2.3.1.3.2, page 4.2-9, lines 21, 24	The temperature difference (standard deviation) Fahrenheit to Celsius conversion is performed incorrectly.	Δ°F = 1.8*Δ°C. That is, the deviations should be 15.6°C and 7.8°C rather than -2.2°C and -10°C.
37	GALL Table IX.D, page IX D-2	(Environment) Air with metal temperature up to 288°C [550°F]– delete and replace with air-indoor uncontrolled	This environment applies to GALL AMR line IV.C2-R-19 for cracking and cyclic loading of pressurizer integral supports that is managed by XI.M1 ASME Section XI Inservice Inspections Subsection IWB, IWC, and IWD. Due to the unique component, a high temperature environment during normal plant operations would be assumed for this component. Specifying a 288°C environment is not necessary.
38	GALL Table IX.D,	(Environment) Air with steam or water	This environment applies to a series of GALL lines for cracking and loss

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
	page IX D-2	leakage – delete and replace with air-indoor uncontrolled	of material of closure bolting that is managed by XI.M18, Closure Bolting Program. AMR lines that apply to closure bolting cracking identify high strength steel bolts as the applicable component. In addition, AMP XI.M18 manages the closure bolting environments to periodically inspect for system leakage and correct its cause.
39	GALL Table IX.D, page IX D-2	(Environment) Air with reactor coolant leakage – delete and replace with air-indoor uncont rolled	With exception of TLAA lines, this environment applies to a series of GALL lines for cracking and loss of material of closure bolting that are managed by XI.M18, Closure Bolting Program or XI.M3 Reactor Head Closure Stud Bolting. AMR lines that apply to closure bolting cracking identify high strength steel bolts as the applicable component. In addition, AMP XI.M18 manages the closure bolting environments to periodically inspect for system leakage and correct its cause. TLAA lines assume a high temperature environment to produce the thermal cycle or cyclic loading required for the TLAA.
40	GALL AMR rows IV.A2.R-74 and IV.A1.R-61, pages IV A2-2, IV A1-7	(Environment) Air with reactor coolant leakage (internal) - for this and the reactor coolant environments in AMR lines, replace both with air-indoor uncontrolled	AMR lines associated with this environment also identify reactor coolant as an environment. Both environments should be deleted and replaced with the air-indoor uncontrolled environment. The two plant specific AMR lines associated with this environment manage cracking of the top hat/vessel flange leak detection lines. Recommend that the further evaluation describe the potential for reactor coolant leakage environment in these top hat/vessel flange leak detection lines.
41	GALL Table IX.D, page IXD-3	(Environment) Gas (internal) – revise environment description to clarify and show applicability regarding compressed air systems	The gas (internal) environment for instrument and service air systems is recommended to apply to system components downstream of the system air dryers and would be evaluated as no aging effects and no aging management. In addition to maintaining internal air quality downstream of the compressed air system dryers; XI.M24, Compressed Air Monitoring, would perform ~~a one-time~~ an opportunistic inspection to confirm that unacceptable degradation is not occurring downstream of the dryers and ensure the intended functions of affected components are maintained during the period of

GALL / SRP comments			
#	Location of Change	Description of Change	Justification For Change
			extended operation. The dryers and upstream components would be evaluated in an air indoor uncontrolled or condensation environment with applicable aging effects managed by XI.M38, Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components. Use of XI.M24 does not change the docketed response to GL 88-14 for the rest of the plant operations.

Attachment 2

NUREG-2191 and NUREG-2192 Markups for Mechanical Comments (Non-AMP)

Comment #1: PWR Reactor Vessel Internals

SRP 3.1.2.2.9 Aging Management of Pressurized Water Reactor Vessel Internals (Applicable to subsequent License Renewal Periods Only)

[First two paragraphs unchanged]

~~Therefore, for PWR facilities' SLRAs, a plant-specific AMP for the RVI components will be needed to demonstrate that the RVI components will be managed in accordance with the requirements of 10 CFR 54.21(a)(3) during the proposed SLR period. Components for inspection, parameters monitored, monitoring methods, inspection sample size, frequencies, expansion criteria, and acceptance criteria are to be justified in the SLRA. The NRC staff will assess the adequacy of the plant-specific AMP against the criteria for the 10 AMP program elements that are defined in Sections A.1.2.3.1 through A.1.2.3.10 of SRP-SLR Appendix A.1.~~

The industry is preparing an update of MRP-227 to address aging effects and relevant time-dependent aging parameters through a cumulative 80-year licensing period. Therefore, applicants may credit the XI.M16A program, which references the industry action to update the program for a cumulative 80-year licensing period.

Restore GALL AMP XI.M16A, with the following text appended to element 10 (Operating Experience):

Licensees crediting this program for management of aging of PWR reactor vessel internal components for a second license renewal must update their program implementation to include the guidance of the upcoming MRP-227 revision that will address aging considerations in the 60-year to 80-year licensing period. This update must be performed prior entering the second period of extended operation (i.e., prior to 60 years of operation).

Comment #1 SRP Table 3.1-1 (Reactor Vessel Internals)

N	118	PWR	Stainless steel, nickel alloy PWR reactor vessel internal components exposed to reactor coolant, neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, cyclical loading, fatigue	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry" and AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-423 IV.B3.R-423 IV.B4.R-423

N	119	PWR	Stainless steel, nickel alloy PWR reactor vessel internal components exposed to reactor coolant, neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement or thermal aging embrittlement; changes in dimensions due to void swelling or distortion; loss of preload due to thermal and irradiation enhanced stress relaxation or creep; loss of material due to wear	~~Plant-specific aging management program~~ AMP XI.M16A, "PWR Vessel Internals"	Yes (SRP-SLR Section 3.1.2.2.9)	IV.B2.R-424 IV.B3.R-424 IV.B4.R-424

Comment #1 GALL IV table example: other rows listed in comment are similar

N	IV.B2.R-423	3.1-1, 118	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant, neutron flux	Cracking due to stress corrosion cracking, irradiation-assisted stress corrosion cracking, cyclical loading, fatigue	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry" and AMP XI.M16A, "PWR Vessel Internals"	Yes

N	IV.B2.R-424	3.1-1, 119	Reactor vessel internal components	Stainless steel; nickel alloy	Reactor coolant, neutron flux	Loss of fracture toughness due to neutron irradiation embrittlement or thermal aging embrittlement; changes in dimensions due to void swelling or distortion; loss of preload due to thermal and irradiation enhanced stress relaxation or creep; loss of material due to wear	~~Plant-specific aging management program~~ AMP XI.M16A, "PWR Vessel Internals"	Yes

Comment #2 CASS pump casings: SRP Table 3.1-1

M	38	BWR/PWR	Cast austenitic stainless steel Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant >250 °C (>482 °F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD." For pump casings and valve bodies, screening for susceptibility to thermal aging is not necessary. The ASME Section XI inspection requirements are sufficient for managing the effects of loss of fracture toughness due to thermal aging embrittlement of CASS pump casings and valve bodies.	No	IV.C1.R-08 IV.C2.R-08
M	50	BWR/PWR	Cast austenitic stainless steel Class 1 piping, piping component, and ~~(including pump casings and~~ control rod drive pressure housings~~)~~ exposed to reactor coolant >250 °F (>482 °C)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No	IV.A2.R-77 IV.C1.R-52 IV.C2.R-52

Comment #2 GALL IV table example: other rows listed in comment are similar

M	IV.C1.R-52	3.1-1, 50	Class 1 piping~~,~~ and piping components~~, including pump casings~~	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)"	No
M	IV.C1.R-08	3.1-1, 38	Class 1 pump casings; valve bodies and bonnets	Cast austenitic stainless steel	Reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections	No

Comment #3 SRP Table 3.1-1, 3.2-1, 3.3-1, and 3.4-1 (other table items listed in comment are also applicable)

~~N~~	~~133~~	~~BWR/PWR~~	~~Steel components exposed to reactor coolant or treated water~~	~~Long-term loss of material due to general corrosion~~	~~AMP XI.M32, "One-Time Inspection"~~	~~No~~	~~IV.A1.R-448~~ ~~IV.C1.R-448~~ ~~IV.C2.R-448~~ ~~IV.D1.R-448~~ ~~IV.D2.R-448~~
~~N~~	~~90~~	~~BWR/PWR~~	~~Steel components exposed to treated water, raw water~~	~~Long-term loss of material due to general corrosion~~	~~AMP XI.M32, "One-Time Inspection"~~	~~No~~	~~V.A.E-434~~ ~~V.B.E-434~~ ~~V.C.E-434~~ ~~V.D1.E-434~~ ~~V.D2.E-434~~
~~N~~	~~193~~	~~BWR/PWR~~	~~Steel components exposed to treated water, raw water, waste water~~	~~Long-term loss of material due to general corrosion~~	~~AMP XI.M32, "One-Time Inspection"~~	~~No~~	~~VII.A4.A-439~~ ~~VII.C1.A-469~~ ~~VII.E1.A-439~~ ~~VII.E3.A-439~~ ~~VII.E4.A-532~~
~~N~~	~~81~~	~~BWR/PWR~~	~~Steel components exposed to treated water, raw water~~	~~Long-term loss of material due to general corrosion~~	~~AMP XI.M32, "One-Time Inspection"~~	~~No~~	~~VIII.A.S-432~~ ~~VIII.B1.S-432~~ ~~VIII.B2.S-432~~ ~~VIII.C.S-432~~ ~~VIII.D1.S-432~~

Comment #3 SRP GALL section VII example (other rows listed in comment are also applicable)

~~N~~	~~VII.G.A-651~~	~~3.3-1, 193~~	~~Any~~	~~Steel~~	~~Treated water, raw water, waste water~~	~~Long-term loss of material due to general corrosion~~	~~AMP XI.M32, "One-Time Inspection"~~	~~No~~

Comment #3 GALL section IX.F

~~Long-term loss of material~~ ~~Long term loss of material is associated with general corrosion of steel components exposed to a water environment that has not included corrosion inhibitors as a preventive action [i.e., treated water, reactor coolant, raw water, or waste water]. Loss of material is managed by conducting volumetric examinations in order to determine whether general corrosion could challenge the component's structural integrity such that a loss of intended function might occur during periods of extended operation [e.g., pressure boundary, leakage boundary (spatial), structural integrity (attached), as defined in SRP-SLR Table 2.1-4(b)].~~

Comment #3 GALL XI.M32, page XI.M32-1

~~In addition, for steel components exposed to water environments that do not include corrosion inhibitors as a preventive action (i.e., 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)].~~

Comment #3 GALL XI.M32, page XI.M32-2

1. Scope of Program: The scope of this program includes systems and components that are subject to aging management using GALL-SLR Report AMPs XI.M2, "Water Chemistry;" XI.M30, "Fuel Oil Chemistry;" and XI.M39, "Lubricating Oil Analysis;" and for which no aging effects have been observed or for which the aging effect is occurring very slowly and will not affect the component's or structure's intended function during the subsequent period of extended operation based on prior operating experience data. The scope of this program also may include other components and materials where the environment in the period of extended operation is expected to be equivalent to that in the prior operating period and for which no aging effects have been observed. ~~The scope of this program includes managing long-term loss of material due to general corrosion for steel components. Long-term loss of material due to general corrosion for steel components need not be managed if two conditions are met: (i) the environment for the steel components includes corrosion inhibitors as a preventive action; and (ii) periodic wall thickness measurements on a representative sample of each environment have been conducted every 5 years up to at least the 50th year of operation. Environments such as treated water, reactor coolant, raw water, and waste water do not typically include corrosion inhibitors.~~

Comment #3 GALL XI.M32, page XI.M32-4

Table XI.M32-1. Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component[1]

Aging Effect	Aging Mechanism	Parameter(s) Monitored	Inspection Method[2]
Loss of Material	Crevice Corrosion	Surface Condition or Wall Thickness	Visual (e.g., VT-1) or Volumetric (e.g., UT)
Loss of Material	General Corrosion	Surface Condition or Wall Thickness	Visual (e.g., VT-3) or Volumetric (e.g., UT)
Loss of Material	Microbiologically-induced Corrosion	Surface Condition or Wall Thickness	Visual (e.g., VT-3) or Volumetric (e.g., UT)
Loss of Material	Pitting Corrosion	Surface Condition or Wall Thickness	Visual (e.g., VT-1) or Volumetric (e.g., UT)
Loss of Material	Erosion	Surface Condition or Wall Thickness	Visual (e.g., VT-3) or Volumetric (e.g., UT)
~~Long-term Loss of Material~~	~~General corrosion~~	~~Wall Thickness~~	~~Volumetric (e.g., UT)~~
Reduction of Heat Transfer	Fouling	Tube Fouling	Visual (e.g., VT-3)
Cracking	SCC or Cyclic Loading	Surface Condition or Cracks	Enhanced Visual (e.g., EVT-1) or Surface Examination (magnetic particle, liquid penetrant) or Volumetric (radiographic testing or UT)

[1]The examples provided in the table may not be appropriate for all relevant situations. If the applicant chooses to use an alternative to the recommendations in this table, a technical justification is provided as an exception to this AMP. This exception lists the aging management review line item component, examination technique, acceptance criteria, evaluation standard, and a description of the justification.

[2]Visual inspection may be used only when the inspection methodology examines the surface potentially experiencing the aging effect.

Comment #4 SRP 3.2.2.2.10 page 3.2-7 (other SRP FE sections identified in the comment are similar)

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.

...

Aggressive Environment: 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

Comment #4 SRP 3.2.2.2.10 page 3.2-8 (other SRP FE sections identified in the comment are similar)

considered high enough to facilitate SCC of aluminum alloys in uncontrolled or untreated aqueous solutions and atmospheric air <u>with the potential for wetting</u>, such as outdoor air, raw water, waste water, and condensation, unless demonstrated otherwise.

...

~~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.~~

Comment #4 SRP Table 3.2-1 example (other SRP table items listed in the comment are similar)

N	102	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to the following external environments: soil, concrete, ~~air – outdoor, air – indoor uncontrolled, air – indoor controlled,~~ condensation, raw water, waste water	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.10)	V.D1.E-445 V.D2.E-445

Comment #4 GALL IV example (other GALL items listed in the comment are similar)

N	V.D1.E-445	3.2-1, 102	Tanks within the scope of AMP XI.M29, "Aboveground Metallic Tanks"	Aluminum	The following external environments: soil, concrete, air – outdoor, ~~air – indoor uncontrolled, air – indoor controlled,~~ condensation, raw	Cracking due to stress corrosion cracking	AMP XI.M29, "Aboveground Metallic Tanks"	Yes

Comment #5 SRP FE example (other sections listed in comment are similar)

FE 3.2.2.2.13 page 3.2-9

...

39 location and site-specific conditions. Moisture level and halide concentration should generally

40 be considered high enough to facilitate pitting and/or crevice corrosion of aluminum alloys in condensation

41 ~~atmospheric~~ and ~~uncontrolled~~ outdoor air, unless demonstrated otherwise. ~~The periodic introduction of~~

~~42 moisture or halides into an air environment from secondary sources should also be considered.~~

~~43 Leakage of fluids from mechanical connections, such as 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.~~ The operating experience (OE) ~~and condition of aluminum alloy components are~~ is evaluated to determine if the plant-specific air environment is aggressive

FE 3.2.2.2.13 page 3.2-10

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 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 and air-indoor uncontrolled, pitting and crevice corrosion is only expected to occur as the result of secondary source of moisture or halides, such as may be present in underground vaults that may not be normally accessible. 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 as identified in plant OE 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: (i) GALL-SLR Report AMP XI.M29, “Aboveground Metallic Tanks,” for tanks; (ii) GALL-SLR Report AMP XI.M36, "External Surfaces Monitoring of Mechanical

Components," for external surfaces of piping and piping components and tanks not within the scope of the XI.M29 program; (iii) GALL-SLR Report AMP XI.M41, "Buried and Underground Piping and Tanks," for underground piping, piping components and tanks; and (iv) 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 aging management programs.

Comment #5 SRP Table 3.2-1 example (other Table items listed in the comment are similar)

M	56a	BWR/PWR	Aluminum piping, piping components exposed to air – indoor uncontrolled (internal)	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.2.2.2.13)	V.F.EP-3
M	56b	BWR/PWR	Aluminum piping, piping components exposed to air – indoor uncontrolled (internal)	Loss of material due to pitting, crevice corrosion None	~~Plant-specific aging management program~~ None	Yes (SRP-SLR Section 3.2.2.2.13)	V.F.EP-3

Comment #5 SRP Table 3.3-1 example (other Table items listed in the comment are similar)

N	223	BWR/PWR	Aluminum underground piping, piping components exposed to air (external)	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes (SRP-SLR Section 3.3.2.2.13)	VII.I.A-752

N	227	BWR/PWR	Aluminum tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air (external)	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.3.2.2.13)	VII.C3.A-756 VII.E5.A-756 VII.H1.A-756
N	234a	BWR/PWR	Aluminum piping, piping components exposed to air – dry, air– indoor uncontrolled, air– indoor controlled	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes (SRP-SLR Section 3.3.2.2.13	VII.J.A-763
N	234b	BWR/PWR	Aluminum piping, piping components exposed to air – dry, air– indoor uncontrolled, air– indoor controlled	~~Loss of material due to pitting, crevice corrosion~~ None	~~Plant-specific aging management program~~ None	Yes (SRP-SLR Section 3.3.2.2.13	VII.J.A-763

Comment #5 GALL AMR examples (other GALL lines listed in the comment are similar)

N	VII.I.A-752	3.3-1, 223	Underground piping, piping components	Aluminum	Air (external)	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M41, "Buried and Underground Piping and Tanks"	Yes

N	VII.C3.A-756	3.3-1, 227	Tanks within the scope of AMP XI.M29, "Aboveground Metallic Tanks"	Aluminum	Air (external)	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M29, "Aboveground Metallic Tanks"	Yes
N	VII.J.A-763a	3.3-1, 234	Piping, piping components	Aluminum	Air – dry, air – indoor uncontrolled, air – indoor controlled	Loss of material due to pitting, crevice corrosion	~~Plant-specific aging management program~~ AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	Yes
N	VII.J.A-763b	3.3-1, 234	Piping, piping components	Aluminum	Air – dry, air – indoor uncontrolled, air – indoor controlled	~~Loss of material due to pitting, crevice corrosion~~ None	~~Plant-specific aging management program~~ None	Yes

Comment #6 SRP FE example (other FE items listed in the comment are similar)

3.2.2.2.2 Loss of Material Due to Pitting and Crevice Corrosion

Loss of material due to pitting and crevice corrosion could occur in SS piping, piping components, and tanks exposed to outdoor air or wetting ~~any air environment when 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 where wetting is possible (e.g., condensation environment), and outdoor air environments are susceptible to loss of material due to pitting or crevice corrosion if the ambient air or 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.~~ For outdoor insulated SS components, rain and changing weather conditions can result in moisture intrusion of the insulation.

The applicant may demonstrate 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, and for indoor, above-ground uninsulated components susceptible to wetting (i.e., in condensation or air-outdoor), describing the indoor and outdoor air environment present at the plant and demonstrating that external pitting or crevice corrosion is not expected.

☐For indoor components not exposed to condensation, cracking of stainless steel is not applicable and does not require management if the plant OE does not reveal a history of cracking of stainless steel exposed to indoor air.

☐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 susceptible to wetting (i.e., in condensation or air-outdoor) in locations in which uninsulated components are not expected to experience aging effects as determined above, 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.~~

☐~~For all components, demonstrating that the aggressive environment is not present by isolating the component from the environment using a barrier to 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~~.

Comment #6 GALL IX.D

~~Air, moist : Air with enough moisture to facilitate the loss of material in steel caused by general, pitting, and crevice corrosion. Moist air in the absence of condensation also is potentially aggressive (e.g., under conditions where hygroscopic surface contaminants are present, etc.).~~

Comment #7 SRP 3.2.2.2.12 example (other SRP FE sections listed in the comment are similar)

Delete section

Comment #7 SRP Table 3.2-1 examples (other SRP lines listed in the comment are similar)

N	85	BWR/PWR	Nickel alloy piping, piping components, heat exchanger components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes (SRP-SLR Section 3.2.2.2.12)~~ No	V.A.E-428 V.D1.E-428 V.D2.E-428

Comment #7 SRP Table 3.3-1 examples (other SRP lines listed in the comment are similar)

M	125	BWR/PWR	Steel (with stainless steel cladding); stainless steel spent fuel storage racks (BWR), spent fuel storage racks (PWR), piping, piping components exposed to treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes (SRP-SLR Section 3.3.2.2.12)~~ No	VII.A2.AP-79 VII.A3.AP-79 VII.E1.AP-79 VII.A2.A-98 VII.A2.A-99

N	203	BWR	Stainless steel; steel with stainless steel cladding, piping, piping components, heat exchanger components exposed to treated water, sodium pentaborate solution	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes (SRP-SLR Section 3.3.2.2.12)~~ No	VII.A4.AP-110 VII.E3.AP-110 VII.E4.AP-110 VII.A4.AP-111 VII.E2.AP-141

Comment #7 GALL AMR examples (other GALL lines listed in the comment are similar)

N	V.A.E-428	3.2-1, 85	Piping, piping components, heat exchanger components	Nickel alloy	Treated water, treated borated water	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes~~ No
M	VII.A2.AP-79	3.3-1, 125	Piping, piping components	Steel (with stainless steel cladding); stainless steel	Treated borated water	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes~~ No
M	VII.A4.AP-110	3.3-1, 203	Piping, piping components	Stainless steel	Treated water	Loss of material due to pitting, crevice corrosion, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes~~ No

Comment #8 SRP Table 3.2-1 rows

~~N~~	~~164~~	~~BWR/PWR~~	~~Gray cast iron piping, piping components exposed to air – indoor uncontrolled, air – outdoor, moist air, condensation, raw water, treated water, waste water (external)~~	~~Loss of material due to general, pitting, crevice corrosion, MIC (raw water, waste water, and treated water environments only)~~	~~AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"~~	~~No~~	~~VII.I.A-455~~
~~N~~	~~165~~	~~BWR/PWR~~	~~Gray cast 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~~ ~~VII.C2.A-456~~ ~~VII.C3.A-456~~ ~~VII.D.A-456~~ ~~VII.E5.A-456~~ ~~VII.G.A-456~~ ~~VII.H1.A-456~~ ~~VII.H2.A-456~~

Comment #8 GALL AMR examples (other GALL lines listed in the comment are similar)

~~N~~	~~VII.C1.A-456~~	~~3.3-1, 165~~	~~Piping, piping components~~	~~Gray cast iron~~	~~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~~

Comment #9 SRP Table 3.2-1 row

Delete Further Evaluation 3.3.2.2.8

Comment #9 SRP Table 3.2-1 row

N	172	BWR/PWR	PVC piping, piping components exposed to ~~sunlight~~ air-outdoor	Reduction in impact strength due to photolysis	~~Plant-specific aging management program~~ AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	~~Yes (SRP-SLR Section 3.3.2.2.8)~~ No	VII.C1.A-458 VII.E5.A-458 VII.G.A-458

Comment #9 GALL AMR examples (other GALL lines listed in the comment are similar)

N	VII.C1.A-458	3.3-1, 172	Piping, piping components	PVC	~~Sunlight~~ Air-outdoor	Reduction in impact strength due to photolysis	~~Plant-specific aging management program~~ AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	~~Yes~~ No

Comment #10

Delete SRP FE 3.1.2.2.15

Delete SRP Table 3.1-1, 27

Delete GALL AMR rows IV.D1.R-436 and IV.D2.R-440

Comment #11 SRP Table 3.1-1

	69	PWR	Nickel alloy steam generator tubes and sleeves exposed to secondary feedwater or steam	Cracking due to outer diameter stress corrosion cracking, ~~or~~ intergranular attack, and/or flow- induced vibration or high-cycle fatigue	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No	~~IV.D1.R-47~~ IV.D1.R-48 ~~IV.D2.R-47~~ IV.D2.R-48
~~N~~	~~125~~	~~PWR~~	~~Nickel alloy steam generator tubes at support plate locations exposed to secondary feedwater or steam~~	~~Cracking due to flow- induced vibration or high-cycle fatigue~~	~~AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators"~~	~~No~~	~~IV.D1.R-437 IV.D2.R-442~~

Comment #11 GALL AMR examples (other line items listed in comment are similar)

~~N~~	~~IV.D1.R-437~~	~~3.1-1, 125~~	~~Tubes (at tube support plate locations)~~	~~Nickel alloy~~	~~Secondary feedwater or steam~~	~~Cracking due to flow-induced vibration or high-cycle fatigue~~	~~AMP XI.M2, "Water Chemistry," and AMP XI.M19, "Steam Generators"~~	~~No~~
	~~IV.D1.R-47~~	~~3.1-1, 69~~	~~Tubes and sleeves~~	~~Nickel alloy~~	~~Secondary feedwater or steam~~	~~Cracking due to outer diameter stress corrosion cracking~~	~~AMP XI.M19, "Steam Generators," and AMP XI.M2,~~	~~No~~
	IV.D1.R-48	3.1-1, 69	Tubes and sleeves	Nickel alloy	Secondary feedwater or steam	Cracking due to intergranular attack, outer diameter stress corrosion cracking, and/or flow-induced	AMP XI.M19, "Steam Generators," and AMP XI.M2, "Water Chemistry"	No

						vibration or high-cycle-fatigue		

Comment #12

Delete VII.H1.A-660, VIII.E.S-440, VIII.F.S-440, VIII.G.S-440

Comment #13 SRP Table 3.3-1

M	139	BWR/PWR	Any material piping, piping components, heat exchangers, tanks with internal coatings/linings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil, waste water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion~~;~~ ~~cracking due to stress corrosion cracking~~	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No	VII.A2.A-414 VII.A3.A-414 VII.A4.A-414 VII.C1.A-414 VII.C2.A-414 VII.C3.A-414 VII.D.A-414 VII.E1.A-414 VII.E2.A-414 VII.E3.A-414 VII.E4.A-414 VII.E5.A-414 VII.F1.A-414 VII.F2.A-414 VII.F3.A-414 VII.F4.A-414 VII.G.A-414 VII.H1.A-414 VII.H2.A-414

Comment #13 GALL AMR example (other rows listed in comment are similar)

M	VII.A2.A-414	3.3-1, 139	Piping, piping components, heat exchangers, tanks with internal coatings/linings	Any material with an internal coating/lining	Closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil,	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion~~;~~ ~~cracking due to stress corrosion~~	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No

Comment #14 SRP Table 3.3-1

M	28	PWR	Stainless steel piping, piping components, tanks exposed to treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes (SRP-SLR Section 3.3.2.2.12)~~ No	VII.E1.AP-82

Comment #14 GALL AMR row

M	VII.E1.AP-82	3.3-1, 28	Piping, piping components; tanks	Stainless steel	Treated borated water >60°C (>140°F)	Cracking due to stress corrosion cracking, MIC	~~Plant-specific aging management program~~ AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	~~Yes~~ No

Comment #15 SRP Table 3.3-1

N	83	BWR/PWR	Stainless steel tanks exposed to treated water	Loss of material due to ~~general (steel only),~~ pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes (SRP-SLR Section 3.4.2.2.9)	VIII.E.SP-162 VIII.G.SP-162

Comment #15 GALL AMR row

N	VIII.E.SP-162	3.4-1, 83	Tanks	Stainless steel	Treated water	Loss of material due to ~~general (steel only),~~ pitting, crevice corrosion, MIC	Plant-specific aging management program	Yes

Comment #16 SRP Table 3.3-1

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 Components"	No	IV.C1.R-429 IV.C2.R-429

Comment #16 GALL AMR example (other row listed in comment is similar)

N	IV.C1.R-429	3.1-1, 122	Non-ASME Code Class 1 piping, piping components	Steel~~; stainless steel, nickel alloy; copper alloy~~	Air – indoor uncontrolled~~, condensation~~	Loss of material due to general ~~(steel, copper alloy only),~~ pitting, crevice corrosion	AMP XI.M36, "External Surfaces Monitoring of Mechanical Components"	No

Comment #17 SRP Table 3.2-1 example (other row listed in comment is similar)

N	106	BWR/PWR	Stainless steel <u>or aluminum</u> tanks (within the scope of AMP XI.M29, "Aboveground Metallic Tanks") exposed to air – indoor uncontrolled, moist air, condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.D1.E-449 V.D2.E-449

Comment #17 GALL AMR example (other rows listed in comment are similar)

N	V.D1.E-449	3.2-1, 106	Tanks within the scope of AMP XI.M29, "Aboveground Metallic Tanks"	Stainless steel <u>or aluminum</u>	Air – indoor uncontrolled, moist air, condensation, air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes

Comment #18 SRP Table 3.2-1 example (other rows listed in comment are similar)

N	99	BWR/PWR	Stainless steel tanks <u>(within the scope of AMP XI.M29, "Aboveground Metallic Tanks")</u> exposed to air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes (SRP-SLR Section 3.2.2.2.2)	V.E.E-442

Comment #18 GALL AMR example (other rows listed in comment are similar)

N	V.E.E-442	3.2-1, 99	Tanks <u>(within the scope of AMP XI.M29, "Aboveground Metallic Tanks")</u>	Stainless steel	Air – outdoor	Loss of material due to pitting, crevice corrosion	AMP XI.M29, "Aboveground Metallic Tanks"	Yes

Comment #19 SRP Table 3.1-1

M	39	BWR/PWR	Steel (with or without stainless steel or nickel alloy cladding), stainless steel, or nickel alloy Class 1 piping, fittings and branch connections < NPS 4 exposed to reactor coolant	Cracking due to stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), intergranular stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), or thermal, mechanical, or	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," AMP XI.M2, "Water Chemistry," and XI.M35, "~~One-Time Inspection of~~ ASME Code Class 1 Small- Bore Piping"	No	IV.C1.RP-230 IV.C2.RP-235

Comment #19 GALL AMR example (other row listed in comment is similar)

M	IV.C1.RP-230	3.1-1, 39	Class 1 piping, fittings and branch connections < NPS 4	Steel (with or without stainless steel or nickel alloy cladding); stainless steel; nickel alloy	Reactor coolant	Cracking due to stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), intergranular stress corrosion cracking (for stainless steel or nickel alloy surfaces exposed to reactor coolant only), thermal, mechanical, vibratory loading	AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," AMP XI.M2, "Water Chemistry," and XI.M35, "~~One-Time Inspection of~~ ASME Code Class 1 Small-bore Piping"	No

Comment #20 SRP Table 3.3-1 (similar 3.4-1 entries also recommended)

N	xx	BWR/PWR	Titanium heat exchanger tubes exposed to Treated water, Closed-cycle cooling water	Reduction in heat transfer due to fouling.	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No	VII.x.x VIII.x.x

N	xx	BWR/PWR	Titanium (ASTM Grades 1, 2, 7, 11, or 12) piping, piping components and heat exchanger components other than heat exchanger tubes exposed to Treated water, Closed-cycle cooling water	None	None	No	VII.x.x VIII.x.x

Comment #20 GALL AMR example (other row in chapter VIII also recommended)

N	VII.x.x (new row)	3.3-1, xx	Heat exchanger tubes	Titanium	Treated water, Closed-cycle cooling water	Reduction in heat transfer due to fouling.	AMP XI.M2, "Water Chemistry," and AMP XI.M32, "One-Time Inspection"	No
N	VII.x.x (new row)	3.3-1, xx	Piping, piping components and heat exchanger components other than heat exchanger tubes	Titanium (ASTM Grades 1, 2, 7, 11, or 12)	Treated water, Closed-cycle cooling water	None	None	No

Comment #21 SRP example (other sections listed in comment are similar)

2.1.5 Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of NRC regulations, the method described herein will be used by the NRC staff in its evaluation of conformance with NRC regulations. Alternatives should be considered acceptable if:

1. They provide reasonable assurance that component intended functions will be maintained, or

2. If consistency with GALL/SRP recommendations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Comment #22 SRP:

Delete SRP Further Evaluation topic 3.1.2.2.12.

Comment #23 SRP 3.1.2.2.14 final paragraph:

~~For SLRAs that apply to BWRs with core plate rim holddown bolts, the NRC staff recommends that an enhanced augmented inspection basis for the bolts be proposed and justified, with a supporting loss of preload analysis.~~ Inspections of these bolts are required if there is not an adequate technical basis to justify continuation of the inspection exemption. If an existing NRC-approved analysis for the bolts exists...

Comment #24 SRP:

Delete SRP Further Evaluation topic 3.1.2.2.17.

Comment #25 SRP Section 1.1-1, end of second paragraph:

However, if the NRC staff approves the aging management activities provided in the renewal application (as described in a Safety Evaluation Report) before the NRC makes a final determination on the SLRA, the approved applicant may also conduct aging management activities during the timely renewal period using the aging management programs (AMPs) included in the SLRA.

Comment #27 SRP Table 1.1-1, I.2.B.b:

Signed original application ~~and 13 copies are~~ is provided to the Document Control Desk. One copy is provided to the appropriate Regional office [10 CFR 50.4(b)(3)]

Comment #35 SRP section 3.1.3.2.3:

41 guidance in Section 4.7 of this SRP-SLR ~~consistent with the action item documented in~~
42 ~~the NRC staff's safety evaluation for MRP-227, Revision 0~~.

Comment #36 SRP section 4.2.3.1.3.2:

21 measured value for delta RTNDT must be less than ~~-2.2~~ 15.6 °C [28 °F] for weld metal. When a
24 the RTNDT can be reduced from ~~-2.2~~ 15.6 °C [28°F] to ~~-10~~ 7.8 °C [14°F] for welds.

Comment #37 GALL Table IX.D, page IX D-2:

~~Air with metal temperature up to 288°C [550°F]~~	~~This environment is synonymous with the more commonly-used phrase "system temperature up to 288 °C [550 °F]."~~

Comment #38 GALL Table IX.D, page IX D-2:

~~Air with steam or water leakage~~	~~Air and untreated steam or water leakage on indoor or outdoor systems with temperatures above or below the dew point.~~

Comment #39 GALL Table IX.D, page IX D-2:

~~Air with reactor coolant leakage~~	~~Air and reactor coolant or steam leakage on high temperature systems (germane to BWRs).~~

Comment #40 GALL AMR Rows pages IV A2-2, IV A1-7:

M	IV.A2.R-74	3.1-1, 19	Closure head: vessel flange leak detection line	Stainless steel	~~Air with reactor coolant leakage (internal), reactor coolant~~ Air-indoor uncontrolled	Cracking due to stress corrosion cracking	Plant-specific aging management program	Yes
M	IV.A1.R-61	3.1-1, 16	Top head enclosure: vessel flange leak detection line	Stainless steel; nickel alloy	~~Air with reactor coolant leakage (internal), reactor coolant~~ Air-indoor uncontrolled	Cracking due to stress corrosion cracking, intergranular stress corrosion cracking	Plant-specific aging management program	Yes

Comment #41 Gas (internal) environment definition, GALL Table IX.D, page IX D-3 :

Gas	Internal gas environments include dry air or inert, nonreactive gases. This generic term is used only ~~with "Common Miscellaneous Material/Environment,"~~ where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the period of extended operation. In compressed air systems, this environment applies to the part of the system downstream from the air dryers. The term "gas" is not meant to comprehensively include all gases in the fire suppression system. The GALL AMP XI.M26, "Fire Protection," is used for the periodic inspection and testing of the halon/carbon dioxide fire

	suppression system.

Attachment 3

NUREG-2191 Mechanical AMPS X.M1 Through XI.M22

<u>AMP Comments Included</u>:

X.M1	Cyclic Load Monitoring
X.M2	Neutron Fluence Monitoring
XI.M1	ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD
XI.M2	Water Chemistry
XI.M3	Reactor Head Closure Stud Bolting
XI.M4	Boiling Water Reactor Vessel ID Attachment Welds
XI.M5	Boiling Water Reactor Feedwater Nozzle
XI.M7	Boiling Water Reactor Stress Corrosion Cracking
XI.M9	Boiling Water Reactor Vessel Internals
XI.M10	Boric Acid Corrosion
XI.M11B	Cracking of Nickel Alloy Components and loss of Material Due to Boric Acid Induced Corrosion in Reactor Coolant Pressure Boundary Components (Pressurized Water Reactors Only)
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel
XI.M16A	PWR Vessel Internals
XI.M17	Flow Accelerated Corrosion
XI.M18	Bolting Integrity
XI.M19	Steam Generators
XI.M20	Open-Cycle Cooling Water System
XI.M21A	Closed Treated Water Systems

Attachment 3
NUREG-2191 Mechanical AMPS X.M1 Through XI.M22

X.M1, Cyclic Load Monitoring

Description of Change and Justification:-

1. **X.M1 Title** - page X.M1-1
   Revise program name from Cyclic Load Monitoring back to Fatigue Monitoring

   Basis:
   Leave program name the same for consistency with current license renewal program and affected utility program documents. This is not a new program and it is based upon the GALL Revision 2 program, so there is no justification for changing its name. The program scope description makes it clear that it addresses all types of cyclic load analyses. It also explains that it can monitor various input parameters, including cyclic loadings, or output parameters, including cumulative fatigue usage or crack growth, which are compared to applicable limits.

   Markup
   1 **X.M1** **~~Cyclic Load~~ *FATIGUE* MONITORING**

2. **X.M1 Program Description** Page X.M1-1, first paragraph
   First paragraph "component locations in the reactor coolant pressure boundary...." It must be clearly stated here that only Class 1 components and piping are being addressed by this requirement.

   Basis:
   Note that NUREG-1800 Rev 2 states in Section 4.3.2.1.3 "Environmental Fatigue Calculations for Code Class 1 Components", so X.M1 should only apply to Class 1 components. The program should state that reactor pressure vessel internals do not fall under this requirement.

   Markup
   ...for ~~specific~~ *Class 1* mechanical or structural components; (b) fatigue analysis calculations for assessing...

3. **X.M1 Program Description** Page X.M1-1, third paragraph
   Clarify that the second aspect of the program described includes cycle-based fatigue monitoring (CBFM) which uses design transient occurrences, and stress-based fatigue monitoring (SBFM), in which actual plant operating conditions (fluid temperatures, pressures, and flow rates) are monitored. These values are periodically used to compute CUF values to-date, which are then compared to the design limit of 1.0. These methods provide a more accurate computation of the fatigue effects of each transient on the monitored components and have been accepted for use by the NRC staff in the past. These methodologies can also be used to confirm the CUF_{en} values to-date are less than the limit of 1.0 for components with environmental fatigue analyses. As noted in the Operating Experience section of this AMP, NRC Regulatory Issue Summary (RIS) 2008-30 must be considered when using the SBFM method.

   Basis:
   Cycle-based and stress-based fatigue monitoring methods are currently in use at many plants and their continued use should be explicitly permitted during the subsequent period of extended operation. The CBFM method periodically determines the cumulative fatigue to-date using the number of occurrences of design transients to-date as input to the fatigue table for the

component being monitored. The SBFM method provides an even more accurate assessment of the actual condition of the component. Reducing this excess conservatism may be necessary in order to maintain the monitored fatigue usage below the limit of 1.0 through the subsequent period of extended operation and beyond.

Markup

For the latter, actual plant operating conditions monitored by this program can be used to inform updated evaluations of the fatigue analyses to ensure they continue to meet the design or analysis-specific limit. *This option may include stress-based fatigue monitoring, in which operating temperatures, pressures, and other parameters are monitored and used to determine the effects of actual operating transients on the cumulative CUF and CUF_{en} for the analyzed components. This option periodically compares cumulative CUF and CUF_{en} to the limit of 1.0.* Technical specification requirements may apply to these activities.

4. **X.M1 Program Description** Page X.M1-1, fourth paragraph
Add the following statement as an alternative to cycle counting. "As an alternative to monitoring transient cycles, the AMP may also directly monitor the critical thermal and pressure transient parameters (temperature, pressure, and flow rate) to determine the actual severity of each event and to compute the resulting fatigue usage affecting specific component locations."

   Basis:

   This statement will make this paragraph consistent with the revised third paragraph amended as described above. The current GALL-SLR sentence above should be revised as proposed above to more closely align it with GALL Revision 2. Monitoring local conditions at critical locations to assess fatigue should be presented as a potential alternative to tracking local transients. This is clearly the intent of GALL, Revision 2. For example, many complex thermal stratification transients can occur in the surge line during heatups and cooldowns. Counting these transients manually would be cumbersome for utility engineers. In this case, monitoring fatigue locally at critical locations by explicitly considering the relevant plant operating parameters is a more efficient and accurate method of assessing the fatigue-effects of these transients, and therefore precludes the need to track the local thermal stratification transients explicitly.

   Markup

   CUF design limits, for example, values used for high energy line break considerations.) In order not to exceed the design limit on CUF, the AMP monitors and tracks the number of occurrences of each of the critical thermal and pressure transients for the selected components, and verifies that the severity of each of the monitored transients is bounded by the design transient definitions. *As an alternative to monitoring transient cycles, the AMP may also directly monitor the critical thermal and pressure transient parameters (temperature, pressure, and flow rate) to determine the actual severity of each event and to compute the resulting fatigue usage affecting specific component locations.*

5. **X.M1 Program Description** Page X.M1-1, fourth paragraph
Delete the note: "(Note that other values may be used as CUF design limits, for example, values used for high energy line break considerations)."

   Basis:

   EPRI Report 1022873, "Improved Basis and Requirement for Break Location Postulation," dated October 2011, Section 7.0, "Conclusion," states that "OE clearly indicates that the potential for high energy line failures is dominated by mechanisms other than thermal fatigue due to design plant transients." It further states that the "consideration of fatigue usage by itself is not a reliable approach to predict crack initiation or leakage." As a result, the use of HELB values as a CUF design limit should not be considered and the statement should be deleted from the AMP.

Markup
...subjected to cyclic stresses. Crack initiation is assumed to begin in a mechanical or structural component when the CUF at a point on or in the component reaches the value of 1.0, which is the ASME Code Section III design limit on CUF values. ~~(Note that other values may be used as CUF design limits, for example, values used for high energy line break considerations.)~~

6. **X.M1 Program Description** Page X.M1-1, fifth paragraph
Need to include a functional description of what can be done to identify the "plant-specific component location". See markup below for suggested wording.

Basis:
The paragraph below should be included in the document because it is not apparent to industry how one identifies the limiting location that satisfies the intent of X.M1. The markup below should be offered at least as an example of a functional (non-prescriptive) procedure that could be used to allow this identification.

SI has one comment on EPRI's comment on X.M1 fifth paragraph (quoted below). Our correction removes the words "six (6)" in the last sentence of the EPRI Markup. The reason for this correction is that in NUREG/CR-6260, the different NSSS designs and vintages have varying numbers of locations mentioned and were not always a value of six. Thus, we recommend that the specific number of locations not be mentioned. The point is made well without the deleted words.

Markup
To identify the "plant-specific component location" an appropriate screening analysis can be performed. This screening analysis can consist of a grouping of Class 1 piping and components that have approximately the same structural properties and experience approximately the same thermal transients that can cause material fatigue. An appropriate fatigue analysis can be performed on the component or piping location representative of the group. The plant-specific component that is more limiting than the locations identified in NUREG/CR-6260 can be identified by reviewing the results of the fatigue analysis of the individual groups.

7. **X.M1 Program Description -** Page X.M1-2, first paragraph
Regulatory Guide (RG) 1.207, Revision 1, does not endorse the use of NUREG/CR-5704 for stainless steel components or NUREG/CR-6583 for carbon and low-alloy steel components, each of which was deemed acceptable in GALL, Revision 2. Add these NUREGs back into the list of acceptable methods for evaluating environmental fatigue, or provide the rationale for why the earlier NUREGS were not acceptable for SLR.

Basis:
For applicants that previously used these NUREGs, this would require the environmental fatigue analyses to be performed over again for subsequent license renewal, which should not be necessary unless the analyses indicate the CUF_{en} values will exceed 1.0 through the subsequent period of extended operation. No justification has been provided that indicate these standards are unacceptable, so their continued use is acceptable. If using these NUREGs is still more conservative for a PWR and/or BWR or for a particular material type, there should be latitude to re-use these NUREGs.

Markup

NUREG/CR–6260, and thus should also be considered. Environmental effects on fatigue for these critical components may be evaluated using the guidance in Regulatory Guide (RG) 1.207, Revision 1 *or in NUREG/CR-6583 for carbon steel components or NUREG/CR-5704 for stainless steel components*. Similar to monitoring *against* CUF limits, the AMP monitors and tracks...

8. **X.M1 Program Description** - Page X.M1-2, third and fourth paragraph
   Add wording "analysis assumptions controlling" as indicated in markup.

   Basis:

   Note that on page X.M1-2, the statements describing monitoring of (Appendix-L) Flaw Tolerance and (Appendices A/C) fracture mechanics analyses are very specific and do not account for situations where monitoring between inspections is simply time-based, and not directly based on monitoring of transient cycles at the affected component.

   Markup

   ... parameter that is used to determine the appropriate inspection frequency. The AMP monitors and tracks *analysis assumptions controlling* the number of occurrences and severity of critical...

   ...appropriate inspection frequency through a fatigue crack growth evaluation. The AMP monitors and tracks the *analysis assumptions controlling* number of occurrences and severity of each of the critical thermal and pressure transients for the selected components that are used...

9. **X.M1 Element 1 Scope of Program** – Page X.M1-3, second paragraph
   Lines 9 -10 states: "This sample set includes the locations identified in NUREG/CR–6260 and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260." Some locations in NUREG/CR-6260 may have projected $CUF/CUF_{en} << 0.5$. If this is the case, a plant should not have to monitor an SC with projected 80-year $CUF/ CUF_{en} < 0.5$.

   Basis:

   Continuously monitoring and updating detailed fatigue analyses for NUREG/CR-6260 locations that have projected 80 year $CUF/ CUF_{en} < 0.5$ is not technically justified, while imposing additional costs on utilities for engineering analysis.

   Markup

   ...This sample set includes the locations identified in NUREG/CR–6260 *with projected 80- year $CUF/ CUF_{en} \geq 0.5$,* and additional plant-specific component locations in the reactor coolant ...

10. **X.M1 Element 3 Parameters Monitored or Inspected** – Page X.M1-3, third paragraph
    Revise first sentence as indicated in markup.

    Basis:

    The current GALL-SLR sentence above should be revised as proposed above to more closely align it with GALL Revision 2. While "fatigue-significant" may have been intended by the Current GALL-SLR sentence, it is not certain as the phrase "contribute to fatigue" seems absolute. This interpretation would result in undue efforts on the utilities part to monitor transients that have a miniscule contribution to fatigue. Furthermore, it is not difficult to determine transient fatigue significance, as the pertinent information is readily available in most component fatigue evaluations.

Markup
The program monitors all applicable plant transients that cause cyclic strains and *are significant contributors* ~~contribute~~ to fatigue, as specified in the fatigue analyses, and *monitors or validates* appropriate environmental parameters that contribute to F_{en} values.

11. **X.M1 Element 3 Parameters Monitored or Inspected** – Page X.M1-3, third paragraph
Lines 18-20 states for the Element 3, Parameters Monitored of Inspected, "actual plant water chemistry that contribute to the fatigue analyses for each component are monitored". This program should not have actual plant water chemistry as a parameter monitored. A similar change should be made to the other elements which impose the plant water chemistry monitoring requirement.

Basis:
As stated on page X.M1-2, "this program relies on ....AMP XI.M2, "Water Chemistry," to provide monitoring of appropriate environmental parameters". Therefore if Water Chemistry AMP is credited then all monitoring should be in the Water Chemistry AMP not in the Cyclic Load Monitoring AMP.

Markup
...analyses, and *monitors or validates the* appropriate environmental parameters that contribute to F_{en} values. The number of occurrences~~,~~ ***and*** the severity of the plant transients~~, and actual plant water chemistry~~ that contribute to the fatigue analyses for each component are monitored. More detailed monitoring of pressure~~,~~ ***and*** thermal conditions~~, and water chemistry~~ at the component location may be performed to allow the fatigue analyses to be assessed for the specified critical locations.

12. **X.M1 Element 4 Detection of Aging Effects** - Page X.M1-3, fourth paragraph
Revise first sentence as indicated in the markup.

Basis:
The current GALL-SLR sentence should be revised as proposed to more closely align it with the program description section of the AMP, paragraph 3, which clearly allows for the monitoring of plant operating conditions.

Markup
The program uses applicant defined activities or methods to track the number of occurrences and severity of transients~~, and water chemistry~~ conditions, *and any applicable plant operating conditions used to inform updated evaluations of the fatigue analyses.*

13. **X.M1 Element 5 Monitoring and Trending** - Page X.M1-3, fifth paragraph
Add the sentence in the markup for clarification.

Basis:
The current GALL-SLR sentence above should be revised as proposed to more closely align it the program description section of the AMP, paragraph 3, which clearly allows for the monitoring of plant operating conditions.

Markup
~~Monitoring of water chemistry conditions is used to ensure calculated F_{en} values remain valid.~~ *Monitoring of actual plant operating conditions is used to inform updated evaluations of the fatigue analyses to ensure they continue to meet the design or analysis-specific limit.* Trending is performed to ensure that the fatigue analyses are...

14. **X.M1 Element 10 Operating Experience** – Page X.M1-4 Lines 37-40
Lines 38-40 discuss the concerns in RIS 2011-14 regarding implementation of software programs to calculate fatigue usage "during plant transient associated with plant transient operations". This should be revised to say "in analyses of plant transients".

    Basis:
    RIS 2011-14 states the concern to be analyst intervention into software programs which perform analyses. The way this is worded could infer the issue was with the use of WESTEMS for fatigue monitoring, which is not the case. WESTEMS used for monitoring does not afford analyst intervention in this manner.

    Markup
    ...is recommended, if such a methodology is used. Furthermore, as discussed in NRC RIS 2011–14, the staff has identified concerns regarding the implementation of computer software packages used to calculate fatigue usage ~~during plant transient~~ associated with plant transient operations.

15. **X.M1 Table X-02 Section 4.3** – Page X02-2,3
Table X-02 requires that CUF_{en} needs to be re-assessed as acceptable before the SLR application, rather than before entry into SLR period, and it specifies that the number of transients be projected and the TLAA is acceptable. This is not necessarily compatible with stress-based monitoring. An alternative should be included that permits the use of CUF projections based on stress-based CUF values computed over time using stress-based fatigue monitoring. The table also appears duplicative between some sections.

    Basis:
    The purpose of computing the 80-year CUF_{en} values is to demonstrate the components should be able to satisfactorily withstand the transient cycles expected to occur through the subsequent period of extended operation, based on past rates of transient occurrence. This objective may also be achieved by making projections of the CUF values and CUF_{en} values periodically computed using stress-based fatigue monitoring. The 80-year CUF and CUF_{en} projections would also provide assurance that the components can withstand the transient cycles expected to occur through the subsequent period of extended operation, based on past rates of CUF and CUF_{en} accumulation. This would be more accurate since the actual transient severities are monitored, which more closely relates to actual fatigue accumulation.

    Markup
    None.

16. **X.M1 Table X-02 Section 4.3** – Page X02-2,3,6
The title of Table X-02 reads "Aging Management Programs Discussed in SRP-SLR Chapter 4" but there are no "Aging Management Programs Discussed in SRP-SLR Chapter 4;" rather, this Section 4 discusses TLAAs. The associated FSAR Supplements in our LRAs merely refer to AMPs (as needed for disposition of the TLAA); it does not contain the AMPs. Thus, the table needs a new title and the column for "Implementation Schedule" should be deleted – this could be confusing to the reader.

    The "Completed" entries merely mean that NRC expects that the TLAA can be dispositioned using (i) or (ii); once again, there is no need for this column.

These examples of standard text for the "Evaluation of TLAAs" can only be used as examples, not for verbatim compliance; just like the SLR-SRP says for Table 3.0-1: Table 3.0-1 of this SRP-SLR provides examples of the type of information to be included in the FSAR Supplement. This must be clarified somewhere.

If Table X-02 is retained, then it should be moved to the SLR-SRP NUREG-2192, similar to Table 3.0-1.

The highlighted sentence at the bottom of Table X-02 should be deleted; there is no need to impose a license condition instead of a licensing commitment:
*An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the subsequent license renewal application to any future aging management activities to be completed before the period of extended operation. ~~The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities by no later than the committed date.~~

17. **X.M1 Program Editorial Comments** – See Attached

X.M1 ~~CYCLIC LOAD~~ *FATIGUE* MONITORING

Program Description

This aging management program (AMP) provides an acceptable basis for managing SCs that are the subject of fatigue or cycle-based time-limited aging analyses (TLAAs) or other analyses that assess fatigue or cyclical loading, in accordance with the requirements in 10 CFR 54.21(c)(1)(iii). Examples of cycle-based fatigue analyses for which this AMP may be used include, but are not limited to: (a) cumulative usage factor (CUF) analyses or their equivalent (e.g., I_t-based fatigue analyses, as defined in specific design codes) that are performed in accordance with American Society of Mechanical Engineers (ASME) design code requirements for ~~specific~~ *Class 1* mechanical or structural components; (b) fatigue analysis calculations for assessing environmentally-assisted fatigue; (c) implicit fatigue analyses, as defined in the USAS B31.1 design code or ASME Section III rules for Class 2 and Class 3 components; (d) fatigue flaw growth analyses that are based on cyclic~~al~~ loading assumptions; (e) fracture mechanics analyses that are based on *cyclic*~~e-based~~ loading assumptions; and (f) fatigue waiver or exemption analyses that are based on *cyclic*~~e-based~~ loading assumptions. This program may be used for fatigue analyses that apply to mechanical or structural components.

Fatigue of components is managed by monitoring one or more relevant fatigue parameters, which include, but are not limited to, the CUF *values*~~factors~~, the environmentally-adjusted ~~(~~CUF_{en}~~)~~*values*, transient cycle limits, and the predicted flaw size (for a fatigue crack growth *analys*i~~es~~). The limit of the fatigue parameter is established by the applicable fatigue analysis and may be a design limit, for example from an ASME Code fatigue evaluation, an analysis-specific value, for example based on the number of cyclic load occurrences assumed in a fatigue exemption evaluation, or the acceptable size of a flaw identified during an inservice inspection.

This program has two aspects, one that verifies the continued acceptability of existing analyses through cycle counting and the other that provides periodically updated evaluations of the fatigue analyses to demonstrate that they continue to meet the appropriate limits. In the former, the program assures that the number of occurrences and severity of each transient remains within the limits of the fatigue analyses, which in turn ensure that the analyses remain valid. For the latter, actual plant operating conditions monitored by this program can be used to inform updated evaluations of the fatigue analyses to ensure they continue to meet the design or analysis-specific limit. *This option may include stress-based fatigue monitoring, in which operating temperatures, pressures, and other parameters are monitored and used to determine the effects of actual operating transients on the cumulative CUF and CUF_{en} for the analyzed components. This option periodically compares cumulative CUF and CUF_{en} to the limit of 1.0.* Technical specification requirements may apply to these activities.

CUF is a computed parameter used to assess the likelihood of fatigue damage in components subjected to cyclic stresses. Crack initiation is assumed to begin in a mechanical or structural component when the CUF at a point on or in the component reaches the value of 1.0, which is the ASME Code Section III design limit on CUF values. ~~(Note that other values may be used as CUF design limits, for example, values used for high energy line break considerations.)~~ In order not to exceed the design limit on CUF, the AMP monitors and tracks the number of occurrences of each of the critical thermal and pressure transients for the selected components, and verifies that the severity of each of the monitored transients is bounded by the design transient definitions. *In order not to exceed the design limit on CUF, the AMP may also directly monitor the critical thermal and pressure transient parameters (temperature, pressure, and flow rate) to determine the actual severity of each event and to compute the resulting fatigue usage affecting specific component locations.*

CUF_{en} is CUF adjusted to account for the effects of the reactor water environment on component fatigue life. For a plant, the effects of reactor water environment on fatigue are evaluated by assessing a set of sample critical components for the plant. Examples of critical components are identified in NUREG/CR–6260; however, plant-specific component locations in the reactor coolant pressure boundary may be more limiting than those considered in

NUREG/CR–6260, and thus should also be considered. Environmental effects on fatigue for these critical components may be evaluated using the guidance in Regulatory Guide (RG) 1.207, Revision 1 *or in NUREG/CR-6583 for carbon steel components or NUREG/CR-5704 for stainless steel components*. Similar to monitoring ~~of~~ *against* CUF limits, the AMP monitors and tracks the number of occurrences and severity of each of the critical thermal and pressure transients for the selected components in order to maintain the CUF_{en} below the design limit of 1.0 *or, if using stress-based monitoring, ensures the cumulative CUF_{en} remains below the limit of 1.0*. This program also relies on the Generic Aging Lessons Learned for Subsequent License Renewal Report (GALL-SLR Report) AMP XI.M2, "Water Chemistry," to provide monitoring of appropriate environmental parameters for calculating environmental fatigue multipliers (F_{en} values). Some of the design fatigue analyses are implicit evaluations or fatigue waivers. Both of these analyses provide the basis for not requiring detailed fatigue analyses (e.g., CUF, CUF_{en}). Implicit evaluations specify allowable stress levels based on the number of anticipated full thermal range transient cycles. As an example, piping components designed to USAS ANSI B31.1 requirements and ASME Code Class 2 and 3 components designed to ASME Section III design requirements include implicit cycle-based maximum allowable stress range calculations. Fatigue waivers are based on transient cycle limits. Fatigue waivers may have been permitted such that a detailed fatigue calculation was not required if a component conformed to certain criteria, such as those established in ASME Code, Section III, NB-3222.4(d). The AMP monitors and tracks the number of critical thermal and pressure transient occurrences for the selected components and verifies that the severity of the monitored transients is bounded by the design transient definitions in order to ensure these implicit fatigue evaluations or fatigue waivers remain valid.

In some cases, flaw tolerance evaluations are used to establish inspection frequencies for components that, for example, exceed CUF or CUF_{en} fatigue limits. As an example, ASME Code, Section XI, Nonmandatory Appendix L provides guidance on the performance of fatigue flaw tolerance evaluations to determine acceptability for continued service of reactor coolant system and primary pressure boundary components and piping subjected to cyclic loadings. In flaw tolerance evaluations, the predicted size of a postulated fatigue flaw, whose initial size is typically based on the resolution of the inspection method, is a computed parameter that is used to determine the appropriate inspection frequency. The AMP monitors and tracks the *analysis assumptions controlling* number of occurrences and severity of critical thermal and pressure transients for the selected components that are used in the fatigue flaw tolerance evaluations to verify that the inspection frequencies remain appropriate.

When a flaw is identified by inservice inspection, ASME Code, Section XI, Nonmandatory Appendices A and C provide guidance on the performance of fatigue flaw crack growth evaluations to determine acceptability for continued service of reactor coolant system pressure boundary components and piping subjected to cyclic loadings. In such a case, the predicted size of an identified flaw is a computed parameter suitable for determining the appropriate inspection frequency through a fatigue crack growth evaluation. The AMP monitors and tracks the *analysis assumptions controlling* number of occurrences and severity of each of the critical thermal and pressure transients for the selected components that are used in the crack growth evaluations to verify that the inspection frequencies remain appropriate.

Evaluation and Technical Basis

1. ***Scope of Program***: The scope includes those mechanical or structural components with a fatigue TLAA or other analysis that depends on the number of occurrences and severity of transient cycles. The program monitors and tracks the number of occurrences and severity of thermal and pressure transients for the selected

the plant-specific limits _or monitors cumulative CUF and CUF_{en} against the design limit of 1.0 using stress-based fatigue monitoring._ The program ensures that the fatigue analyses remain within their allowable limits, thus minimizing the likelihood of failures from fatigue-induced cracking of the components caused by cyclic strains in the component's material. In addition, the program can be used to monitor actual plant operating conditions to perform updated evaluations of the fatigue analyses to ensure they continue to meet the design limits.

For the purposes of ascertaining the effects of the reactor water environment on fatigue, applicants include CUFen calculations for a set of sample reactor coolant system components. This sample set includes the locations identified in NUREG/CR–6260 _with projected 80-year CUF/ $CUF_{en} \geq 0.5$,_ and additional plant-specific component locations in the reactor coolant pressure boundary if they may be more limiting than those considered in NUREG/CR–6260. Component locations within the scope of this program are updated based on operating experience, plant modifications, and inspection findings.

2. ***Preventive Actions***: This program does not involve preventive actions.

3. ***Parameters Monitored or Inspected***: The program monitors all applicable _significant_ plant transients that cause cyclic strains and _are significant contributors_ ~~contribute~~ to fatigue, as specified in the fatigue analyses, and appropriate environmental parameters that contribute to Fen values. The number of occurrences, _and_ the severity of the plant transients~~, and actual plant water chemistry~~ that contribute to the fatigue analyses for each component are monitored. _Alternatively m_~~M~~ore detailed monitoring of pressure~~,~~ _and_ thermal conditions~~, and water chemistry~~ at the component location may be performed to allow the fatigue analyses to be assessed for the specified critical locations.

4. ***Detection of Aging Effects***: The program uses applicant defined activities or methods to track the number of occurrences and severity of transients~~, and water chemistry~~ conditions, _and any applicable plant operating conditions used to inform updated evaluations of the fatigue analyses_. Technical specification requirements may apply to these activities.

5. ***Monitoring and Trending***: Monitoring and trending of the number of occurrences of each of the transient cycles and their severity is used to track the occurrences of all _significant_ transients needed to ensure the continued acceptability of the fatigue analyses, or to update the analyses. ~~Monitoring of water chemistry conditions is used to ensure calculated Fen values remain valid.~~ _Monitoring of actual plant operating conditions is used to inform updated evaluations of the fatigue analyses to ensure they continue to meet the design or analysis-specific limit._ Trending is performed to ensure that the fatigue analyses are managed and that the fatigue parameter limits will not be exceeded during the subsequent period of extended operation, thus minimizing the possibility of fatigue crack initiation of metal components caused by cyclic strains ~~or water chemistry conditions~~. The program provides for revisions to the fatigue analyses or other corrective actions (e.g., revising augmented inspection frequencies) on an as-needed basis, if the values assumed for fatigue ~~parameters~~ analyses are approached, transient severities exceed the design or assumed severities, transient counts exceed the design or assumed quantities, transient definitions have changed, unanticipated new fatigue loading events are discovered, or the geometries _or applied loadings_ of components are modified.

6. ***Acceptance Criteria***: The acceptance criterion is maintaining the value of all relevant fatigue parameters to values less than or equal to the limits established in the fatigue analyses, with consideration of reactor water environmental effects, where appropriate, as described in the program description and scope of program.

7. ***Corrective Actions***: Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality 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 components (SCs) within the scope of this program.

   The program also provides for corrective actions to prevent the appropriate limits of the fatigue analyses from being exceeded during the subsequent period of extended operation. Acceptable corrective actions include repair of the component, replacement of the component, and a more rigorous analysis of the component to demonstrate that the design limit will not be exceeded during the subsequent period of extended operation. In addition, a flaw tolerance analysis with appropriate (e.g., inclusion of environmental effects) crack growth rate curves and associated inspections performed in accordance with Appendix L of ASME Section XI is an acceptable correction action. For CUF_{en} analyses, scope expansion includes consideration of other locations with the highest expected CUF_{en} values.

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***: The program reviews industry experience relevant to fatigue cracking. Applicable operating experience relevant to fatigue cracking is to be considered in selecting the locations for monitoring. As discussed in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2008-30, the use of certain simplified analysis methodology to demonstrate compliance with the ASME Code fatigue acceptance criteria could be nonconservative; therefore a confirmatory analysis is recommended, if such a methodology is used. Furthermore, as discussed in NRC RIS 2011–14, the staff has identified concerns regarding the implementation of computer software packages used to calculate fatigue usage ~~during plant transient~~ associated with plant transient operations.

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

X.M2 Neutron Fluence Monitoring

Description of Change and Justification:

1. **X.M2 Program Description** - Page X.M2-1
The program description begins by saying this program provides an acceptable basis for managing neutron fluence-based TLAAs. This statement runs counter to the license renewal rule that provides for managing the effects of aging, but not for managing TLAAs.

    Basis:
    The rule specifies that TLAAs are evaluated; not managed. The second paragraph repeats the thought that this program manages neutron embrittlement TLAAs. The program should be described as what it is, that is, a program to determine the time-limited assumptions involved in the neutron fluence-based TLAAs.

    Markup
    This ~~aging management~~ program _ensures the validity of the neutron fluence inputs into the_ ~~(AMP) provides an acceptable basis for managing~~ neutron fluence-based time-limited aging analysis (TLAAs)~~in accordance with requirements in 10 CFR 54.21(c)(1)(iii)~~. This program monitors neutron fluence for reactor pressure vessel (RPV) components and reactor vessel internal (RVI) components and is used in conjunction with the ~~guidance in~~ Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) AMP XI.M31, "Reactor Vessel Surveillance." Neutron fluence is a time-dependent input parameter for evaluating the loss of fracture toughness due to neutron irradiation embrittlement. Accurate neutron fluence values are also necessary to identify the ~~location of the~~ RPV beltline _materials_ ~~region~~ for which neutron fluence is projected to exceed 1 × 1017 n/cm2 (E > 1 MeV) during the subsequent period of extended operation.

    ~~The assessment of~~ _N_eutron fluence is an input to a number of RPV irradiation embrittlement analyses that are mandated by specific regulations in 10 CFR Part 50. These analyses are TLAAs for ~~subsequent~~ license renewal applications (SLRAs) and are the topic of the acceptance criteria and review procedures in Standard Review Plan for Subsequent License Renewal (SRP-SLR) Section 4.2, "Reactor Vessel Neutron Embrittlement Analyses." The neutron irradiation embrittlement TLAAs that are _validated_ ~~managed~~ by this AMP include, but are not limited to: ~~(a) neutron fluence,~~ (b) pressurized thermal shock (PTS) analyses for ....

    .
    .
    .

    Guidance on acceptable methods and assumptions for determining reactor vessel neutron fluence is ~~described~~ in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." The methods developed and approved using the guidance ~~contained~~ in RG 1.190 are specifically intended _for determining_ ~~to calculate~~ neutron fluence in the region of the RPV close to the active fuel region of the core and are not intended to apply to vessel regions significantly above and below the active fuel region of the core, nor to RVI components. ~~Therefore, the use of RG 1.190-adherent methods to estimate neutron fluence for the RPV regions significantly above and below the active fuel region of the core and RVI components may require additional~~

~~justification, even if those methods were approved by the NRC for RPV neutron fluence calculations.~~ This program monitors in-vessel or ex-vessel dosimetry capsules and evaluates the dosimetry data, as needed. ~~The implementation of~~ Such dosimetry capsules may be needed when the reactor surveillance program has exhausted the available capsules for in-vessel exposure.

2. **X.M2 Program Description** - Page X.M2-1
   Add close paraphrases to end of last sentence in second paragraph.

   Basis:
   Editorial

   Markup

   .... The neutron irradiation embrittlement TLAAs that are managed by this AMP
   .... have been relocated into a pressure-temperature limits report (PTLR)).

3. **X.M2 Program Description** - Page X.M2-1, Lines 10-12
   Lines 10-12 states, "Accurate neutron fluence values are also necessary to identify the location of the RPV beltline region for which neutron fluence is projected to exceed 1 x 10^{17} n/cm^2 (E>1 MeV) during the subsequent period of extended operation." A similar "generic" fluence threshold acceptable to NRC is needed to determine the areas where RVI components are susceptible to Irradiation Assisted Stress Corrosion Cracking (IASCC) so that appropriate inspections are performed and inspection frequencies determined. As described in BWRVIP-26-A, "The threshold fluence level for IASCC has been estimated to be ~5×10^{20} n/cm^2 (E>1 MeV). Therefore this value should be identified as the accepted neutron fluence threshold for IASCC. Since this is an NRC approved document, is this the accepted neutron fluence threshold for IASCC?

   Basis:
   Without an NRC accepted threshold for IASCC within the context of the neutron fluence monitoring, a significant cost for possible unnecessary and frequent inspections of components could be realized during the 60 – 80 year period. In particular, regions above and below existing Top Guide, Core Shroud, Jet Pump and RPV Attachment weld locations, which typically within the active core region, but may extend similar to the "extended" beltline region.

   Markup
   ...Accurate neutron fluence values are also necessary to identify the location of the RPV beltline region for which neutron fluence is projected to exceed 1 × 10^{17} n/cm2 (E > 1 MeV) during the subsequent period of extended operation. *Additionally, accurate neutron fluence values are necessary to identify the location of RVI components susceptible to Irradiation Assisted Stress Corrosion Cracking (IASCC) for which neutron fluence is projected to exceed 5×10^{20} n/cm^2 (E>1 MeV) during the subsequent period of extended operation.*

4. **X.M2 Program Description and Elements 1, 3, 4, and 7** - Pages X.M2-1 thru 4
   Remove reference to reactor vessel internal components due to the following:

   1) current regulations do not involve fluence monitoring of the reactor internals components,

2) the design of the reactor vessel surveillance capsules and placement of these capsules has been optimized to monitor fluence of the reactor vessel not the reactor internals,

3) existing models and fluence calculations for the reactor vessel include some of the reactor internals to account for attenuation of the neutrons through stainless steel but fluence results for the internals have not generally been generated and documented/reported in the reactor vessel surveillance capsule reports, and

4) the concern regarding fluence of the reactor internals must be addressed through calculations and expert elicitation since there are no surveillance capsules for reactor internals fluence monitoring.

Basis:
In addition to items stated above, industry bounding fluence projections for individual reactor vessel internal components were/will be determined by BWRVIP and MRP activities to establish recommended inspection requirements and frequencies for reactor vessel internal components for the second period of extended operation.

Markup
See attached sheets.

5. **X.M2 Program Description** - Page X.M2-1
Within X.M2 and several SRP further evaluation sections, there is vague discussion regarding additional requirements or further evaluation needed but no supporting rationale or any guidance as to what constitutes an acceptable approach is provided. Lines 40-46 state that fluence methods that have been used and approved under the guidance contained in Reg. Guide 1.190 to calculate fluence near the active core region may not apply to vessel regions above and below the core height, nor to RVI components and may require additional justification. Criteria for what constitutes an acceptable justification are not specified. How is that to be achieved?

Basis:
Concern that changes go beyond compliance with Appendix H considerations without offering a technical basis or justification.

Markup
None.

6. **X.M2 Program Description** – Page X.M2-2 lines 2 and 3 and **Element 5** Pages X.M2-3 lines 30-33
A statement is recommended regarding periodic monitoring. By design, the surveillance capsule dosimetry is withdrawn infrequently. Periodic measurements will help to confirm continued accuracy of the neutron fluence calculations. ASTM E2956-14 "Standard Guide for Monitoring the Neutron Exposure of LWR Reactor Pressure Vessels" should be referenced.

Markup
None

7. **X.M2 Element 5** - Page X.M2-3

Lines 15-18 states "The use of RG 1.190-adherent methods to estimate neutron fluence for the RPV beltline regions significantly above and below the active field region of the core, and RVI components may require additional justification, even if those methods were approved by the NRC for RPV neutron fluence calculations."
Comment: Why is this needed? What safety problem is to be solved? If an owner has an approved calculation and safety/license/regulatory issues are resolved, why would additional justification be needed and would an owner be obligated to resubmit?

Basis:
Concern that changes go beyond compliance with Appendix H considerations without offering a technical basis or justification.

<u>Markup</u>
None

8. **X.M2 Element 6** - Page X.M2-3
Lines 38-44 - Item 6 "Acceptance Criteria" states that RG1.190-adherent methods (for other locations) may require additional justification regarding the level of detail used to represent the core neutron source, the methods to synthesize the 3-D flux field, and the order of the quadrature used in the neutron transport calculations. The applicability of existing qualification data may also require additional justification. **Comment:** Acceptable criteria are not specified. How is that to be achieved?

   Basis:
   Concern that changes go beyond compliance with Appendix H considerations without offering a technical basis or justification.

   <u>Markup</u>
   None.

9. **X.M2 Element 10** - Page X.M2-4
Lines 35-36 – Item 10 Operating Experience states "The program reviews industry and plant operating experience relevant to neutron fluence." **Comment:** What specific industry operating experience is meant to be reviewed? Fluence evaluations for licensees are often proprietary and not available for other licensees to review.

   Basis:
   Concern that changes go beyond compliance with Appendix H considerations without offering a technical basis or justification.

   <u>Markup</u>
   None.

X.M2 NEUTRON FLUENCE MONITORING

Program Description

This ~~aging management~~ program *ensures the validity of the neutron fluence inputs into the* ~~(AMP) provides an acceptable basis for managing~~ neutron fluence-based time-limited aging analysis (TLAAs) ~~in accordance with requirements in 10 CFR 54.21(c)(1)(iii)~~. This program monitors neutron fluence for reactor pressure vessel (RPV) components ~~and reactor vessel internal (RVI) components~~ and is used in conjunction with the ~~guidance in~~ Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) AMP XI.M31, "Reactor Vessel Surveillance." Neutron fluence is a time-dependent input parameter for evaluating the loss of fracture toughness due to neutron irradiation embrittlement. Accurate neutron fluence values are also necessary to identify the ~~location of the~~ RPV beltline *materials* ~~region~~ for which neutron fluence is projected to exceed 1×10^{17} n/cm^2 (E > 1 MeV) during the subsequent period of extended operation. *Additionally, accurate neutron fluence values are necessary to identify the location of RVI components susceptible to Irradiation Assisted Stress Corrosion Cracking (IASCC) for which neutron fluence is projected to exceed 5×10^{20} n/cm^2 (E>1 MeV) during the subsequent period of extended operation.*

~~The assessment of n~~*N*eutron fluence is an input to a number of RPV irradiation embrittlement analyses that are mandated by specific regulations in 10 CFR Part 50. These analyses are TLAAs for ~~subsequent~~ license renewal applications (SLRAs) and are the topic of the acceptance criteria and review procedures in Standard Review Plan for Subsequent License Renewal (SRP-SLR) Section 4.2, "Reactor Vessel Neutron Embrittlement Analyses." The neutron irradiation embrittlement TLAAs that are *validated* ~~managed~~ by this AMP include, but are not limited to: ~~(a) neutron fluence,~~ (b) pressurized thermal shock (PTS) analyses for pressurized water reactors (PWRs), as mandated by 10 CFR 50.61 or alternatively [if applicable for the current licensing basis (CLB)] by 10 CFR 50.61a; (c) RPV upper-shelf energy (USE) analyses, as mandated by Section IV.A.1 of 10 CFR Part 50, Appendix G, and (d) pressure-temperature (P-T) limit analyses that are mandated by Section IV.A.2 of 10 CFR Part 50, Appendix G and controlled by plant Technical Specifications (TS) update and reporting requirements (i.e., the 10 CFR 50.90 license amendment process for updates of P-T limit curves located in the TS limiting conditions of operation, or TS administrative control section requirements for updates of P-T limit curves that have been relocated into a pressure-temperature limits report (PTLR).

The calculations of neutron fluence also factor into other analyses or technical report methodologies that assess irradiation-related aging effects. Examples include, but are not limited to: (a) determination of the RPV beltline as defined in Regulatory Issue Summary (RIS) 2014-11, "Information On Licensing Applications For Fracture Toughness Requirements For Ferritic Reactor Coolant Pressure Boundary Components~~;~~" ~~(b) evaluation of the susceptibility of RVI components to neutron radiation damage mechanisms, including irradiation embrittlement (IE), irradiation assisted stress corrosion cracking (IASCC), irradiation-enhanced stress relaxation or creep (IESRC) and void swelling or neutron induced component distortion;~~ and (~~c~~b) evaluating the dosimetry data obtained from an RPV surveillance program.

Guidance on acceptable methods and assumptions for determining reactor vessel neutron fluence is ~~described~~ in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." The methods developed and approved using the guidance contained in RG 1.190 are specifically intended *for determining* ~~to calculate~~ neutron fluence in the region of the RPV close to the active fuel region of the core and are not intended to apply to vessel regions significantly above and below the active fuel region of the core~~, nor to RVI components~~. ~~Therefore, the use of RG 1.190-~~

~~adherent methods to estimate neutron fluence for the RPV regions significantly above and below the active fuel region of the core and RVI components may require additional justification, even if those methods were approved by the NRC for RPV neutron fluence calculations.~~ This program monitors in-vessel or ex-vessel dosimetry capsules and evaluates the dosimetry data, as needed. ~~The implementation of~~ ~~s~~Such dosimetry capsules may be needed when the reactor surveillance program has exhausted the available capsules for in-vessel exposure. Guidance for performing periodic measurements to confirm the continued accuracy of the neutron transport calculations and neutron fluence projections can be found in ASTM E2956-14, "Standard Guide for Monitoring the Neutron Exposure of LWR Reactor Pressure Vessel."

Evaluation and Technical Basis

1. ***Scope of Program***: The scope of the program includes RPV ~~and RVI~~ components that are subject to a neutron embrittlement TLAA or other analysis involving time-dependent neutron irradiation. The program monitors neutron fluence throughout the subsequent period of extended operation ~~for determining the susceptibility of the components to IE, IASCC, IESRC, and void swelling or distortion~~. The program also continues to ensure the adequacy of the neutron fluence estimates by: (a) monitoring plant and core operating conditions relative to the assumptions used in the neutron fluence calculations, and (b) continuously updating the qualification database associated with the neutron fluence method as new calculational and measurement data become available for benchmarking. This program is used in conjunction with GALL-SLR Report AMP XI.M31, "Reactor Vessel Surveillance."

   Updated neutron fluence calculations, plant modifications, and RPV surveillance program data are used to identify component locations within the scope of this program, including the beltline region of the RPV. Applicable requirements in 10 CFR Part 50, and if appropriate, plant Technical Specifications (TSs), related to calculating neutron fluence estimates and incorporating those calculations into neutron irradiation analyses for the RPVs ~~and RVIs~~ must be met.

2. ***Preventive Actions***: This program is a condition monitoring program through calculation of neutron fluence values, and thus there are no specific preventive actions. Because this program can be used to ensure that the inputs and assumptions associated with neutron fluence in the irradiation embrittlement TLAAs (described in SRP-SLR Section 4.2) remain within their respective limits, this program can prevent those TLAAs from being outside of the acceptance criteria that are set as regulatory or design limits in the analyses. Since the program is used to ensure that the inputs and assumptions associated with neutron fluence in irradiation embrittlement TLAAs will remain within their respective limits, this program does have some preventative aspects to it.

3. ***Parameters Monitored or Inspected***: The program monitors component neutron fluence as determined by the neutron fluence analyses, and appropriate plant and core operating parameters that affect the calculated neutron fluence. The calculational methods, benchmarking, qualification, and surveillance data are monitored to ensure the adequacy of neutron fluence calculations. Neutron fluence levels in specific components are monitored to ensure component locations within the scope of this program are identified.

   Neutron fluence is estimated using a computational method that incorporates the following major elements: (1) determination of the geometrical and material input data for the reactor core, vessel and internals, and cavity; (2) determination of the characteristics of the neutron flux emitting from the core; (3) transport of the neutrons from the core to the vessel, and into the cavity; and (4) qualification of the calculational procedure.

Guidance on acceptable methods and assumptions for determining RPV neutron fluence is described in NRC RG 1.190. The use of RG 1.190-adherent methods to estimate neutron fluence for the RPV beltline regions significantly above and below the active field region of the core~~, and RVI components~~ may require additional justification, even if those methods were approved by the NRC for RPV neutron fluence calculations.

4. ***Detection of Aging Effects***: The program uses applicant-defined activities or methods to track the RPV~~ and RVI~~ component neutron fluence levels. The neutron fluence levels estimated in this program are used as input to the evaluation for determining applicable aging effects for RPV~~ and RVI~~ components, including evaluation of TLAAs as described in SRP-SLR Section 4.2.

5. ***Monitoring and Trending***: Monitoring and trending of neutron fluence is needed to ensure the continued adequacy of various neutron fluence analyses as identified as TLAAs for the SLRA. When applied to RPV~~I~~ components ~~and to components~~ significantly above and below the active field region of the core, the program also assesses and justifies whether the current neutron fluence methodology for the CLB is acceptable for monitoring and projecting the neutron fluence values for these components during the subsequent period of extended operation, or else appropriately enhances (with justification) the program's monitoring and trending element activities accordingly on an as-needed basis. Trending is performed to ensure that plant and core operating conditions remain consistent with the assumptions used in the neutron fluence analyses and that the analyses are updated as necessary.

Neutron fluence estimates are typically determined using a combination of plant and core operating history data that address past plant operating conditions, and projections that are intended to address future operation. Although projections for future operation may conservatively over-estimate the core neutron flux to cover potential variations in plant and core operation and increases in neutron flux at any given time, there is no explicit requirement to do so. Therefore, projections for future plant and core operation should be periodically verified to ensure that any projections used in the neutron fluence calculations remain bounding with respect to actual plant operating conditions.

This program monitors in-vessel or ex-vessel dosimetry capsules and evaluates the dosimetry data, as needed. Additional dosimetry capsules may be needed when the reactor surveillance program has exhausted the available capsules for in-vessel exposure. Guidance for performing periodic measurements to confirm the continued accuracy of the neutron transport calculations and neutron fluence projections can be found in ASTM E2956-14, "Standard Guide for Monitoring the Neutron Exposure of LWR Reactor Pressure Vessel."

6. ***Acceptance Criteria:*** There are no specified acceptance values for neutron fluence; the acceptance criteria relate to the different parameters that are evaluated using neutron fluence, as described in SRP-SLR Section 4.2.

NRC RG 1.190 provides guidance for acceptable methods to determine neutron fluence for the RPV beltline region. It should be noted, however, that applying RG 1.190-adherent methods to determine neutron fluence in locations other than those close to the active fuel region of the core may require additional justification regarding, for example, the level of detail used to represent the core neutron source, the methods to synthesize the three-dimensional flux field, and the order of angular quadrature used in the neutron transport calculations. The applicability of existing qualification data may also require additional justification.

7. ***Corrective Actions***: Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality 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 components (SCs) within the scope of this program.

   The program provides for corrective actions by updating the analyses for the RPV components~~, or assessing the need for revising the augmented inspection bases for RVI components,~~ if the neutron fluence assumptions in RPV analyses ~~or augmented inspection bases for RVI components~~ are projected to be exceeded during the subsequent period of extended operation. Acceptable corrective actions include revisions to the neutron fluence calculations to incorporate additional operating history data, as such data become available; use of improved modeling approaches to obtain more accurate neutron fluence estimates; and rescreening of RPV ~~and RVI~~ components when the estimated neutron fluence exceeds threshold values for specific aging mechanisms.

   When the fluence monitoring activities are used to confirm the validity of existing RPV neutron irradiation embrittlement analyses and result in the need for an update of an analysis that is mandated by a specific 10 CFR Part 50 regulation, the corrective actions to be taken follow those prescribed in the applicable regulation.

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***: The program reviews industry and plant operating experience relevant to neutron fluence. Applicable operating experience affecting the neutron fluence estimate is to be considered in selecting the components for monitoring. RG 1.190 provides expectations for updating the qualification database for the neutron fluence methods via the operational experience gathered from RPV material surveillance program data. This operational experience is in accordance with the requirements of

10 CFR Part 50 Appendix H.

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

XI.M1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

Description of Change and Justification:

1. **XI.M1 Program Description** Page XI.M1-1
   Delete the wording "in the 2007 edition, with 2008 addenda" and replace with "in accordance with the applicable plant ASME Code Section XI edition(s) and approved addenda."

   Basis:
   The specific ASME Code editions and addenda will differ between the different units, and change as the code requirements are revised. Having the specific Code year and addenda may lead to unnecessary exceptions on the various SLR applications. Also, this revised wording will more closely align with the Description of Program in Table 3.0-1.

   Markup
   ... effects. Inspection of these components is covered in Subsections IWB, IWC, and IWD, respectively, in ~~the 2007 edition, with 2008~~ *accordance with the applicable plant ASME Code Section XI edition(s) and approved addenda*. The program generally includes periodic visual, surface, and/or volumetric examination and leakage test of Class 1, 2, and 3 pressure-retaining components and their integral attachments.

2. **XI.M1 Elements 3, 4, 5, 6** Pages XI.M1-1 through XI.M1-3
   The separator "and" for these code references should be changed to "or" since only one Code paragraph applies to a particular ASME component. This editorial occurrence is common in several locations throughout the document.

   Basis:
   Only one Code paragraph applies to a particular ASME component.

   Markup
   3. Parameters Monitored or Inspected
   The ASME Section XI ISI program detects degradation of components by using the examination and inspection requirements specified in ASME Section XI Tables IWB-2500-1, IWC-2500-1, ~~and~~ *or* IWD-2500-1 for Class 1, 2, and 3 components, respectively.

   4. Detection of Aging Effects
   Components are examined and tested as specified in Tables IWB-2500-1, IWC-2500-1, ~~and~~ or IWD-2500-1 for Class 1, 2, and 3 components, respectively. The tables specify the extent and schedule of the inspection and examination methods for the components of the pressure-retaining boundaries.

5. Monitoring and Trending
For Class 1, 2, and 3 components, the inspection schedule of IWB-2400, IWC-2400, ~~and~~ or IWD-2400, and the extent and frequency of IWB-2500-1, IWC-2500-1, ~~and~~ or IWD-2500-1, respectively, provides for timely detection of degradation. The sequence of component examinations established during the first inspection interval is repeated during each successive inspection interval, to the extent practical. Volumetric and surface examination results are compared with recorded preservice examination and prior inservice examinations. Flaw conditions or relevant conditions of degradation are evaluated in accordance with IWB-3100, IWC-3100, ~~and~~ or IWD-3100.

Examinations that reveal indications that exceed the acceptance standards described below are extended to include additional examinations in accordance with IWB-2430, IWC-2430, ~~and~~ or IWD-2430 for Class 1, 2, and 3 components, respectively. Examination results that exceed the acceptance standards below are repaired/replaced or accepted by analytical evaluation in accordance with IWB-3600, IWC-3600 ~~and~~ or IWD-3600, as applicable. Those items accepted by analytical evaluation are reexamined during the next three inspection periods of IWB-2410 for Class 1 components, IWC-2410 for Class 2 components, and IWD-2410 for Class 3 components.

6. Acceptance Criteria
Any indication or relevant conditions of degradation are evaluated in accordance with IWB-3000, IWC-3000, ~~and~~ or IWD-3000 for Class 1, 2, and 3 components, respectively. Examination results are evaluated in accordance with IWB-3100, IWC-3100, ~~and~~ or IWD-3100 by comparing the results with the acceptance standards of IWB-3400 and IWB-3500 for Class 1, IWC-3400 and IWC-3500 for Class 2, and IWD-3400 and IWD-3500 for Class 3 components. Flaws that exceed the size of allowable flaws, as defined in IWB-3500, IWC-3500 ~~and~~ or IWD-3500 may be evaluated by using the analytical procedures of IWB-3600, IWC-3600 ~~and~~ or IWD-3600 for Class 1, 2 and 3 components, respectively.

XI.M2 Water Chemistry

Description of Change and Justification:-

1. **XI.M2 Program Description**

   The "Program Description" section references: BWRVIP-190 Revision 0 (1016579) for BWRs; and "PWR Primary Water Chemistry Guidelines" Revision 6 and "PWR Secondary Water Chemistry Guidelines" Revision 7 for PWRs. These water chemistry guidelines are periodically updated by EPRI. For example, most BWRs have updated their water chemistry programs to BWRVIP-190 Revision 1 and most PWRs have updated to PWR Primary Water Chemistry Guidelines" Revision 7.

   Basis:
   Continued referencing of earlier versions of these guidelines will result in unnecessary exceptions. Updates and revision of these guidelines are based on operating experience and thorough research, and are reviewed and approved by the industry. Therefore it is recommended that the "Program Description" section reference the most recent revision of the guidelines or reference the revision in place at the time the as a SLR-GALL is approved.

   <u>Markup</u>
   The water chemistry program for boiling water reactors (BWRs) relies on monitoring and control of reactor water chemistry based on industry guidelines contained in the <u>current approved revision of</u> Boiling Water Reactor Vessel and Internals Project (BWRVIP)-190 ~~([Electric Power Research Institute [(EPRI]) 1016579).]~~. The BWRVIP-190 has three sets of guidelines: (i) one for reactor water, (ii) one for condensate and feedwater, and (iii) one for control rod drive (CRD) mechanism cooling water. The water chemistry program for pressurized water reactors (PWRs) relies on monitoring and control of reactor water chemistry based on industry guidelines contained in <u>current approved revisions of</u> EPRI ~~1014986~~ <u>3002000505</u> ("PWR Primary Water Chemistry Guidelines-," Revision ~~6~~<u>7</u>) and EPRI 1016555 (, "PWR Secondary Water Chemistry Guidelines-," Revision 7).

2. **XI.M2 Program Description**
   Add control of dose rates as an additional benefit of using additives in PWRs.

   Basis:
   Control of dose rates is an important benefit of additives that should be included in the AMP.

   <u>Markup</u>
   The program includes specifications for chemical species, impurities and additives, sampling and analysis frequencies, and corrective actions for control of reactor water chemistry. System water chemistry is controlled to minimize contaminant concentration and mitigate loss of material due to general, crevice, and pitting corrosion and cracking caused by SCC. For BWRs, maintaining high water purity reduces susceptibility to SCC, and chemical additive programs such as hydrogen water chemistry or noble metal chemical application also may be used. For PWRs, additives are used for reactivity control, ~~and~~ to control pH <u>*and dose rates*</u>, and inhibit corrosion.

XI.M3 Reactor Head Closure Stud Bolting

Description of Change and Justification:

1. **XI.M3 Preventive Actions**
Remove the 150ksi preventive measure recommendation by deleting 2.(d).

Basis:
The program Element 2 description includes a preventive measure (to reduce the potential for SSC) in which the bolting material for reactor head closure studs have an actual measured yield strength less than 150 ksi. This limitation (yield strength less than 150 ksi) is based on a position described in Regulatory Guide 1.65, Revision 1 (issued in 2010).

The reactor head studs for many nuclear power plants were fabricated consistent with Regulatory Guide 1.65, Revision 0 (issued in 1973). This earlier version of Regulatory Guide 1.65 did not take the position that reactor head studs should be fabricated from materials with actual measured yield strength less than 150 ksi; but rather, took the position that the maximum ultimate tensile strength of stud bolting material should not exceed 170 ksi. As such, many nuclear plants have reactor head closure studs in which the actual measure yield strength slightly exceeds 150 ksi but with an actual ultimate tensile strength less than 170 ksi. Previous 40 to 60 year License Renewal Applications for plants in this situation have declared exceptions to this recommendation and provided through justifications for the exceptions. These justifications included the basis that these studs are UT examined for cracks in accordance with ASME Section XI.

Since many nuclear plants did not have to opportunity prior to 2010, to order reactor head studs with yield strength less than 150 ksi, this recommendation is not a reasonable preventive measure for reactor head studs fabricated prior to 2010. The opportunity to take advantage of this one-time preventive measure is not valid for these studs, but could be used for purchasing reactor head studs going forward.

The 150 ksi limitation is intended to reduce the potential for cracking due to SCC. The existing program performs UT examinations for cracking of these studs per ASME Code, Section XI, Table IWB-2500-1. As such cracking due to SSC will be identified and corrected regardless of material in which the studs were fabricated. Recent operating experience related to cracking of reactor head closure studs has shown no instances of cracking in these components.

Continuing to recommend this limitation (less than 150 ksi) for studs fabricated prior to 2010 is unnecessary and will results in unnecessary declarations of exceptions in future SLR applications.

Markup
Preventive Actions: Preventive measures may include:

(a) Avoiding the use of metal-plated stud bolting to prevent degradation due to corrosion or hydrogen embrittlement;

(b) Using manganese phosphate or other acceptable surface treatments;

(c) Using stable lubricants. Of particular note, use of molybdenum disulfide (MoS_2) as a lubricant has been shown to be a potential contributor to SCC and should not be used

(d) ~~Using bolting material for closure studs that has an actual measured yield strength less than 1,034 megapascals (MPa) (150 kilo-pounds per square inch)~~. Or revise by adding the 170ksi for existing studs and 150ksi for newly-purchased studs going forward.

XI.M4 Boiling Water Reactor Vessel ID Attachment Welds

Description of Change and Justification:

1. **XI.M4 Element 4** - Page XI.M4-1
   The vessel ID attachment welds are visually examined in accordance with the requirements of ASME Code, Section XI, Table IWB-2200-1, Examination Category B-N-2. Revise Element 4 as follows: "~~In addition, certain attachment welds are subject to augmented examinations.~~ *The inspection and evaluation guidelines of BWRVIP-48-A recommend more stringent inspections for certain attachment welds.* BWRVIP-48-A specifies the nondestructive examination methods, inspection locations, and inspection frequencies for these augmented examinations."

   Basis:
   The scope of program clearly states that the welds within the scope of the program are those covered under BWRVIP-48-A and that BWRVIP-48-A provides augmented inspection criteria. The sentence recommended for deletion implies that in addition to the welds covered in Exam Category B-N-2, BWRVIP-48-A covers additional welds with augmented exams. The scope of welds covered by Exam Category B-N-2 is the same as the scope of welds in BWRVIP-48-A. The sentence added is from Gall Rev. 2 and is consistent with Element 1 and clarifies why the inspection methods in BWRVIP-48 can supersede those specified by Exam Category B-N-2.

   Markup

   Detection of Aging Effects: The extent and schedule of the inspections prescribed by BWRVIP-48-A and ASME Code, Section XI, are designed to maintain structural integrity and ensure that aging effects are discovered and repaired before a loss of intended function. The vessel ID attachment welds are visually examined in accordance with the requirements of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-N-2. ~~In addition, certain attachment welds are subject to augmented examinations.~~ *The inspection and evaluation guidelines of BWRVIP-48-A recommend more stringent inspections for certain attachment welds.* BWRVIP-48-A specifies the nondestructive examination methods, inspection locations,

   and inspection frequencies for these augmented examinations. The nondestructive examination techniques that are appropriate for the augmented examinations, including the uncertainties inherent in delivering and executing these techniques and applicable for inclusion in flaw evaluations, are included in BWRVIP-03.

XI.M5 Boiling Water Reactor Feedwater Nozzle

Description of Change and Justification:-

1. **XI.M5 Element 4 Detection of Aging Effects**, AND
   XI.M5 UFSAR Supplement - Pages XI 01-20, 21
   This AMP should be eliminated completely, since the activities have been incorporated in the normal station activities. As an alternative to deleting the program, modify wording as shown in Markup section.

   Basis:
   a. For all feedwater thermal sleeve designs, the inspection frequency for Zones 1, 2 and 3 is per GE NE 523 A71-0594-A, Revision 1 [Table 6-1]. The way these paragraphs are written implies that there are different source requirements for the required inspection frequency depending on the thermal sleeve design and that these frequencies may be different than that in Table 6.1. Table 6.1 includes all information that was added to Element 4 and the UFSAR Supplement that is recommended for deletion.

   b. Depending on the UT Method used, the inspection interval can be more frequent than once every 10 years (for plants with triple thermal sleeve design) per GE NE 523 A71-0594-A, Revision 1 as presented in Table 6-1. For instance if a manual UT method is used (as was done at LGS recently, due to unavailability of the automated UT equipment) the exam frequency had to be every 3 years until the frequency was reset to 10 years after auto UT was performed.

   Markup
   XI.M5 - SRP Table 3.0-1:

   ~~*Description for plants that do not have single sleeve interference fit feedwater spargers:*~~

   This program is a condition monitoring program that manages the effects of cracking in the reactor vessel feedwater nozzles. This program implements the guidance in GE-NE-523-A71-0594-A, Revision 1, "Alternate BWR Feedwater Nozzle Inspection Requirements," dated May 2000. Cracking is detected through ultrasonic examinations of critical regions of the BWR feedwater nozzle, as depicted in Zones 1, 2, and 3 on ["Figure 4-1," if the nozzle is clad, or "Figure 4-2," if the nozzle is un-clad] of GE NE 523 A71-0594-A, Revision 1. The ultrasonic examination procedures, equipment, and personnel are qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. The examination frequency for all three zones is *in accordance with GE NE 523 A71-0594-A, Revision 1 [Table 6-1].* ~~once every 10-year ASME Code, Section XI, in-service inspection interval.~~ Examination results are evaluated in accordance with ASME Code, Section XI, Subsection IWB-3130.

   ~~*Description for plants that have single sleeve interference fit feedwater spargers:*~~

   ~~This program is a condition monitoring program that manages the effects of cracking in the reactor vessel feedwater nozzles. This program implements the guidance in GE-NE-523-A71-0594-A, Revision 1, "Alternate BWR Feedwater Nozzle Inspection Requirements," dated May 2000. Cracking is detected through ultrasonic examinations of critical regions of the BWR feedwater nozzle, as depicted in Zones 1, 2, and 3 on ["Figure 4-1," if the nozzle is clad, or "Figure 4-2," if the nozzle is un-clad] of GE NE 523 A71-0594-A, Revision 1.~~

~~The ultrasonic examination procedures, equipment, and personnel are qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. The examination frequency for Zones 1 and 2 is once every [X] years, and the examination frequency for Zone 3 is once every [Y] years. Examination results are evaluated~~ in ~~accordance with ASME Code, Section XI, Subsection IWB-3130.~~

GALL XI.M5 Element 4 Markup:

Detection of Aging Effects: Cracking is detected through ultrasonic critical regions of the BWR feedwater nozzle. These critical regions cover the nozzle inner radius and bore as depicted in Zones 1, 2, and 3 on Figures 4-1 and GE-NE-523-A71-0594-A, Revision 1. The ultrasonic examination procedures, equipment, and personnel are qualified by performance demonstration in with ASME Code, Section XI, Appendix VIII.

~~For plants without single sleeve interference fit feedwater spargers, the frequency for Zones 1, 2, and 3 is once every 10-year ASME Code, Section XI, ISI interval.~~

~~For plants with single sleeve interference fit feedwater spargers, t~~*T*he inspection for Zones 1*,* ~~and~~ 2*, and 3* is in accordance with Table 6-1 of GE-NE-523-A71-Revision 1*, not to exceed once every 10-year ASME Code, Section XI, ISI Interval*. mechanics analysis and the particular type of ultrasonic examination method that employed. The plant-specific fracture mechanics analysis should use the latest fatigue crack growth rates in a water environment that have been endorsed by the U.S. Nuclear Regulatory Commission (NRC). ~~For these plants, the inspection for Zone 3 is twice the inspection interval established for Zones 1 and 2, not to once every 10 years.~~

2. **XI.M5 Program Description**
NUREG-0619 should be sunset and this AMP eliminated.

Basis:
NRC produced NUREG-0619 and included their implementation positions in GL 81-11. The original problem was BWR Feedwater nozzle inner radius cracking and limited UT capabilities. Crack initiation was eliminated by plant operational changes – no inner radius cracking in 30+ years for any sparger type. Inspection capabilities are much advanced over those in 1981 and the use of Section XI Appendix VIII assures adequate flaw identification.

Markup
None.

XI.M7 Boiling Water Reactor Stress Corrosion Cracking

<u>Description of Change and Justification:</u>

1. **XI.M7 Element 1** - Page XI.M7-1
   The GALL AMP, as discussed in the Program Description, is based on the applicant commitment to NRC GL 88-01 which defined the scope of components within the commitment to be piping and welds containing reactor coolant at temperature above 90° C (200° F). This should be changed to remain consistent with NRC GL 88-01.

   Basis:
   The GALL AMP, as discussed in the Program Description, is based on the applicant commitment to NRC GL 88-01 which defined the scope of components within the commitment to be piping and welds containing reactor coolant at temperature above 90° C (200° F). This should be changed to remain consistent with NRC GL 88-01. Note that the UFSAR Supplement section for this AMP still correctly references 93° C and 200° F. The change in temperature is a contradiction to NRC's own technical basis referenced two sentences later – e.g., the scope of GL 88-01 has been shown to be adequate and the inspection programs implemented by the industry have managed SCC of BWR piping extremely well.

   <u>Markup</u>
   ....austenitic–SS and nickel alloy that are 4 inches or larger in nominal diameter containing reactor coolant at a temperature above *93*~~60~~ °C [*200*~~140~~ °F] during power operation, regardless of code classification. The program also applies to pump ...

2. **XI.M7 Element 1** - Page XI.M7-1

   It is unnecessary to call out specific components within the scope of the AMP. There may be plants where the size of the CRDRL nozzle cap is less than 4 inches, or is not stainless steel, and therefore, the nozzle-to-cap weld would not be within this AMP and an unnecessary GALL exemption would need to be documented.

   Basis:
   There is adequate discussion of the program scope to be clear without calling out this specific component. If the statement must remain to support deletion of AMP XI.M6, then it should clarify that the nozzle-to-cap weld may be in the scope of the AMP.

   Markup:
   ~~Control rod drive return line nozzle caps and associated welds are included in the scope of the program.~~ NUREG–0313, Rev. 2 and NRC GL 88-01,

3. **XI.M7 Elements 3 and 4** - Page XI.M7-2

   Delete the references to BWRVIP-75-A.

   Basis:
   BWRVIP-75-A does not include guidance relative to examination or inspection methods or test techniques. BWRVIP-75-A only provides optional guidance to that provided in GL 88-01, relative to the number of welds that need to be inspected and the frequency of inspections (extent and schedule, as discussed in GALL). This is stated in the program description and Element 4. Therefore reference to BWRVIP-75-A should be deleted from Element 3 and modified in Element 4.

Markup

1. Scope of Program: The program focuses on (a) managing and implementing countermeasures to mitigate IGSCC and (b) performing ISI to monitor IGSCC and its effects on the intended function of BWR piping components within the scope of renewal. The program is applicable to all BWR piping and piping welds made of austenitic–SS and nickel alloy that are 4 inches or larger in nominal diameter reactor coolant at a temperature above 60 °C [140 °F] during power operation, regardless of code classification. The program also applies to pump casings, valve bodies, and reactor vessel attachments and appurtenances, such as head spray and vent components. ~~Control rod drive return line nozzle caps and associated welds are included in the scope of the program.~~ NUREG–0313, Rev. 2 and NRC GL 88-01, respectively, describe the technical basis and staff guidance regarding mitigation of IGSCC in BWRs. Attachment A of NRC GL 88-01 delineates the staff-approved positions regarding materials, processes, water chemistry, weld overlay partial replacement, stress improvement of cracked welds, clamping devices, crack characterization and repair criteria, inspection methods and personnel, inspection

3. Parameters Monitored or Inspected: The program detects and sizes cracks and detects leakage by using the examination and inspection guidelines delineated in NUREG–0313, Rev. 2, and NRC GL 88-01. ~~or the referenced BWRVIP-75-A guideline as approved by the NRC staff.~~

4. Detection of Aging Effects: The extent, method, and schedule of the inspection test techniques delineated in NRC GL 88-01 ~~or BWRVIP-75-A~~ are designed to structural integrity and ensure that aging effects are discovered and repaired before the loss of intended function of the component. Modifications to the extent and schedule of inspection in NRC GL 88-01 are allowed in accordance with the inspection guidance in approved BWRVIP-75-A. Prior to crediting hydrogen water chemistry to modify extent and frequency of inspections in accordance with BWRVIP-75-A, the applicant should meet conditions described in the staff's safety evaluations regarding BWRVIP-62-A. program uses volumetric examinations to detect IGSCC. Inspection can reveal and leakage of coolant. The extent and frequency of inspection recommended by the program are based on the condition of each weld (e.g., whether the weldments were made from IGSCC-resistant material, whether a stress improvement process was applied to a weldment to reduce residual stresses, and how the weld was repaired, if it had been cracked).

XI.M9 Boiling Water Reactor Vessel Internals

Description of Change and Justification:

1. **XI.M9 Program Description** - Page XI.M9-1
Page XI.M9-1, rows 19 thru 44 (Program Scope) describe screening criteria applicable to CASS reactor internals and page XI.M9-3, row 28 includes a fluence threshold of 1E17 n/cm2 for consideration of fracture toughness in CASS reactor internals. The content of Section XI.M9 does not reflect this fact. A recommended approach is to defer to an NRC accepted approach (as documented in BWRVIP-234 and the associated NRC SE).

   An allowance for an alternative screening criteria is mentioned on page XI.M9. However, the text should be clarified to confirm that one acceptable alternative is the screening criteria associated with BWRVIP-234 and the associated NRC SE. Further, it reasonable to clarify that CASS BWR reactor internals continuing to meet the screening criteria contained in BWRVIP-234 (as accepted with modification by NRC NRR) do not require examination until such time as the screening criteria are no longer met. Specifically, the technical bases for exemption should stand independent of operating time or licensed operating period.

   Basis:
   There are ongoing activities related to NRC review of the BWRVIP approach for management of CASS internals. A draft SE recently received by the BWRVIP for review indicates that, with slight modification, NRC DE accepts the BWRVIP position in BWRVIP-234. As a result, castings meeting these revised screening criteria do not require inspection.

   Markup
   None.

2. **XI.M9 Element 1** - Page XI.M9-2
Modify the scope of the program as described in the markup section. Delete the phrase, "BWRVIP-50-A is a repair design" document and is not needed for aging management and should not be referenced. (applies generically to all repair design criteria documents)

   Basis:
   BWRVIP-183 establishes an inspection scope of 10% of the grid beam cells to be inspected every 12 years with at least 5% of the inspections performed in the first 6 years of each 12-year interval. All BWRs that entered the 60-year PEO are already implementing this inspection schedule and should be continuing that schedule through the SLR PEO. Requiring the 12-year inspection interval to reset and re-start at the beginning of the subsequent PEO, and requiring that 5% of the inspections be performed in the second 6-year period of the 12-year interval starting at the beginning of the SLR PEO will disrupt the scheduling of inspections per BWRVIP-183 and could likely delay inspections that would be scheduled to maintain the current BWRVIP-183 inspection schedule. Most plants perform all 10% of the inspections within the first 6 years of each 12-year interval, primarily for efficiency purposes. I don't expect that the NRC intended to require the applicant to possibly delay inspections to be GALL compliant. The revised wording implements a continued inspection schedule in accordance with BWRVIP-183, which is believed to be what was intended.

   Markup

   Top guide: BWRVIP-26-A and BWRVIP-183 provide guidelines for inspection and evaluation; ~~BWRVIP-50-A provides guidelines for repair design criteria~~. The

requires inspect~~s~~*ion* of ~~5~~*10* percent of the top guide locations using enhanced visual technique, EVT-*1 every 12 years with at least 5 percent within the first 6 years of each 12-year interval.*~~after entering the subsequent period of extended operation.~~
~~An additional 5 percent of the top guide locations will be inspected within 12 years after entering the subsequent period of extended operation.~~

3. **XI.M9 Element 1** - Page XI.M9-3
   Modify the scope of the program as delineated in the markup section.

   Basis:
   Control rod drive housing and lower plenum components are managed consistent with BWRVIP-47-A as described in GALL Report AMP XI.M8, Boiling Water Reactor Penetrations. Therefore, components managed by BWRVIP-47-A do not need to also be managed by this AMP or discussed within Element 1, Scope of Program for this AMP.

   Markup
   ~~*Control rod drive (CRD) housing and lower plenum components:* BWRVIP-47-A provides guidelines for inspection and evaluation; BWRVIP-55-A provides guidelines repair design criteria.~~

4. **XI.M9 Element 3,** Page XI.M9-4, Lines 4-7)
   Consider deletion of the reference to the aging effect of stress relaxation for jet pump hold down beams.

   Basis:
   Jet pump beams are replaceable component, and stress relaxation has not been identified as a degradation mechanism in BWRVIP-138R1-A. It should also be noted that the draft SRP-SLR does not address this aging effect (Reference Paragraph 3.1.2.2.14 of draft NUREG-2192*).*

   Markup
   This program also manages loss of preload due to thermal or irradiation-enhanced stress relaxation for core plate rim holddown bolts ~~and jet pump assembly holddown beam bolts~~ by performing visual inspections or stress analyses to ensure adequate structural integrity.

5. **XI.M9 Element 4**
   Modify the detection of aging effects section as described in the markup section.

   Basis:
   ASME Section XI, Subsection IWB, Table IWB-2500-1, Examination Category B-N-2 covers welded core support structures that are managed within this AMP and interior attachments to reactor vessels that are components managed consistent with BWRVIP-48-A as described in GALL Report AMP XI.M4, Boiling Water Reactor ID Attachment Welds. Therefore, components managed by BWRVIP-48-A are not managed by this AMP.

   ASME Section XI, Subsection IWB, Table IWB-2500-1, Examination Category B-N-1 covers Reactor Vessel internal components with Item Number B.13.10, as clarified in Note 1 of the table. The examination method specified for Item Number B13.10 is VT-3, not VT-1, and therefore needs correction. The VT-1 examinations specified for item Number B13.20 is for internal attachment welds within the beltline that are managed by GALL Report AMP XI.M4, Boiling Water Reactor ID Attachment Welds, consistent with BWRVIP-48-A guidelines.

Markup

Detection of Aging Effects: The extent and schedule of the inspection and test techniques prescribed by the applicable and staff-approved BWRVIP guidelines are designed to maintain structural integrity and ensure that aging effects will be discovered and repaired before the loss of intended function of BWR vessel internals. Vessel internal components are inspected in accordance with the requirements of ASME Section Subsection IWB*, Table IWB-2500-1*, Examination Category B-N-2 *for core support structures, and Examination Category B-N-1 for other reactor internal components.* ~~ASME Section XI inspection specifies visual VT-1 examination to detect discontinuities and imperfections such as cracks, corrosion, wear, or erosion, on the surfaces of components.~~ This inspection ~~also~~ specifies visual VT-3 examination to determine the general and structural condition of the component supports by (a) verifying parameters, such as clearances, settings, and physical displacements and (b) detecting discontinuities and imperfections, such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion. BWRVIP program requirements provide for inspection of BWR internals to manage loss of material and cracking using appropriate examination techniques such as visual examinations (e.g., EVT-1, VT-1) and volumetric examinations [e.g., ultrasonic testing (UT)].

XI.M10 Boric Acid Corrosion

Description of Change and Justification:-

1. **XI.M10 Element 3** - Page XI.M10-2
   Consider clarification of this paragraph to identify that the listed parameters monitored in the 2nd paragraph apply to inside containment only.

   Basis:
   As written, the paragraph could be misinterpreted to monitor these parameters throughout the plant where available resulting in monitoring that provides no value relative to the Boric Acid Program.

   Markup
   In order to identify potential plant issues not detected during walkdowns and maintenance, *inside containment* the program tracks airborne radioactivity monitors, humidity monitors, temperature monitors, reactor coolant system water inventory balancing, and containment air cooler thermal performance. The program also looks for evidence of boric acid deposits on control rod drive (CRD) mechanism shroud fans, containment air recirculation fan coils, containment fan cooler units, and airborne filters.

2. **XI.M10 Element 4** - Page XI.M10-2
   A technical justification for not removing obstructions to visual inspections should be clarified for insulated components.

   Basis:
   Criteria for removing insulation for inspection is already provided in Element 4. Additional justification should not be required for insulated components unless specific leakage is observed.

   Markup
   ... Conditions leading to boric acid corrosion, such as crystal buildup and evidence of moisture, are readily detectable by visual inspection, though removal of insulation may be required in some cases. *For non-insulated components,* obstructions to visual inspections are removed unless a technical justification is documented by the program owner. *For insulated components, the technical justification is required only if there is evidence of leakage.* Criteria for removing insulation for bare-metal inspections include the safety significance of the location, evidence of leakage from under the insulation, bulging of the insulation, and operating experience. ...

3. **XI.M10 Element 4** - Page XI.M10-2
   Shifting the burden of proof on whether insulation or other visual obstruction removal is required to facilitate visual inspection from condition-driven when external indicators suggest the possibility of a leak, to documenting in a technical evaluation why a visual "obstruction" was not removed [4 – Detection of Aging Effects] is unwarranted.

   Basis:
   BAC Programs are well-established, regularly reviewed by INPO, and required to be "learning programs" that monitor and incorporate OE routinely as appropriate. While reflecting that evolution in the GALL may be reasonable, using SLR as a way to establish new program expectations is not. There is no SLR-related operational or aging impact or change that warrants alteration of a licensee's BAC Program. Existing practice is more than adequate and the increased burden does not improve safety.

Markup
None.

4. **XI.M10 Element 5** - Page XI.M10-2
Section should be revised to require maintaining a list of active borated water leaks and not all borated water leaks.

   Basis:
   This paragraph should restrict the list to only active leaks. While many plants record both active and inactive leaks, inactive leaks do not affect structural integrity based on low corrosion rates.

   Markup
   The program maintains a list of all *active* borated water leaks to track the condition of components in the vicinity of leaks and to identify locations with repeat leakage.

5. **XI.M10 References** - Page XI.M10-4
Update the "Boric Acid Corrosion Guidebook" reference from Revision 1 to Revision 2.

   Basis:
   References should reflect latest industry issued guidance.

   Markup
   None.

XI.M11B - Cracking of Nickel Alloy Components and loss of Material Due to Boric Acid Induced Corrosion in Reactor Coolant Pressure Boundary Components (Pressurized Water Reactors Only)

Description of Change and Justification:-

1. **XI.M11B Element 4** - Page XI.M11-2
   A baseline volumetric exam of all susceptible material nickel alloy bottom-mounted instrument nozzles may not be possible due to geometry/accessibility of the components. Industry visual examinations have been proven capable of detecting relevant indications before the effects of aging progress to the point of causing a loss of intended function. Industry recommends deleting this exam from the guidance.

   Basis:
   If the identified inspections are necessary to assure safety, it is recommended that NRC should work through the ASME process to have such requirements codified. If safety is not an issue and this is being sought for additional data, it is inappropriate. What is inadequate about the existing rules from a plant safety perspective?

   The requirement mandates the use of qualified method in accordance with ASME Code Section XI. Such methods have not been developed for many of these locations (bottom-mounted instrument nozzles, branch connections, etc.). To do so would take years of development and significant resources. This seems an undue burden when operating experience has shown little degradation in these locations and the safety need has not been identified.

   The term "adequate periodicity" is vague and would likely be a source of conflict. Crisp definitions are needed and adequacy should be based on objective parameters that are consistent with a clearly established safety need.

   Markup
   None.

2. **XI.M11B Element 4** - Page XI.M11-2
   A baseline volumetric exam of all susceptible material nickel alloy bottom-mounted instrument nozzles may not be possible due to geometry/accessibility of the components.

   Basis:
   The MRP's BMN safety assessment, shared with NRC in public meetings, concluded that a program of regular visual examinations for evidence of leakage provides adequate protection against challenges to nuclear safety from BMN degradation. While NRR has not necessarily formally accepted this position, they have rescinded previous efforts through the ASME Code to require BMN volumetric exams.

   If "qualified volumetric examination method" is meant to imply an ASME Section XI or PDI-level program, the qualification program itself would be a significant industry burden to develop much less implement. As noted above, it is not necessary to assure safety.

   Markup
   None.

3. **XI.M11B Element 4** - Page XI.M11-2
Include consideration of the PWSCC temperature threshold when recommending baseline volumetric examinations for branch line connections and CRDM housings that typically operate below the 550 °F threshold temperature.

    Basis:
    None.

    Markup
    None.

4. **XI.M11B Element 4** - Page XI.M11-2
GALL-SLR recommends a baseline volumetric or inner-diameter surface inspection for all susceptible nickel alloy branch line connections and associated welds as identified in Table 4-1 of MRP-126 if such components or welds are of a sufficient size to create a loss of coolant accident (LOCA) through a complete failure (guillotine break) or ejection of the component. Industry visual examinations have been proven capable of detecting relevant indications before the effects of aging progress to the point of causing a loss of intended function. Industry recommends deleting this exam from the guidance.

    Basis:
    The need for examining these locations were considered in the development of Code Case N-770 through the ASME process. The committee did not choose to require such volumetric examinations. NRC chose to interpret the code requirements differently and conclude a volumetric examination was required for some branch connections. NRC's position was documented in RIS 2015-10 and ASME's position is documented in Interpretation XI-1-13-27. Given the opposing views, the ASME committee opened an action to further evaluate the situation. Analyses are underway to determine what if any locations should be examined volumetrically. The analysis is due mid-2016 and will be used in consideration of revising code rules. Therefore since the locations under consideration are within the systems subject to ASME Section XI provisions and the ASME code committee (which includes industry and NRC as stakeholders) is currently evaluating this issue and since the resolution will be documented in the ASME code publications and since NRC is obligated to use the ASME Section XI code in its rulemaking, the recommendation above should be removed from the GALL-SLR. The issue should be resolved through the ASME committee process and NRC's routine rulemaking. If the ASME committee process and NRC's routine rulemaking processes identify any GALL-SRP AMP changes, the changes should be incorporated using the ISG process.

    Markup
    None

XI.M12 Thermal Aging Embrittlement of Cast Austenitic Stainless Steel

Description of Change and Justification:

1. **XI.M12 Program Description**, Page XI.M12-1, second paragraph
   Pump casings should be treated the same as valve bodies and not require screening or guidance addressing pump casings should be added.

   Basis:
   In accordance with letter dated May 19, 2000, from Christopher Grimes, Nuclear Regulatory Commission (NRC), to Douglas Walters, Nuclear energy Institute (NEI) screening for susceptibility to thermal aging embrittlement is not required for pump casings and valve bodies.

   The above letter states under Valve Bodies and Pump Casings (page 9):
   "Valve bodies and pump casings are adequately covered by existing inspection requirements in Section XI of the ASME Code, including the alternative requirements of ASME Code Case N-481 for pump casings. Screening for susceptibility to thermal aging is not required and the current ASME Code inspection requirements are sufficient."

   Note that the May 19, 2000 Grimes letter provided screening exclusions that referenced Code case N-481, which has been annulled. By practice, ASME Section XI code cases are annulled when the appropriate provisions of the case have been incorporated into the Code and that edition / addenda of the code has been endorsed by NRC in 10CFR505.55a. Since N-481 has been annulled, the conclusion is the code committee incorporated the appropriate elements of the case into the code itself. Further, it was in an edition or addenda NRC has endorsed in 10CFR50.55a. Since ASME did not include the screening for susceptibility provisions of the code case in the code and since NRC did not condition the use of the code it is logical to conclude that the screening is not needed. As such, the use of the code case should be dropped from GALL-SLR and Section XI as written is adequate for use.. Screening of CASS pump casings for thermal embrittlement susceptibility should not be needed, ASME code inspection requirements are sufficient.

   In addition, pump casings (B-L-2) and valve bodies (B-M-2) are included in ASME Section XI Table IWB-2500-1 and require a visual, VT-3 inspection and acceptance standard IWB-3519.

   Markup
   For *pump casings and* valve bodies, based on the results of the assessment documented in the letter dated May 19, 2000, from Christopher Grimes, Nuclear Regulatory Commission (NRC), to Douglas Walters, Nuclear Energy Institute (NEI) (May 19, 2000 NRC letter), screening for significance of thermal aging embrittlement is not required. The existing ASME Code, Section XI inspection requirements are adequate for *pump casings and* valve bodies.

2. **XI.M12 Description of Program**, Table XI-01, Page XI 01-25
   AMP XI.M12, Thermal Aging Embrittlement of CASS Description of Program should read as shown in Markup section.

   Basis:
   Changes to Table XI-01, XI.M12 Description of Program are to simplify the description and bring it in to better alignment with the GALL-SLR XI.M12 Scope of Program.

   Markup
   The program consists of the determination of the susceptibility potential *to a significant* ~~significance~~ loss of fracture toughness due to thermal embrittlement of *ASME Code Class 1* CASS piping and piping components in both BWR and PWR reactor coolant pressure boundaries~~-emergency core cooling system (ECCS) systems, including interfacing pipe linesto the chemical and volume control system and to the spent fuel pool; and in BWR ECCS systems, including interfacing pipe lines to the supression chamber spray system in regards to thermal aging embrittlement~~ based on casting method, molybdenum content, and ferrite percentage. For potentially susceptible piping and piping components aging management is accomplished either through enhanced volumetric examination, enhanced visual examination, or a component-specific flaw tolerance evaluation.

XI.M16A PWR Vessel Internals

Description of Change and Justification:

1. **XI.M16A Program Description**
GALL-SLR deletes this program in its entirety, replacing it with a plant-specific AMP per SRP-3.1.3.2.9. The program should be retained and informed as industry and/or staff research discovers revisions, through the applicant's OE program. Consideration should be given to retaining the AMP XI.M16A regarding PWR Reactor Internals aging management, as the existing MRP-227-A-based program for 40-60 years is the most reasonably sound and technical robust aging management program based on proactive inspections and activities to monitor aging mechanisms in the plants.

Bases:
This AMP is based on the results of EPRI program MRP-227 and MRP-227A (the version reviewed and approved by NRC staff). It is based upon component rankings, inspections and evaluations of the effects of age-related processes and degradations.

Even though there may not be any component histories within the 60-80 year range of reactor operations, there is no reason to suspect that the identified aging and aging effects (for 40-60 years) are suddenly discontinuous so that component behavior would be totally unknown and undefinable. Fluence increases, void swelling, IASCC and other known effects can be projected as aging effects into the 60-80 year timeframe and under periodic monitoring just like any other corrosion or aging effect, unless it is known that there exists some discontinuity, some "cliff-effect," over which the component or effect will precipitously crash without any foreknowledge. Instead, this program should be thought of in a similar manner as a TLAA managed as per 10 CFR 54.21.c.1.iii, in that a systematic set of periodic inspections and associated corrective actions are defined so as to monitor and manage effects of aging of components before any loss of intended functions. Triple-i (iii) treatment is indicated (ref. the VY NRC Commission decisions) for a previously-calculated aging effect but —while it is a known aging effect— it can no longer be calculated; rather it can be managed by a programmatic set of inspections and/or tests, and repaired, replaced or re-evaluated prior to indications of failure. (We are not saying this ought necessarily to be a TLAA, but we are making the point that it can be handled in a manner analogous to a TLAA, where management of components is acceptable even though calculations per se do not exist to show total acceptability for the period of extended operation of 60-80 years.)

These techniques and inspection strategies have been proven over many years both within the BWRVIP and PWR-MRP programs, and will remain the basis for SLR aging management applications as well. As previously noted by industry, this aging management program based upon MRP-227-A is supplemental to the existing ASME Section XI In-Service Inspection programs as detailed by Chapter XI.M1; and its continued use will provide reasonable assurance of the long-term integrity and safe operation of pressurized water reactor (PWR) vessel internal components. Industry has an on-going initiative through EPRI to establish any supplemental requirements to MRP-227-A that may be needed to address the SLR application for 60-80 years life. This effort is expected to be completed in the 2019-2020 time-frame.
Additionally, industry is developing a PWR Internals Position Paper that similarly supports the MRP-227 processes and revisions as the bases for utility aging management efforts.

Markup
None.

XI.M17 Flow Accelerated Corrosion

Description of Change and Justification

1. **XI.M17 Program Title**
   Change Title to "Flow-Accelerated Corrosion And Other Wall-thinning Erosion-Corrosion Mechanisms"

   Basis:
   a. GALL-SLR has expanded this beyond simply "Flow Accelerated Corrosion" and so the name should reflect this. It is a misnomer to name it "FAC" under the proposed guidance. It should be changed to something such as "[FAC] plus erosion management." In addition, since the agency has stated that "since there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms..." all applicants will in essence be required to analyze and prepare management programs for both types of aging effect. That appears to be an over-reach; instead management of wall-thinning due to erosion should be excludable by an applicant (see below) if there is no real OE for that aging effect at the facility.

   b. NSAC-202L-R4, Recommendations for an Effective Flow-Accelerated Corrosion Program (EPRI Technical Report 3002000563) states in Footnote 1, on page 1-1 that "erosion, it should be noted, is not part of the degradation mechanism." As such the term erosion, if included in this AMP, should be explicitly distinguished from FAC, and handled as such, throughout the AMP.

   Markup
   See attached pages.

2. **XI.M17 Program Description** – Page XI.M17-1
   The AMP should not be extended into coverage of treated water systems. The justification(s) provided do not lead to nor warrant the inclusion. Any erosion mechanisms covered under this AMP should be in secondary and non- treated water systems, involving wall-thinning and limited to management of the aging effects for SSCs within scope of license renewal. This proposed AMP does not seem to observe those boundaries.

   Basis:
   a. GALL-SLR continues the program as proposed in LR-ISG-2012-01, in which coverage of "erosion" was justified by citing GALL-R2, 3.2.2.2.4. However that section does not cover wall-thinning mechanisms, rather erosion of an orifice due to high dP over a period of time. That this instance involved borated water was immaterial to the erosion effect. So this is not a justification to extend this AMP to treated (borated) water, or as a justification to postulate erosion due to wall-thinning.

   b. Another instance that does not provide justification is the notification by Westinghouse of ECCS loop injection throttle valves potentially failing over a short period of time due to erosion during LOCA accidents (See IN 97-76, 10/30/1997). That was identified as a short-term mechanism under Part 50.46, and corrected by design change, and furthermore had nothing to do with wall thinning.

   c. If there are examples that justify expanding the program (and there could be, however the commenter does not know them), then those examples should be presented.

   d. Other cases of justification should also be checked and those that do not cover FAC or wall-thinning erosion should be removed for the AMP.

Markup
See attached pages.

3. **XI.M17 Program Description** – Page XI.M17-1
FAC portions of this AMP need to be limited to FAC susceptible piping.

Basis:
Piping is susceptible to FAC if it is subject to temperatures in excess of 200°F.

Markup
...The program includes (a) identifying ~~all susceptible~~ piping systems and components susceptible to either mechanism; (b) developing FAC predictive models...

4. **XI.M17 Program Description** – Page XI.M17-1
Delete the phrase stating "periodic monitoring in lieu of eliminating... mechanisms."

Basis:
   a. 10 CFR 54 (the Rule)/SOCs specify that the applicant needs to effectively "manage" the "effects" of aging; it is not a requirement that any aging mechanism needs to or is required to be totally eliminated. "Eliminating the cause of" any aging mechanism is beyond the scope of 10 CFR Part 54. This type of reasoning should be eliminated from the AMP and appropriate justification used to align the AMP for effectively **managing** the aging **EFFECT.**
   b. Periodic monitoring is actually an acceptable aging management component. However, the commenter recognizes that more actions may also be needed.

Markup
...This program ~~may~~ also manages wall thinning caused by mechanisms other than FAC, in situations where *such mechanisms exist at a facility.* ~~periodic monitoring is used in lieu of eliminating the cause of various erosion mechanisms~~.

5. **XI.M17 Element 1** – Page XI.M17-1
Revise element 1 (and similar parts throughout the elements) to state "the FAC portion of the program..." instead of simply saying "the FAC program..."

Basis:
Since two distinct mechanisms are being incorporated into one AMP, the AMP should use a consistently parallel construct throughout in order to distinguish when the FAC mechanism is being discussed and when the wall-thinning via erosion mechanism is being discussed.

Markup
See attached pages.

6. **XI.M17 Element 1** – Page XI.M17-1
Lines 19-22 are incorrect since the term "high-energy" is deleted. Re-insert the term "high-energy" into the definition of FAC to accurately align to NSCA-202L.

Basis:
In revising this sentence the staff has made it incorrect; the FAC program in NSAC-202L limits FAC to **high-energy** systems, and LRISG-2012-01 eliminated that phrase for GALL-R2.

Markup
None.

7. **XI.M17 Element 1** – Page XI.M17-1
Lines 25-27: The scope for wall-thinning due to erosion should be limited to non-treated water systems. In revising this sentence the staff has made it incorrect; the FAC program in NSAC-202L limits FAC to high-energy systems, and LRISG-2012-01 eliminated that phrase for GALL-R2.

   Basis:
   If there are no OE examples that show an industry trend for wall-thinning of pressure boundaries due to erosion in treated water systems, then they should be excluded from scope. If there are examples, then those should be added to the GALL-SLR to support the inclusion. (Since this is a **new** GALL for SLR and not simply a revision to GALL-R2, comments on this issue should again be applicable.) For treated water systems where particulates are controlled any erosion would only be due to cavitation, droplet impingement or flashing. The staff's response in 2012-01 was not convincing, since the two examples given by the staff involved neither FAC nor flow erosion: rather cavitation (the eroding of an **orifice** not the walls) and impingement in a 2-phase environment (SG FW impingement plates), sections 3.2.2.2.4 and 3.1.2.2.8. Neither one deals with **wall-thinning due to erosion**, so neither one supports the argument and neither should pertain to this discussion. The FW plates effect is apparent only for 1 or 2 Westinghouse SG designs with a bottom-mounted FW preheater, so it is not appropriate to extend this peculiarity to apply as an ostensibly industry-wide issue; in any case this impingement is not wall-thinning of piping or a pressure boundary due to erosion. If there are no OE examples that show an industry trend for wall-thinning of pressure boundaries due to erosion in treated water systems, then they should be excluded from scope. If there are examples, then those should be added to the GALL-SLR to support the inclusion.

   Markup
   None.

8. **XI.M17 Element 1** – Page XI.M17-1
Lines 25-29 should include phrasing to denote that wall-thinning erosion should be included only for facilities that have instances or OE-related to it for reasons stated in Comment 7.

   Basis:
   Furthermore, the sentence should add that components in the scope of second license renewal are contemplated. It is immaterial to the AMP if non-scope components are monitored or managed for this aging effect.

   Markup
   …The program ~~may~~ also includes components that are subject to wall thinning due to erosion mechanisms such as cavitation, flashing, droplet impingement, or solid particle impingement in various water systems *if there is OE of this nature at the facility*. Since there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms, ~~susceptible~~ components *of any material and within the scope of license renewal* ~~of any material~~ may be ~~included~~ *susceptible and exhibit erosion, which would then be managed* in the erosion portion of the program.

9. **XI.M17 Element 1** – Page XI.M17-1
Further comments on Element 1.

   Basis:

a. In further consideration of systems that ought not to be in scope, one would not expect (nor has the commenter heard of any) either FAC or erosion to be occurring in a PWR reactor coolant system, however it is a high-energy, high flow system, yet is treated water and has extremely low dissolved O_2 and no particulate or suspended materials to speak of. Nor in the pressurizer where there is two-phase water – water and steam— yet low flow and again, low O_2 and no particulate. Neither in downstream tailpieces of the PORVs nor safety valves, where there would be (if any flow) two-phase high-energy flow, yet very infrequently and not enough time at those flow conditions to cause detectable erosion.

b. Why should applicants have to prove for their facility, that erosion is not occurring for these types of systems? It should be sufficient that, if an erosion condition occurred or has some indications based upon relevant plant OE (or even a "twin" or similar plant where those conditions could also reasonably exist at the applicant facility), in other words, if there is truly relevant OE or occurrences then for those systems and components, either examine to see if you have the erosion (and document not having it) or monitor and manage it under the AMP because the situation is a real one for your facility. Perhaps this is what the staff has in mind but the scope appears much more broad to this commenter than that, and so that's why the comment is made here.

c. On the other hand, there may be cases where in a service water system, for example, erosion downstream of a flow control valve may cause wall thinning of the pipe, and so that situation needs to be managed under the new AMP as a flow erosion (not FAC). The commenter would agree that that situation needs either managing under this AMP or some sort of design change to resolve it. If the design change indeed resolves it, then following a period of successful confirmation, no more erosion aging management should be needed for that location.

<u>Markup</u>
None.

9. **XI.M17 Element 2** – Page XI.M17-1
Lines 30-31 should be revised to reflect the FAC "portion" of the program. Add a similar statement for the "erosion portion" – it is condition monitoring (or, staff chooses the type). Also Technical Issues Input form GALL-48 for AMP XI.M17 was not addressed, i.e., the phrase "monitoring of water chemistry to..." was not removed from Element 2.

Basis:

a. Stating that the AMP should manage two aging effects is fine, but the AMP should drop the phrases like "may include components" or "may be used to manage...erosion" and simply state that both issues are the intended scope and purpose of this SLR AMP.

b. As explained for lines 25-29 above, this AMP is actually designed in such a way that an applicant must inspect and test virtually all water systems in the plant to show that something is not occurring. Unless limited to those occurrences of erosion at the facility, this is too broad of a reach. This commenter does not contest the staff desire to have the AMP cover two things; however, the statement also means that all applicants would need to perform AMRs on virtually all piping systems, both treated and untreated water, primary and secondary, to show that either erosion is not happening at all in their plant or that they are managing it via the AMP, unless the scope can be narrowed to what occurs at the facility if the facility has such occurrences... which is how this scope should be designed to cover.

c. Previous comment continued: While it is true that (as was stated in staff responses to ISG 2012-01) one could say that an applicant may always propose a plant-specific AMP or line items, that response contributes nothing to objective, reasoned discussions of which way is the appropriate way to design an AMP. The staff is giving clear indication that it prefers the AMP to be designed as proposed in GALL-SLR, unless of course the applicant desires an indefinite number of RAI rounds and questions and subsequent re-work. So the AMP should be revised to simply treat the topic as the 2-part AMP that is being presented, with balanced discussions of each mechanism and its management

d. Furthermore, aging management, under the Rule, was not intended to identify and propose "materials known to be totally resistant to" any aging mechanism— the intent is to identify and manage the **effects** of aging— so this type of justification should be removed from the AMP and suitable justifications that are consistent with the Rule inserted instead.

Markup
See attached pages.

10. **XI.M17 Element 2** – Page XI.M17-1
Technical Issues Input form GALL-48 for AMP XI.M17 was not addressed, i.e., the phrase "monitoring of water chemistry to..." was not removed from Element 2. The phrase "monitoring of water chemistry to control" in line 32 of element 2 should be deleted in favor of "controlling pH and dissolved oxygen..."

Basis:
The phrase implies this AMP is also required to monitor chemistry parameters outside of the monitoring performed by XI.M2, Water Chemistry. Making the edit retains the recommendation for control of the parameters without introducing the potential confusion of which program needs to be central in the monitoring and tasks related to water chemistry.

Markup
...However, it is noted that ~~monitoring of water chemistry to control~~ *controlling* pH and dissolved oxygen content are effective ...

11. **XI.M17 Element 4** – Page XI.M17-2, Lines 25-26
Lines 25-26, delete "before the loss of intended function" and replace with "in accordance with minimum wall requirements per the construction Code or ASME Code, Section XI."

Basis:
Minimum wall requirements per the construction Code or ASME Section XI have been used by the industry in the determination of the extent and the schedule of inspection, not the loss of intended function.

Markup
The extent and schedule of the inspections ensure detection of wall thinning ~~before the loss of intended function~~ in accordance with minimum wall requirements per the construction Code or ASME Section XI.

12. **XI.M17 Element 4** – Page XI.M17-2, Lines 32-33
In the section "Detection of Aging Effects" - Line 32 references an old EPRI report (1011231) dated 2004 for identifying potential damage locations due to erosion mechanisms. A more current document for identifying erosion locations dated 2010 is EPRI report 1022187 entitled "Plant Susceptibility Screening for Erosive Attack." The more recent EPRI report should be referenced in this sentence and to clarify the applicability to erosion mechanisms.

Basis:
Editorial

Markup
For erosion mechanisms, the program includes the identification of susceptible locations based on the extent-of-condition reviews from corrective actions in response to plant-specific and industry operating experience. Components in this category may be treated in a manner similar to other "susceptible-not-modeled" lines discussed in NSAC-202L. EPRI *1022187* provides guidance for identifying potential damage locations *due to erosion mechanisms*. EPRI TR-112657 or NUREG/–CR6031 provides additional insights for cavitation. For cavitation, in addition to wall-thinning, the extent-of-condition review may need to consider the consequences of vibrational loading caused by cavitation.

13. **XI.M17 Element 5** – Pages XI.M17-2 and XI.M17-3
The two paragraphs here are examples of good parallel treatment of the two different mechanisms being managed. One would strongly request the staff to review and improve other sections, so that this type of equal treatment is presented throughout the AMP.

14. **XI.M17 Element 10** – Pages XI.M17-5
Revise first sentence to refer that for FAC, problems in high-energy single-phase systems have occurred (further statements can be made for FAC and two-phase flow, or wall-thinning due to erosion mechanisms…)

Basis:
a. For FAC, the term "high energy" should be retained as it is for NSAC-202L.
b. The staff deleted the term "high energy" from the scope of the AMP yet the first three examples cited here in Element 10 are exactly that.

Markup
See attached pages.

12. **XI.M17 Element 10** – Pages XI.M17-5, Lines 8-9
Better examples need to be cited—not ones that have a dubious relationship to the point being justified— for use in justifying the AMP here.

Basis:
a. Many of the systems/components listed here (such as most of the PWR feedwater, and virtually all of the condensate systems) are not within the scope of license renewal, so their use to justify an AMP seems dubious at best.
b. If these systems/components are not within the scope of license renewal, then the staff should not necessarily expect them to be a part of the AMP. The applicant of course may be managing them anyway for economic and personnel safety reasons, but those reasons do not per se place these components within the scope of Part 54 nor under aging management from the AMP.
c. IE bulletin 87-01 deals with high-energy systems (hot, pressurized condensate and feedwater piping); IN 92-35, high-energy FW piping inside a BWR containment (hot, pressurized); 95-11, hot pressurized condensate (heater drain flows); the impression is that once again, high-energy systems are in focus yet the staff deleted that term from this proposed AMP. Unless adequate justification is presented otherwise, the term high-energy should be retained for

FAC. (Note that there may still be justification for low energy fluid systems having wall-thinning erosion, so no adjustment requested for that).

Markup
None.

13. **XI.M17 Element 10** – Pages XI.M17-4, lines 11-12
Add the qualifying phrase "for single-phase, low energy fluids"

Basis:
This discussion pertains to the wall-thinning due to erosion, and so the qualifier should be added to clarify that.

Markup
See attached pages.

14. **XI.M17 Element 10** – Pages XI.M17-4, lines 14-15
Vibrational loading is not pertinent to the AMP, so it should be deleted. This also affects Element 4, XI.M17-3, lines 34-35.

Basis:
Cavitation/ second-order effects that are not directly wall thinning or pressure boundary thinning are not within the stated scope of this AMP as given in GALL-SLR. While such vibrational loading due to cavitation erosion of a flow orifice's opening (such as GALL-SLR 3.2.2.2.3) could be an issue in initiating for example, a crack in a nearby small-bore piping weld, one should not expect this AMP to manage that cracking. That issue should be addressed in a more appropriate place.

Markup
See attached pages.

15. **XI.M17 References**, Page XI.M17-4
On lines 27, 28 & 29, Delete reference for EPRI 1011231 and replace with EPRI 1022187.

Basis:
Current revision of EPRI standard.

Markup
EPRI 1022187, "Plant Susceptibility Screening for Erosive Attack." Palo Alto, California: Electric Power Research Institute. November 2010.

16. **XI.M17 All Elements**, Pages XI.M17-1 through XI.M17-4
Leave the term "may" in the various locations that it is and add it to all other places that mention managing wall thinning due to erosion.

Basis:
The way the AMP is worded now is acceptable. We would prefer it is made clear that the program is the FAC program but it is acceptable to manage wall thinning due to erosion using this AMP if desired. To do that, Volume 1 line items that specify the FAC program for managing erosion should be followed by an identical line specifying a Plant Specific Program requiring further evaluation. Any statements in the SER or elsewhere in the GALL that imply that only the FAC Program can be used to manage erosion, should be clarified. However, the issue boils

down to who manages the program. It's clear to us that the entire industry is going to eventually have to look for erosion mechanisms in plant systems beyond those susceptible to FAC and the current wording gives some flexibility in who does it. Also, the term "Erosion-Corrosion" is an old term that we no longer use. We don't need to use that in the title.

<u>Markup</u>
None.

XI.M17 Markup

XI.M17 FLOW-ACCELERATED CORROSION And Wall-thinning Mechanisms due to Erosion

Program Description

This program manages wall thinning caused by flow-accelerated corrosion (FAC)~~,~~ and ~~may also be used to manage~~ wall thinning due to other erosion mechanisms (if those mechanisms are present). The FAC portion of the program is based on commitments made in response to the U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 89-08, and relies on implementation of the Electric Power Research Institute (EPRI) guidelines in the Nuclear Safety Analysis Center (NSAC)-202L[1] for an effective FAC program. The program includes (a) identifying ~~all susceptible~~ piping systems and components susceptible to either mechanism; (b) developing FAC predictive models to reflect component geometries, materials, and operating parameters; (c) performing analyses of FAC models and, with consideration of operating experience, selecting a sample of components for inspections; (d) inspecting components; (e) evaluating inspection data to determine the need for inspection sample expansion, repairs, or replacements, and to schedule future inspections; and (f) incorporating inspection data to refine FAC models. The program includes the use of predictive analytical software, such as CHECWORKS™, that uses the implementation guidance of NSAC-202L. This program ~~may~~ also manages wall thinning caused by mechanisms other than FAC, in situations where such mechanisms exist at a facility. ~~periodic monitoring is used in lieu of eliminating the cause of various erosion mechanisms.~~

Evaluation and Technical Basis

1. ***Scope of Program:*** The FAC portion of the program, described by the EPRI guidelines in NSAC-202L, includes procedures or administrative controls to assure that structural integrity is maintained for carbon steel piping components containing single- and two-phase flow conditions. This program also includes the pressure retaining portions of pump and valve bodies within these systems. The FAC program was originally outlined in NUREG–1344 and was further described through the NRC GL 89-08. The program ~~may~~ also includes components that are subject to wall thinning due to erosion mechanisms such as cavitation, flashing, droplet impingement, or solid particle impingement in various water systems if there is OE of this nature at the facility. Since there are no materials that are known to be totally resistant to wall thinning due to erosion mechanisms, ~~susceptible~~ components of any material and within the scope of license renewal ~~of any material~~ may be ~~included~~ susceptible and exhibit erosion, which would then be managed in the erosion portion of the program.

2. ***Preventive Actions:*** The FAC portion of the program is a condition monitoring program; No preventive action has been recommended in this program. The erosion portion of the program is also a condition monitoring program (? And preventive?). However, it is noted that ~~monitoring of water chemistry to control~~ controlling pH and dissolved oxygen content are effective in reducing FAC, and the selection of appropriate component material, geometry, and hydrodynamic conditions, can be effective in reducing both FAC and erosion mechanisms.

3. ***Parameters Monitored or Inspected:*** The aging management program (AMP)

monitors the effects of wall thinning due to FAC and erosion mechanisms by measuring

[1]As described in this AMP-R2 (Revision 2), -R3 (Revision 3), and –R4 (Revision 4) of NSAC-202L are acceptable versions of the EPRI guideline.

wall thicknesses. In addition, relevant changes in system operating parameters, (e.g., temperature, flow rate, water chemistry, operating time), that result from off-normal or reduced-power operations are considered for their effects on the FAC models. Also, opportunistic visual inspections of internal surfaces are conducted during routine maintenance activities to identify degradation.

4. ***Detection of Aging Effects:*** Degradation of piping and components occurs by wall thinning. For FAC, the inspection program delineated in NSAC-202L includes identification of susceptible locations, as indicated by operating conditions or special considerations. For periods of extended operation beyond 60 years, piping systems that have been excluded from wall thickness monitoring due to operation less than 2 percent of plant operating time (as allowed by NSAC-202L) will be reassessed to ensure adequate bases exist to justify this exclusion. If actual wall thickness information is not available for use in this assessment, a representative sampling approach can be used. This program specifies nondestructive examination methods, such as ultrasonic testing (UT) and/or radiography testing (RT), to quantify the extent of wall thinning. Opportunistic visual inspections of up-stream and down-stream piping and components are performed during periodic pump and valve maintenance or during pipe replacements to assess internal surface conditions. Wall thicknesses are also measured at locations of suspected wall thinning that are identified by internal visual inspections. A representative sample of components is selected based on the most susceptible locations for wall thickness measurements at a frequency in accordance with NSAC-202L guidelines to ensure that degradation is identified and mitigated before the component integrity is challenged. Expansion of the inspection sample is described in NSAC-202L, following identification of unexpected or inconsistent inspection results in the initial sample. The extent and schedule of the inspections ensure detection of wall thinning before the loss of intended function. Inspections are performed by personnel qualified in accordance with site procedures and programs to perform the specified task.

For erosion mechanisms, the program includes the identification of susceptible locations based on the extent-of-condition reviews from corrective actions in response to plant-specific and industry operating experience. Components in this category may be treated in a manner similar to other "susceptible-not-modeled" lines discussed in NSAC-202L. EPRI 1011231 provides guidance for identifying potential damage locations. EPRI TR-112657 or NUREG/–CR6031 provides additional insights for cavitation. ~~For cavitation, in addition to wall thinning, the extent-of-condition review may need to consider the consequences of vibrational loading caused by cavitation~~.

5. ***Monitoring and Trending:*** For FAC, CHECWORKS™ or similar predictive software calculates component wear rates and remaining service life based on inspection data and changes in operating conditions (e.g., power uprate, water chemistry). Data from each component inspection are used to calibrate the wear rates calculated in the FAC model with the observed field data. The use of such predictive software to develop an inspection schedule provides reasonable assurance that structural integrity will be maintained between inspections. The program includes the evaluation of inspection results to determine if additional inspections are needed to ensure that the extent of wall thinning is adequately determined, that intended function will not be lost, and that corrective actions are adequately identified.

For erosion mechanisms, the program includes trending of wall thickness measurements to adjust the monitoring frequency and to predict the remaining service life of the component for scheduling repairs or replacements. Inspection results are evaluated to determine if assumptions in the extent-of-condition review remain valid. If degradation is associated with infrequent operational alignments, such as surveillances or pump starts/stops, then trending activities may need to consider the number or duration of these occurrences. Periodic wall thickness measurements of replacement components may be required and should continue until the effectiveness of corrective actions has been confirmed.

6. ***Acceptance Criteria:*** Components are suitable for continued service if calculations determine that the predicted wall thickness at the next scheduled inspection will meet the minimum allowable wall thickness. The minimum allowable wall thickness is the thickness needed to satisfy the component's design loads under the original code of construction, but additional code requirements may also need to be met. A conservative safety factor is applied to the predicted wear rate determination to account for uncertainties in the wear rate calculations and UT measurements. As discussed in NSAC-202L, the minimum safety factor for acceptable wall thickness and remaining service life should not be less than 1.1.

7. ***Corrective Actions:*** Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 components (SCs) within the scope of this program.

   The program includes reevaluation, repair, or replacement of components for which the acceptance criteria are not satisfied, prior to their return to service. For FAC, long-term corrective actions could include adjusting operating parameters or replacing components with FAC-resistant materials. However, if the wear mechanism has not been identified, then the replaced components should remain in the inspection program because FAC-resistant materials do not protect against erosion mechanisms. Furthermore, when carbon steel piping components are replaced with FAC-resistant material, the susceptible components immediately downstream should be monitored to identify any increased wear due to the "entrance effect" as discussed in EPRI 1015072.

   For erosion mechanisms, long-term corrective actions to eliminate the cause could include adjusting operating parameters and/or changing components' geometric designs; however, the effectiveness of these corrective actions should be verified. Periodic monitoring activities should continue for any component replaced with an alternate material, since a material that is completely resistant to erosion mechanisms is not available.

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:*** ~~Wall-thinning~~FAC problems in high-energy single-phase systems have occurred in feedwater and condensate systems [~~NRC IE Bulletin No. 87-01~~; NRC Information Notice (IN) 92-35 [BWR Feedwater piping inside Containment], ~~IN 95-11~~, IN 2006-08] and ~~in two-phase piping in extraction steam~~ (deleted unless this piping is within scope for license renewal) lines (NRC IN 89-53, IN 97-84) and ~~moisture separator reheater and feedwater heater drains (NRC IN 89-53, IN 91-18, IN 93-21, IN 97-84)~~. Observed wall thinning may be due to mechanisms other than FAC (for single phase, low energy fluids) or less commonly, due to a combination of mechanisms [NRC IN 99-19, LER 483/1999-003, licensee event reports (LER) 499/2005-004, LER 277/2006-003, LER 237/2007-003, LER 254/2009-004]. ~~Vibrational loading resulting from cavitation has caused problems (LER 366/2008-001, LER 499/2010-001).~~

The program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience, 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.

10 CFR 50.55a, "Codes and Standards." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.

EPRI 1015072, "Flow-Accelerated Corrosion–The Entrance Effect." Palo Alto, California: Electric Power Research Institute. November 2007.

EPRI 1011231, "Recommendations for Controlling Cavitation, Flashing, Liquid Droplet Impingement, and Solid Particle Erosion in Nuclear Power Plant Piping Systems." Palo Alto, California: Electric Power Research Institute. November 2004.

EPRI TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure." Revision B-A. ML013470102. Palo Alto, California: Electric Power Research Institute. December 1999.

XI.M18 Bolting Integrity

Description of Change and Justification:

1. **XI.M18 Element 3** - Page XI.M18-2

   Revise this element to say, "Specifically, bolting for safety-related *and non-safety related* pressure retaining components is inspected for *signs of* leakage."

   Basis:

   The words ("surface discontinuities and imperfections, and clearances and physical displacements for signs of loose joints") are much more intrusive than the ASME Section XI Leak Test VT-2 inspection requirements for Class 1 pressure retaining components, which requires inspection only for leakage.

   The closure bolting on many safety related pressure retaining components (potentially thousands) are insulated, operate at high temperatures, are located in containment, may be located at elevations above the operating deck, and may be located in areas of the plant with high radiological exposures. As a result, inspection for: "surface discontinuities and imperfections, and clearance and physical displacements for sign of loose joints" may require the removal of insulation, erection of scaffolding, high radiological exposure, asbestos abatement, system outages, erection of lighting, and other measures to ensure personnel safety. These measures are unnecessary and could impact personnel safety. As an alternative, inspection of safety related safety-related pressure retaining components for leakage (consistent ASME Section XI Leak Test requirements), System Manager walkdowns to identify joint leakage, and relying on existing containment unidentified leakage instrumentation is more reasonable and has less impact on personnel safety.

   Markup

   Specifically, bolting for safety-related *and non-safety related* pressure retaining components is inspected for *signs of* leakage.~~, surface discontinuities and imperfections, and clearances and physical displacements for signs of loose joints. Bolting for other pressure retaining components is inspected for signs of leakage.~~

2. **XI.M18 Element 4** - Page XI.M18-2, Lines 29-37

   Provide alternative recommendations for when bolts of a specific material/environment grouping do not become available during maintenance for bolt thread inspection in a ten year period. This could be to: 1) consider pump and system performance as an indication of joint leakage, and 2) diver inspection of the submerged bolts.

   Basis:

   Most submerged closure bolting are located on submerged pumps.

   The following words suggest that inspection of submerged bolting is performed opportunistically during maintenance activities (when bolt heads are accessible and bolts are disassembled):

   Bolting in locations that preclude detection of joint leakage, such as in submerged environments, is visually inspected for loss of material during maintenance activities. In this case, bolt heads are inspected when made accessible, and bolt threads are inspected when joints are disassembled".

However, the following words suggest that within a ten-year period a minimum of 20 percent of the bolts up 25 bolts (per material environment group) must be disassembled for the sole purpose of inspecting bolt threads:

At a minimum, in each 10-year period during the subsequent period of extended operation, the program includes the inspection of a representative sample of 20 percent of the population of bolt heads and threads (defined as bolts with the same material and environment combination) or a maximum of 25 bolts per population at each unit."

This suggests that if a specific submerged bolting material/environment population does not become available during maintenance in a ten period, then 20% up to 25 bolts in this grouping must be removed from the submerged environment and dissembled for the sole purpose inspecting the bolt threads. This seems to be an unreasonable recommendation.

Alternate recommendations to when bolts of a specific material/environment grouping do not become available during maintenance for bolt thread inspection in a ten-year period could be to: 1) consider pump and system performance as an indication of joint leakage, and 2) diver inspection of the submerged bolts.

Markup
Bolting in locations that preclude detection of joint leakage, such as in submerged environments, is visually inspected for loss of material during maintenance activities. In this case, bolt heads are inspected when made accessible, and bolt threads are inspected when joints are disassembled. At a minimum, in each 10-year period during the subsequent period of extended operation, the program includes the inspection of a representative sample of 20 percent of the population of bolt heads and threads (defined as bolts with the same material and environment combination) or a maximum of 25 bolts per population at each unit. *If opportunistic maintenance activities do not provide access to 20 percent of the population (for a material/environment combination) up to a maximum of 25 bolt heads and threads over a 10-year period, then other activities such as diver inspections and pump performance may be considered,*...

3. **XI.M18 Element 4** - Page XI.M18-3, first and third bullets
Revise the questions in Element 4 as indicated in the markup section of this comment.

Basis:
Editorial

Markup
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 *which have* 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~~ *mechanisms*?

4. **XI.M18 Element 4** - Page XI.M18-3, second to last paragraph
UT examination of non-safety related bolting with unknown yield strength is not necessary.

Basis:

The Bolting Integrity program includes other features which are intended to manage cracking of non-safety related closure bolting regardless of whether the closure bolting is high strength or not. For example, element 3 recommends that non-safety related closure bolting is monitored for leakage. In which case the leakage would be entered into the corrective action program and the condition is corrected. Therefore, UT examination of non-safety related bolting with unknown yield strength is not necessary.

<u>Markup</u>

High strength closure bolting (with actual yield strength greater than or equal to 1,034 MPa [150 ksi] may be subject to SCC. For bolting with yield strength greater than or equal to 1,034 MPa [150 ksi] ~~and bolting for which yield strength is unknown (regardless of code classification or size of bolting)~~, volumetric examination in accordance to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1, should be performed.

5. **XI.M18 Element 4** - Page XI.M18-3, top paragraph

If the UT examination of non-safety-related bolting with unknown yield strength is considered necessary by the NRC (rejection of comment 3 above), then it is requested the wording be revised to clarify scope (for non-safety-related bolting). If the UT examination of non-safety-related bolting with unknown yield strength is considered necessary by the NRC (rejection of comment 3 above), then it is requested the above wording be revised to clarify scope (for non-safety related bolting). For example:

1) Must the <u>actual</u> yield strength (e.g., via a CMTR) be known for non-safety related bolting?
2) Is it acceptable to use the specified (e.g., from design and procurement specifications or fabrication and vendor drawings) bolting material or bolt head markings to determine the specified yield strengths for non-safety related bolting?
3) Is it acceptable to exclude non-safety related bolting based on materials that are not susceptible to SCC (e.g., Carbon Steel)?
4) Is it acceptable to exclude non-safety related bolting with low operating temperatures?

Without further specificity of this nature the above recommendation could result in the unnecessary UT examination on tens of thousands of non-safety related closure bolts.

Basis:

The Bolting Integrity program includes closure bolting from many non-safety related systems. For bolting in this category (e.g., non-safety related closure bolting) the <u>actual</u> yield strength would not have been provided by the manufacturer. As such the <u>actual</u> yield strength of these bolts is unknown. This could be potentially tens of thousands of non-safety related bolts. Therefore, this recommendation could force the UT examination of many pressure retaining bolts on non-safety related systems simply because the <u>actual</u> yield strength of the bolts was not provided by the manufacturer.

<u>Markup</u>

High strength closure bolting (with actual yield strength greater than or equal to 1,034 MPa [150 ksi]) may be subject to SCC. For bolting with <u>*actual*</u> yield strength greater than or equal to 1,034 MPa [150 ksi] and bolting for which yield strength is unknown (regardless of code classification or size of bolting), volumetric examination in accordance to that of ASME Code Section XI, Table IWB-2500-1., Examination Category B-G-1, should be performed." *Specified bolting materials (e.g., from* design and procurement specifications or fabrication and vendor drawings) *may be used to determine if the bolting is a high strength closure.*

6. **XI.M18 Element 4** - Page XI.M18-3, last paragraph
Remove the sentence, "Non-ASME Code inspections follow site procedures that include inspection parameters for items such as lighting, distance offset, and cleaning processes that ensure an adequate examination."

Basis:
In this program inspection of non-ASME Code bolting consists of system walkdowns which monitor for joint leakage. The deleted words below are overly prescriptive for this activity.

Markup
Inspections are performed by personnel qualified in accordance with site procedures and programs to perform the specified task. Inspections within the scope of the ASME Code follow procedures consistent with the ASME code. ~~Non-ASME Code inspections follow site procedures that include inspection parameters for items such as lighting, distance offset, and cleaning processes that ensure an adequate examination.~~

XI.M19 Steam Generators

Description of Change and Justification:

1. **XI.M19 Program Description**, Page XI.M19-1 Line 21
   Paragraph 4 in the Program Description references a specific revision to NEI 97-06 specifically revision 3. NEI 97-06 may be revised in the future. Delete the specific revision.

   Basis:
   This precludes any future revisions to any of the industry documents by referencing specific revisions. Industry guidance is revised from time to time to reflect needed changes. We need the capability to revise industry guidelines.

   Markup
   The Steam Generator program at PWRs is modeled after Nuclear Energy Institute (NEI) 97-06, ~~Revision 3~~, "Steam Generator Program Guidelines." This program references a number of ...

2. **XI.M19 Element 3**, Page XI.M19-3 Lines 2-3
   Element 3 references a specific version of the EPRI PWR Steam Generator Primary-to-Secondary Leakage Guidelines and the EPRI Steam Generator Integrity Assessment Guidelines by incorporating the document numbers in to the sentence. Delete the document number in the sentence.

   Basis:
   This precludes any future revisions to any of the industry documents by referencing specific revisions. Industry guidance is revised from time to time to reflect needed changes. We need the capability to revise industry guidelines.

   Markup
   Water chemistry parameters are also monitored as discussed in GALL-SLR Report AMP XI.M2. The EPRI PWR Steam Generator Primary-to-Secondary Leakage Guidelines ~~(EPRI 1008219)~~ provides guidance on monitoring primary-to-secondary leakage. The EPRI Steam Generator Integrity Assessment Guidelines ~~(EPRI 1019038)~~ provide guidance on secondary side activities.

3. **XI.M19 Element 4**, Page XI.M19-3 Line 26
   Element 4 references a specific version of the EPRI PWR Steam Generator Examination Guidelines by incorporating the document number into the sentence. Delete the document number in the sentence.

   Basis:
   This precludes any future revisions to any of the industry documents by referencing specific revisions. Industry guidance is revised from time to time to reflect needed changes. We need the capability to revise industry guidelines.

   Markup
   The inspections and monitoring are performed by qualified personnel using qualified techniques in accordance with approved licensee procedures. The EPRI PWR Steam Generator Examination Guidelines ~~(EPRI 1013706)~~ contains guidance on the qualification of steam generator tube inspection techniques.

XI.M20 Open-Cycle Cooling Water System

Description of Change and Justification:

1. **XI.M20 Program Description,** Page XI.M20-1
Delete the word "preclude" on line 10 and substitute wording that reflects the NRC GL 89-13 intent, e.g., significantly reduce the incidence of flow blockage as a result of biofouling.

    Basis: NRC Generic Letter 89-13 does not require the preclusion of biofouling on the safety-related components, only the management of the biofouling to ensure the intended function is not impacted adversely. To preclude biofouling might require extensive modifications and significant changes to chemical control operations.

    Markup
    ... (SSCs) to the ultimate heat sink. The program is comprised of the aging management aspects of the applicant's response to NRC GL 89-13 including: (a) a program of surveillance and control techniques to ~~preclude~~ *significantly reduce the incidence of flow blockage as a result of* biofouling; (b) a program to verify heat transfer capabilities of all safety-related heat exchangers cooled by the OCCW system; and (c) a program for routine inspection and maintenance to ensure that corrosion, erosion, loss of coating integrity, fouling, and biofouling cannot degrade the performance of safety-related systems serviced by the OCCW system.

2. **XI.M20 References**
There is no reference to, or inclusion of the significant industry learning and guidance relative to open cooling water systems corrosion and fouling control as documented in EPRI reports 1025318, 1008282, and 1010059.

    Basis:
    EPRI 1025318, Open Cooling Water Chemistry Guideline, September 2012; EPRI 1008282, Life Cycle Management Sourcebook for Nuclear Plant Service Water Systems, March 2005; and EPRI 1010059, Service Water Piping Guideline, September 2005 have captured significant industry experience and contain industry standards for controlling system corrosion and fouling. INPO 13-005, Guidelines for the Conduct of Chemistry at Nuclear Power Stations, notes the EPRI guidance available for open cooling water chemistry control. It seems appropriate that the above three (3) EPRI documents should be at least referenced as industry guidance or recommendations that aid in meeting the objectives of GL 89-13 and AMP XI.M20.

    Markup
    None.

XI.M21A Closed Treated Water Systems

Description of Change and Justification:

1. **XI.M21A Program Description** Page XI.M21A-1
   Page XI.M21A-1 Lines 19-22 are confusing descriptions of closed cooling water systems, and include one system (aux. boiler system) which is not a cooling system at all.

   Basis:
   (1) Auxiliary boiler systems produce steam, and are not cooling water systems. It is inappropriate and confusing to include auxiliary boilers with closed cooling water systems when it would be more appropriate to include them with the secondary water chemistry or BWR chemistry aging management programs.

   (2) The examples of systems managed by this AMP are described as: (a) closed-cycle cooling water systems (as defined by GL 89-13); (b) closed portions of HVAC systems; (c) diesel generator cooling water; and (d) aux. boiler systems. GL 89-13 defines a closed-cycle system is part of a safety-related service water system which, among other things, does not directly reject heat to the ultimate heat sink. Does this mean that (b) and (c) are non-safety-related closed cooling water systems, whereas (a) includes safety-related HVAC systems and diesel cooling water systems? This distinction is important and needs clarification since Page XI.M21A-2 Lines 19-20 state that "For CCCW systems as defined in NRC GL 89-13, EPRI 1007820 is used" and that for all other systems, which would imply all non-safety-related closed cooling water systems, "the applicant selects an appropriate industry standard document".

   Note that the EPRI Closed Cooling Water Chemistry Guideline are applicable to both safety-related and non-safety-related closed cooling water systems, which includes plant-related HVAC systems and diesel generator cooling water systems.

   (3) Does this description include standby or dedicated shutdown diesels since they are skid mounted and reject their heat via radiators directly to the ultimate heat sink which is the atmosphere? Note that the EPRI Closed Cooling Water Chemistry Guideline is also applicable for the diesel cooling water system for these diesels also.

   Markup
   ...Letter (GL) 89-131); closed portions of heating, ventilation, and air conditioning (HVAC) systems; and diesel generator cooling water~~; and auxiliary boiler systems~~.
   Examples of systems...

2. **XI.M21A Program Description** Page XI.M21A-1
   Insert AMP purpose sentence from Table 3.0-1 into program description on lines 6-7, since the current program description never states the objective of the program. Insert clarifying wording about the systems that are not covered by this aging management program.

   Basis:
   The program description never states the objectives of the aging management program.

Markup

... These systems are also recirculating systems in which the rate of recirculation is much higher than the rate of addition of makeup water (i.e., closed systems). *This Closed Treated Water Systems aging management program is a mitigation program that also includes condition monitoring to verify the effectiveness of the mitigation activities.* The program includes (a) water treatment, including the use of corrosion inhibitors, to modify the chemical composition of the water such that the function of the equipment is maintained and such that the effects of corrosion are minimized; (b)...

Examples of systems not addressed by this AMP include *those systems containing* boiling water reactor (BWR) coolant, pressurized water reactor (PWR) primary and secondary water, and PWR/BWR condensate *that do not contain corrosion inhibitors.* ~~systems.~~...

3. **XI.M21A Element 3** Page XI.M21A-2
Lines 19 - 20 state that "For CCCW systems as defined in NRC GL 89-13, EPRI 1007820 is used." The referenced EPRI document is out of date and has been superseded by EPRI 3002000590. The GALL should state that the latest approved EPRI Closed Cooling Water Chemistry Guideline should be used.

Basis:

EPRI 1007820 is Rev. 1 of the Closed Cooling Water Chemistry Guideline that was issued in April 2004. This guideline is out of date and has been superseded by EPRI 3002000590, Closed Cooling Water Chemistry Guideline, Rev. 2, December 2013.

This comment was identified previously in a more generic form in the NEI Industry Comments submitted by letter dated 8/6/14 which identified technical issue SLR-M23 stating that AMPs (e.g., water chemistry AMPs) that reference EPRI reports such as water chemistry guidelines, should allow the use of the latest approved version of the EPRI report. This comment has **not** been incorporated into the GALL document.

Markup

...For CCCW systems, as defined in NRC GL 89-13, ~~EPRI 1007820 is used~~ *the latest approved EPRI chemistry document is used for the control of closed cooling water parameters*.

4. **XI.M21A Element 3** Page XI.M21A-2
Lines 14-22 lists several references which can be used as industry standard documents for systems which do not meet the GL 89-13 definition of a closed cycle system; however, the industry uses only the EPRI Closed Cooling Water Chemistry Guideline as the industry standard.

Basis:

INPO 13-005, Guidelines for the Conduct of Chemistry at Nuclear Power Stations, October 2013, and the desire to use industry best practices drives the use of the most recently approved revision of the EPRI Closed Cooling Water Chemistry Guideline as the industry standard for safety-related and non-safety-related closed cooling water systems.

Markup

...specific water chemistry parameters monitored and the acceptable range of values for these parameters are in accordance with ~~industry standard guidance documents~~ the Closed Cooling Water Chemistry Guideline produced by the Electric Power Research Institute (EPRI), ~~the American Society of Heating Refrigeration and Air Conditioning Engineers, the Cooling Technology Institute, the American Boiler Manufacturer's Association, American Society for Testing and Materials (ASTM) standards, water chemistry guidelines recommended by the equipment manufacturer, Nalco Water Handbook, or the ASME. For~~ including CCCW systems, as defined in NRC GL 89-13~~, EPRI 1007820 is used~~. ~~For other systems, the applicant selects an appropriate industry standard document.~~ In all cases, the ~~selected industry standard guidance document~~ EPRI Closed Cooling Water Chemistry Guideline is used in its entirety for the water chemistry control or guidance.

5. **XI.M21A Element 3** Page XI.M21A-2
Lines 23- 27 do not appear to be written consistently with Lines 9-22 of Element 3

   Basis:
   For consistency with the previous paragraph in Element 3 discussing water chemistry monitoring (Lines 9 to 22), consider the following revision.

   Markup
   ~~The visual appearance of surfaces provides evidence of loss of material. Surface discontinuities revealed by surface or volumetric examination techniques provide evidence of cracking. The heat transfer capability of heat exchanger surfaces is evaluated by either visual inspections to determine surface cleanliness, or functional testing to verify that design heat removal rates are maintained. The condition of surfaces exposed to water is monitored by visual inspection and surface or volumetric examinations for evidence of loss of material and cracking, and for fouling that would impact heat exchanger performance.~~
   The visual appearance of the surfaces is evaluated for evidence of loss of material. The results of surface or volumetric examinations are evaluated for surface discontinuities indicative of cracking. The heat transfer capability of heat exchanger surfaces is evaluated by either visual inspections to determine surface cleanliness, or functional testing to verify that design heat removal rates are maintained.

6. **XI.M21A Element 4** Page XI.M21A-2
The inspection for this area is predominately pipe. Clarifying language for pipe inspection to susceptible areas for degradation or acceptable sample size should be provided. As the intent is not to inspect the entire length of the piping system, but similar to inspections for FAC.

   Basis:
   NUREG-2191, Element 4, provides criteria for representative sample sizes of 20% of population, or maximum of 25 components per population at each unit, etc. The definition provided for a component is having the same material, water treatment program and aging effect combination.

   Markup
   None.

Attachment 4

NUREG-2191 Mechanical AMPS X.M23 Through XI.M42 With Exception of XI.M31

<u>Comments Included</u>:

XI.M23	Inspection of Overhead Heavy Load and Light Load (Related To Refueling) Handling Systems
XI.M24	Compressed Air Monitoring
XI.M26	Fire Protection
XI.M27	Fire Water System
XI.M29	Aboveground Metallic Tanks
XI.M30	Fuel Oil Chemistry
XI.M32	One-Time Inspection
XI.M33	Selective Leaching
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore-Piping
XI.M36	External Surfaces Monitoring of Mechanical Components
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
XI.M39	Lubricating oil Analysis
XI.M41	Buried and Underground Piping and Tanks
XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks

Draft NUREG-2191 AMPs XI.M23 – XI.M42 Industry Comments
(AMP XI.M31 comments under separate cover)

Description of Change/Comment and Justification
(Note; "XI.M31-x" refers to a page number in GALL-SLR)

GALL-SLR Element 7, All AMPs

Comment 1, All AMPs – Element 7

Remove the requirement that results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality. Just specify that results not meeting acceptance criteria are entered into the site's Corrective Action Program and addressed as required by the program.

- Site Corrective Action Programs are well established programs that are audited by the industry and inspected by the NRC on a regular basis. The program includes provisions for entering a wide variety of conditions into the program and evaluating those conditions to determine appropriate corrective actions. That evaluation includes determining which conditions should be labeled as "conditions adverse to quality" or "significant conditions adverse to quality." When items are identified by the NRC that were not addressed appropriately, violations are given. Every failure to meet AMP acceptance criteria does not rise to the level of being a condition adverse to quality. That requirement would result in cumulative effects that could overwhelm the program and make it ineffective.
- **Markup**: Results that do not meet the acceptance criteria are ~~addressed as conditions adverse to quality or significant conditions adverse to quality under those specific portions of the quality assurance (QA) program~~ entered into the site's Corrective Action Program that ~~are~~ is used to meet Criterion XVI, "Corrective Action," of 10 CFR Part 50, Appendix B to ensure appropriate corrective actions are taken in accordance with that program.

XI. M23 Inspection of Overhead Heavy Load and Light Load (Related To Refueling) Handling Systems

Description of Change/Comment and Justification
(Note; "XI.M31-x" refers to a page number in GALL-SLR)

XI.M23-1, line 24, Element 1(c)

Delete SCC phrase from part (c).

- SCC is not an aging mechanism for bolting associated with cranes and hoists. The bolting material is almost exclusively carbon steel; not stainless steel that is much more susceptible to SCC. The vast majority of cranes and hoists are in Air-Indoor Uncontrolled environment that doesn't result in possibility of aggressive environment or high temperatures that increase susceptibility to SCC. The visual monitoring that is in place is intended to identify cracking if it exists. There is no need to call out SCC as an aging mechanism in the AMP since cracking by any mechanism is inspected for within the periodic inspection required by the ASME B30 Standards.
- **Markup**: [...] in the rail system, and (c) cracking ~~due to SCC~~ of high strength bolts.

XI.M23-1, lines 30-33, Element 3

Revise Element 3 regarding special monitoring of high strength bolts.

- This new statement about special monitoring of high strength bolts is not needed. The referenced AMSE B30 series of standards includes periodic visual inspection of bolting, regardless of material, size, or yield strength. The visual inspections performed under ASME B30 standards are intended to identify any degradation of the bolting components regardless of bolting size. Therefore the statement should be deleted and cracking should be added to the prior sentence.
- **Mark-up:** Surface condition is monitored by visual inspection to ensure that loss of material is not occurring due to corrosion or wear. Bolted connections are monitored for loose bolts, missing or loose nuts, ~~and~~ other conditions indicative of loss of preload, and cracking. ~~High strength (actual measured yield strength greater than 150 kilopounds per square inch (ksi) or 1034 kilopascals (MPa)) bolts greater than 1 inch in diameter are monitored for SCC~~.

XI.M23-1, lines 40-43, & M23-2, lines 1-2, Element 4

Unnecessary NDE requirements added for structural bolting for cranes in this scope. This new requirement to do NDE beyond visual inspection is excessive and not required.

- The standard for crane maintenance and inspection, throughout all industries where cranes are used, is the ASME B30 series of standards. In many of these crane applications the cranes are in severe outdoor environments and used under more frequent and severe service than cranes used in the nuclear power industry where the vast majority of in scope cranes are in controlled indoor environments and used to support infrequent maintenance activities.

- The ASME B30 standards for periodic inspection only require visual inspection of bolting to identify aging effects including loosening, corrosion, and cracking and have been proven to be adequate within the nuclear power industry and other industries where cranes are under heavier duty with more continuous service.
- There is nothing special or different about the bolting used on cranes at nuclear power plants that warrant requiring additional periodic NDE examination of high strength bolting. The most likely causes of cracking of structural bolts on crane systems are fatigue or excessive forces caused by the bolt becoming loose.
- Bridge cranes such as Refueling Cranes are evaluated as part of License Renewal for fatigue to verify that their lifetime usage, extending through the SLR PEO will be within the crane design, and the periodic visual examination of bolting has been effective to identify loose bolts as intended by the periodic visual inspections required by the ASME B30 Standards.
- The periodic visual inspections are performed frequently; every 2 years for frequently used cranes or just prior to use for infrequently used cranes. Therefore the periodic visual inspection of bolting required by ASME B30 standards is adequate to identify cracked or loose bolts prior to loss of function.
- **Mark-up:** [...] Bolted connections are visually inspected for loose bolts or missing nuts at the same frequency as crane rails and structural components. ~~Visual inspection of high strength (actual measured yield strength greater than 150 kilopounds per square inch (ksi) or 1034 kilopascals (MPa) structural bolting greater than 1 in. (25 mm) in diameter is supplemented with volumetric or surface examinations to detect cracking at an interval not to exceed 5 years, unless justified~~.

XI.M23-2, lines 9-10, Element 6

In element 6, the statement for volumetric or surface examinations should be deleted.

- The same reasoning applies as described in the Bases for recommended changes to Elements 1, 3, and 4 above.
- **Mark-up:** Any visual indication of loss of material due to corrosion or wear and any visual sign of loss of bolting preload is evaluated according to ASME B30.2 or other applicable industry standard in the ASME B30 series. ~~Volumetric or surface examinations confirm the absence of cracking in high strength bolts.~~

XI.M24 Compressed Air Monitoring

XI.M24-1, Program Description and applicable program elements

Recommend revising the Compressed Air Monitoring AMP to be applicable to the air/gas environment downstream of the compressed air system dryers that can be evaluated as a dry air environment. The AMP scope would confirm the air dryers maintain moisture and other corrosive contaminants in the system's air below specified limits to ensure that the system and components maintain their intended functions. If components upstream of the compressed air system dryers are within the scope of license renewal, their internal air environment would be evaluated as a plant indoor air or condensation environment and would be managed by AMP XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components. The following considerations would apply to revision of the applicable program elements.

- See program description markup
- The scope of the AMP manages the dry gas portions of the compressed air system downstream of the Compressed air system dryers. The internal environment is considered as a dry gas environment.
- Compressed air system components upstream of the compressed air dryers are evaluated as a plant indoor air or condensation environment and would be managed by AMP XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components.
- Use of XI.M24 does not change the docketed response to GL 88-14 for the rest of the plant operations.
- Compressed air system gas quality is managed consistent with the docketed response to GL 88-14. Acceptance criteria for air quality and moisture limits are established based on industry standards.
- Opportunistic inspections of the internal surfaces environment downstream of the compressed air system(s) dryers is performed to verify the system-wide effectiveness of the air quality controls of the Compressed Air Monitoring AMP. The opportunistic inspections would confirm that unacceptable degradation is not occurring downstream of the dryers and ensure the intended functions of affected components are maintained during the period of extended operation
- Revision of the gas environment in GALL-SLR Chapter IX is covered by a prior comment.

XI.M29 Markup

Program Description

The purpose of the compressed air monitoring program is to provide reasonable assurance of the integrity of the compressed air system. The program consists of monitoring moisture content, corrosion, and performance of the compressed air system downstream of the air dryers. This includes (a) preventive monitoring of water (moisture) and other potential contaminants to keep within the specified limits; and (b) an opportunistic inspection of the internal surfaces of components ~~for indications of loss of material due to corrosion~~ downstream of the air dryers to verify the effectiveness of the compressed air system air quality controls.

~~The compressed air monitoring aging management program (AMP) is based on results of the plant owner's response to the U.S. Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-14 (as applicable to license renewal) and reported in previous NRC Information Notice (IN) 81-38; IN 87-28; IN 87-28, Supplement 1; and by the Institute of Nuclear Power Operations (INPO) Significant Operating Experience Report (SOER) 88-01. NRC GL 88-14, issued after several years of study of problems and failures of instrument air systems, recommends~~

that ~~each holder of an operating license perform an extensive design and operations review and verification of its instrument air system.~~ NRC GL 88-14 also recommends that the licensees describe their program for maintaining proper instrument air quality. This AMP does not include all aspects of NRC GL 88-14 because many of the issues in the GL are not relevant to license renewal.

This AMP does not change the applicant's docketed response to NRC GL 88-14 for the rest of its operations. ~~The program utilizes the aging management aspects of the applicant's response to NRC GL 88-14 for license renewal with regard to preventative measures, inspections of components, and testing and to ensure that the compressed air system will be able to perform its intended function for the period of extended operation.~~ The AMP also incorporates the air quality provisions provided in the guidance of the Electric Power Research Institute (EPRI) TR 108147. ~~The American Society of Mechanical Engineers (ASME) operations and maintenance standards and guides (ASME OM-2012, Division 2, Part 28) provides additional guidance for maintenance of the instrument air system by offering recommended test methods, test intervals, parameters to be measured and evaluated, acceptance criteria, corrective actions, and records requirements.~~

Compressed air system components upstream of the compressed air dryers are managed by AMP XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components.

XI.M26 Fire Protection

XI.M26-1, Program Description line 5, and Element 3, XI.M26-2 line 6.

Suggest changing the language from "housings" to "assemblies" as this will capture the housing as well as the entire system.

- **Mark-up (Program Description):** The fire barrier inspection program requires periodic visual inspection of fire barrier penetration seals; fire barrier walls, ceilings, and floors; fire damper assemblies~~housings~~; and...
- This comment is also reflected in the mark-up for Element 3 below.

XI.M26, Element 3 lines 4-7, and 4, lines 16-20.

Inspections should also include structural steel fire proofing.

- **Mark-up (Element 3):** Visual inspection of penetration seals examines the surface condition of the seals for any sign of degradation. Visual inspection of the surface condition of the fire barrier walls, ceilings, and floors and other fire barrier materials detects any sign of degradation including structural steel fire proofing. Fire damper assemblies ~~housings~~ are inspected for signs of corrosion and cracking. Fire-rated doors are visually inspected to detect any degradation of door surfaces.
- **Mark-up (Element 4):** Visual inspection by fire protection qualified personnel of the fire barrier walls, ceilings, floors, and doors; fire damper housings; and other fire barrier materials including structural steel fire proofing performed in walkdowns at a frequency in accordance with an NRC-approved fire protection program ensure timely detection of cracking, spalling, and loss of material.

XI.M26-1 and several similar locations (see below)

Recommend to include clean agents in various texts as shown below, in addition to halon/CO2.

- Plants may have phased out halon systems and replaced them with clean agent systems. The document should reflect the other types of gaseous system that may be used.

XI.M26, Section 2, Program Description, Line 7 and 8

- **(Mark-up):** The AMP also includes periodic inspection and testing of the halon/carbon dioxide (CO2), or clean agent fire suppression system.

XI.M26 Section 2 Program Description Line 39 and 40

- **(Mark-up):** It also manages the aging effects on the intended function of the halon/CO2, or clean agent suppression system.

XI.M26 Section 3 Parameters Monitored or Inspection Line 9 and 10

- **(Mark-up):** The periodic visual inspections of the surface condition for the halon/CO2, or clean agent fire suppression system are performed.

XI.M26 Section 4 Detection of Aging Effects Line 24 and 25

- **(Mark-up):** Visual inspections of the halon/CO2, or clean agent fire suppression system are performed to detect any sign of corrosion before the loss of the component intended function.

XI.M26 Section 6 Acceptance Criteria Line 38-40

- **(Mark-up):** Also, inspection results for the halon/CO2, or clean agent fire suppression system are acceptable if there are no indications of excessive loss of material.

XI.M27 Fire Water System

XI.M27 – 4 Table XI.M27-1 footnote 5, Inspection frequency for inaccessible areas

Inspections described in NFPA-25 as "annual" should be described in this AMP as "every refueling cycle" based on based on LRAs that have taken exception to the annual requirement. Recommend revising footnote 5 of Table XI.M27-1 to allow a refueling frequency rather than annual for NFPA 25 inspections.

- Footnote 5 of Table XI.M27-1 allows Items in areas that are inaccessible because of safety considerations such as those raised by continuous process operations, radiological dose, or energized electrical equipment to be inspected during each scheduled shutdown but not more often than every refueling outage interval.

Revise footnote #5 Not all nuclear sites are licensed to NFPA 25, 2011 Edition.

- The revised AMP references guidance in NFPA 25, 2011 Edition, which not all plants are licensed to, and will require code compliance reviews against site procedures for those plants.
- The NFPA 25 requirements, including those identified in Table XI.M27-1, Inspection and Testing Recommendations, are overly stringent and the systems are not designed for the frequency of the inspections, which will result in deviation requests.

XI.M27-5, Lines 11-12, Element 6 – Acceptance Criteria

Item c) of Element 6 states "no fouling exists" which is overly stringent.

- Justification: This requirement for "no fouling" is overly stringent and impossible to meet unless all piping is replaced approximately every 5 years. 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.
- **Mark-up:** The acceptance criteria are: (a) the water-based fire protection system is able to maintain required pressure and flow rates, <u>and</u> (b) minimum design wall thickness is maintained, ~~and (c) no fouling exists in the sprinkler systems that could cause corrosion or flow blockage in the sprinklers~~.

XI.M27-5, Lines 21-23, Element 7 – Corrective Actions

The Element states "if the presence of sufficient foreign organic or inorganic material to obstruct pipe or sprinklers is detected during pipe inspections, the material is removed and its source is determined and corrected." This is overly restrictive and burdensome.

- Justification: Most piping systems for fire water systems are carbon steel and use lake/river water for the water source. This piping fouls and will contain organic material that occurs on the inside of the piping due to the nature of the organics in lake/river water. This requirement will necessitate significant cleaning of the piping systems on a regular basis, the potential addition of a chemical treatment system, and/or replacement of the piping.
- This is overly stringent since flow testing should be adequate to ensure functionality/ operability and corrective actions to clean the piping performed

once flow testing results indicate a degradation in pipe flow characteristics prior to a flow test failure occurring.

- **Mark-up:** [...] If the presence of sufficient foreign organic or inorganic material to obstruct pipe or sprinklers is detected during pipe inspections, the material is removed and ~~its source is determined and corrected~~ the inspection results are entered into the site's Corrective Action Program for further evaluation.

XI.M29 Aboveground Metallic Tanks
(**Note:** All mark-ups for this AMP are contained in the long text following the four comments.)

XI.M29 – 1, Program Description and Element 1

Revise the Program Description and Element 1 to clarify that the scope of tanks includes only metallic tanks. That change will provide clarification and consistency with the statement in Element 3 that describes inspections of metallic tanks.

- o The second sentence of the Program Description states that "all outdoor tanks (except fire water storage tanks) and certain indoor tanks are included".
- o The first sentence in Element 1 states that "Tanks within the scope of this program include all outdoor tanks except the fire water storage tank, constructed on soil or concrete. Indoor large volume storage tanks..."

XI.M29 – 2, Element 4

Change the placement of Table XI.M29-1 so that it is the final information included in Element 4.

- o Relevant information that should precede Table XI.M29-1 does not appear until after the table.
- o For example, footnote #9 in Table XI.M29-1 mentions "Alternatives to Removing Insulation", which is text that should be placed prior to the table but currently follows the table.

XI.M29 – 3 Element 4

Change the word "piping" to "tanks" in the description of *Alternatives to Removing Insulation* (Item b).

- o This appears to be a typographical error since the subject of the AMP is aboveground metallic tanks, not piping.

XI.M29 – 4, Table XI.M29-1, *Tank Inspection Recommendations*, Element 4 ():

In Table XI.M29-1, footnote #11, for performing surface examinations to detect cracking, requires inspection of "either 25 sections of the tank's surface (e.g., 1-square-foot sections) or 20 percent of the tank's surface".

Footnote #7, for volumetric inspections to detect loss of material, requires that "at least 25 percent of the tank's internal surface is to be inspected".

- o Since surface examinations and volumetric examinations both are valid NDE techniques, the extent of inspections should be consistent.
- o Footnote #7 should be revised to require "at least 20 percent of the tank's internal surface is to be inspected".

XI.M29 Markup

Program Description

The Aboveground Metallic Tanks aging management program (AMP) manages the effects of loss of material and cracking on the outside and inside surfaces of aboveground tanks constructed on concrete or soil. All metallic outdoor tanks (except fire water storage tanks) and certain metallic indoor tanks are included. If the tank exterior is fully visible, the tank's outside surfaces may be inspected under the program for inspection of external surfaces [Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report AMP XI.M36] for visual inspections of external surfaces recommended in this AMP; surface examinations are conducted in accordance with the recommendations of this AMP. [...]

Evaluation and Technical Basis

1. ***Scope of Program:*** Tanks within the scope of this program include all metallic outdoor tanks except the fire water storage tank, constructed on soil or concrete. Indoor large volume metallic storage tanks (i.e., those with a capacity greater than 100,000 gallons) designed to internal pressures approximating atmospheric pressure and exposed internally to water are also included. If the tank exterior [...]

   [...]

4. ***Detection of Aging Effects:*** [...].

When necessary to detect cracking in materials susceptible to cracking such as stainless steel (SS), and aluminum, the program includes surface examinations. When surface examinations are required to detect an aging effect, the program states how many surface examinations will be conducted, the area covered by each examination, and how examination sites will be selected.

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." 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."

The sample inspection points are distributed in such a way that inspections occur on the tank dome (if it is flat), near the bottom, at points where structural supports, pipe, or instrument nozzles penetrate the insulation and where water could collect such as on top of stiffening rings. In addition, inspection locations are based on the likelihood of corrosion under insulation occurring (e.g., given how often a potential inspection location is subject to alternate wetting and drying in environments where trace contaminants could be present, how long a system at a potential inspection location operates below the dew point).

Alternatives to Removing Insulation:

a. Subsequent inspections may consist of examination of the exterior surface of the insulation for indications of damage to the jacketing or protective outer layer of the insulation when the results of the initial inspection meet the following criteria:

i. No loss of material due to general, pitting or crevice corrosion, beyond

that which could have been present during initial construction is observed, and
ii. No evidence of stress corrosion cracking (SCC) is observed.

If the external visual inspections of the insulation reveal damage to the exterior surface of the insulation or jacketing, or there is evidence of water intrusion through the insulation (e.g., water seepage through insulation seams/joints), periodic inspections under the insulation continue as conducted for the initial inspection.

b. Removal of tightly adhering insulation that is impermeable to moisture is not required unless there is evidence of damage to the moisture barrier. If the moisture barrier is intact, the likelihood of corrosion under insulation (CUI) is low for tightly adhering insulation. Tightly adhering insulation is considered to be a separate population from the remainder of insulation installed on in scope components. The entire population of in scope ~~piping~~ tanks that has tightly adhering insulation is visually inspected for damage to the moisture barrier with the same frequency as for other types of insulation inspections. These inspections are not credited towards the inspection quantities for other types of insulation.

Potential corrosion of tank bottoms is determined from ultrasonic testing (UT) thickness measurements of the tank bottoms that are taken whenever the tank is drained or at intervals not less than those recommended in Table XI.M29-1. Measurements are taken to ensure that significant degradation is not occurring and that the component's intended function is maintained during the period of extended operation.

When inspections are conducted on a sampling basis, subsequent inspections are conducted in different locations unless the program states the basis for why repeated inspections will be conducted in the same location.

Inspections and tests are performed by personnel qualified in accordance with site procedures and programs to perform the specified task. Inspections and tests within the scope of the American Society of Mechanical Engineers (ASME) Code follow procedures consistent with the ASME code. Non-code inspections and tests follow site procedures that include inspection parameters for items such as lighting, distance offset, surface coverage, presence of protective coatings, and cleaning processes that ensure an adequate examination.

Table XI.M29-1. Tank Inspection Recommendations [1, 2]

[...]

Table XI.M29-1. Tank Inspection Recommendations (Footnotes section) [1, 2]
7. At least ~~25~~ 20 percent of the tank's internal surface is to be inspected using a method capable of precisely determining wall thickness. The inspection method is capable of detecting both general and pitting corrosion and be demonstrated effective by the applicant. [...] 11. A minimum of either 25 sections of the tank's surface (e.g., 1-square-foot sections for tank surfaces, 1-linear-foot sections of weld length) or 20 percent of the tank's surface are examined. The sample inspection points are distributed in such a way that inspections occur in those areas most susceptible to degradation (e.g., areas where contaminants could collect, inlet and outlet nozzles, welds).

~~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." 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."~~

~~The sample inspection points are distributed in such a way that inspections occur on the tank dome (if it is flat), near the bottom, at points where structural supports, pipe, or instrument nozzles penetrate the insulation and where water could collect such as on top of stiffening rings. In addition, inspection locations are based on the likelihood of corrosion under insulation occurring (e.g., given how often a potential inspection location is subject to alternate wetting and drying in environments where trace contaminants could be present, how long a system at a potential inspection location operates below the dew point).~~

~~Alternatives to Removing Insulation:~~
~~a. Subsequent inspections may consist of examination of the exterior surface of the insulation for indications of damage to the jacketing or protective outer layer of the insulation when the results of the initial inspection meet the following criteria:~~

~~i. No loss of material due to general, pitting or crevice corrosion, beyond that which could have been present during initial construction is observed, and~~

~~ii. No evidence of stress corrosion cracking (SCC) is observed.~~

~~If the external visual inspections of the insulation reveal damage to the exterior surface of the insulation or jacketing, or there is evidence of water intrusion through the insulation (e.g., water seepage through insulation seams/joints), periodic inspections under the insulation continue as conducted for the initial inspection.~~

~~b. Removal of tightly adhering insulation that is impermeable to moisture is not required unless there is evidence of damage to the moisture barrier. If the moisture barrier is intact, the likelihood of corrosion under insulation (CUI) is low for tightly adhering insulation. Tightly adhering insulation is considered to be a separate population from the remainder of insulation installed on in-scope components. The entire population of in-scope piping that has tightly adhering insulation is visually inspected for damage to the moisture barrier with the same frequency as for other types of insulation inspections. These inspections are not credited towards the inspection quantities for other types of insulation.~~

~~Potential corrosion of tank bottoms is determined from ultrasonic testing (UT) thickness measurements of the tank bottoms that are taken whenever the tank is drained or at intervals not less than those recommended in Table XI.M29-1. Measurements are taken to ensure that significant degradation is not occurring and that the component's intended function is maintained during the period of extended operation.~~

~~When inspections are conducted on a sampling basis, subsequent inspections are~~

~~conducted in different locations unless the program states the basis for why repeated inspections will be conducted in the same location.~~

~~Inspections and tests are performed by personnel qualified in accordance with site procedures and programs to perform the specified task. Inspections and tests within the scope of the American Society of Mechanical Engineers (ASME) Code follow procedures consistent with the ASME code. Non-code inspections and tests follow site procedures that include inspection parameters for items such as lighting, distance offset, surface coverage, presence of protective coatings, and cleaning processes that ensure an adequate examination.~~

XI.M30 Fuel Oil Chemistry

XI.M30-1, Program Description

Change lines 18 and 21, from "is to be" or "is" to "should be"

- The AMP language carries the impression that it is a requirement, whereas the GALL-SLR is a set of recommendations.

XI 01-32 (GALL-SLR, Table XI-01), FSAR Description of M30, page XI 01-32.

The summary has not been updated to agree with the AMP itself.

- Statement changes are needed to bring the FSAR summary into agreement with the program description in XI.M30.
- This same comment applies to SRP-SLR page 3.0-35, Table 3.0-1, for XI.M30.
- Change : "Monitoring and controlling fuel oil contamination in accordance with the guidelines of American Society for Testing and Materials (ASTM) Standards D1796, D2276, D2709, and D4057 maintains the fuel oil quality"...

To

- "Fuel oil quality is maintained by monitoring and controlling fuel oil contamination in accordance with the plant's technical specifications. Guidelines of the American Society for Testing and Materials (ASTM) Standards, such as ASTM D 0975, D 1796, D 2276, D 2709, D 6217, and D 4057, also may be used".

XI.M30-1, Lines 5-8 Program Description.

Delete reference year identifiers in the ASTM Standard numbers mentioned in the section.

- Basis: The years on the ASTM Standards should not be included for this guidance document, as they are different for most of the stations in the industry, and are updated frequently. Some of the ASTM documents identified are approximately 20 years old and have already been revised to more current and up to date methods. The NRC Reg Guide 1.137, Rev 2, "FUEL OIL SYSTEMS FOR EMERGENCY POWER SUPPLIES," uses the updated (current) ASTM methods for reference. In addition, the FSAR Summary Table XI-01, page XI 01-32, for XI.M30, observes this non-year designator convention.
- **Markup:** Fuel oil quality is maintained by monitoring and controlling fuel oil 6 contamination in accordance with the plant's technical specifications (TSs). Guidelines of the American Society for Testing and Materials (ASTM) Standards, such as ASTM D 0975~~-04~~, D 1796~~-97~~, D 2276~~-00~~, D 2709~~-96~~, D 6217~~-98~~, and D 4057~~-95~~, also may be used. Exposure to fuel oil contaminants, such as water and microbiological organisms, is minimized by periodic draining or cleaning of tanks and by verifying the quality of new oil before its introduction into the storage tanks.

XI.M30-2, Lines 36-38 Element 6, Acceptance Criteria.

Delete reference year identifiers in the ASTM Standards mentioned in the section.

- Basis: The years on the ASTM Standards should not be included for this guidance document, as they are different for most of the stations in the industry, and are updated frequently. Some of the ASTM documents identified are approximately 20 years old and have already been revised to more current and up to date methods. The NRC Reg Guide 1.137, Rev 2, "FUEL OIL SYSTEMS FOR EMERGENCY POWER SUPPLIES," uses the updated (current) ASTM methods for reference.
- **Markup:** Acceptance criteria for fuel oil quality parameters are as invoked or referenced in a plant's TSs. [...] ASTM D 0975-~~04~~ or other appropriate standards may be used to develop fuel oil quality acceptance criteria. Suspended water concentrations are in accordance with the applicable fuel oil quality specifications.

XI.M30-3 & -4, XI.M30 References Section.

Delete reference year identifiers in the ASTM Standards.

- Basis: The years on the ASTM Standards should not be included for this guidance document, as they are different for most of the stations in the industry, and are updated frequently. Some of the ASTM documents identified are approx. 20 years old and have already been revised to more current and up to date methods. The NRC Reg Guide 1.137, Rev 2, "FUEL OIL SYSTEMS FOR EMERGENCY POWER SUPPLIES," uses the updated (current) ASTM methods for reference.
- **Markup:** See references as follows.
  - 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. 2015.
  - API. API 653, "Tank Inspection, Repair, Alteration, and Reconstruction." Washington, DC: American Petroleum Institute. April 2009.
  - ASTM. ASTM D 0975-~~04~~, "Standard Specification for Diesel Fuel Oils." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~2004.~~
  - _____. ASTM D 4057-~~95~~, "Standard Practice for Manual Sampling of Petroleum and Petroleum Products." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~2000.~~
  - _____. ASTM D 2276-~~00~~, "Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~2000.~~
  - _____. ASTM D 6217-~~98~~, "Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~1998.~~

- _____. ASTM D 1796-~~97~~, "Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~1997.~~
- _____. ASTM D 2709-~~96~~, "Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge." West Conshohocken, Pennsylvania: American Society for Testing Materials. ~~1996.~~

XI.M32 One-Time Inspections

XI.M32-2, Element 1, Scope of program, lines 21-25.

Some aspects of this AMP are confusing and seemingly incorrect. (**Note** that a similar change should be made in XI.M32 entries in GALL Table XI.01 and SRP Table 3.0-1.)

- The statement in Element 1 that "Long-term loss of material due to general corrosion for steel components need not be managed if two conditions are met: (i) the environment for the steel components includes corrosion inhibitors as a preventive action; and (ii) periodic wall thickness measurements on a representative sample of each environment have been conducted every 5 years up to at least the 50th year of operation" is not required since by definition, the long-term loss of material does not involve environments where corrosion inhibitors are used.
- Additionally, the use of corrosion inhibitors and the performance of periodic inspections **is** aging management so the statement "Long-term loss of material due to general corrosion for steel components need not be managed if two conditions are met..." is not correct.
- The statement "periodic wall thickness measurements on a representative sample of each environment have been conducted every 5 years up to at least the 50th year of operation" is confusing. What GALL AMP is performing these periodic inspections? They are not addressed in GALL AMP XI.M38 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components.
- **Markup**: ~~The scope of this program includes managing long-term loss of material due to general corrosion for steel components. Long-term loss of material due to general corrosion for steel components need not be managed if two conditions are met: (i) the environment for the steel components includes corrosion inhibitors as a preventive action; and (ii) periodic wall thickness measurements on a representative sample of each environment have been conducted every 5 years up to at least the 50th year of operation. Environments such as treated water, reactor coolant, raw water, and waste water do not typically include corrosion inhibitors.~~

XI.M32 -3 and -4, lines 41 and 1, Element 3,

Revise element 3 to reference Table XI.M32-1 by name.

- Examples of parameters monitored and the related aging effect are provided in the ~~table~~ Table XI.M32-1 ~~in Element 4, below~~.

XI.M32 – 4, Table XI.M32-1, row 6

Recommend deleting long term loss of material aging effect.

- It would be difficult to satisfy the XI.M32 element 1 recommendation for representative samples conducted every 5 years up to at least the 50^{th} year of operation.
- In addition, aging effects for raw water and waste water environments are more effectively managed by other AMPs.
- **Markup:**

~~Long-term loss of Material~~	~~General corrosion~~	~~Wall Thickness~~	~~Volumetric (e.g., UT)~~

XI.M32 -2, Element 4

Revise element 4 regarding population for inspections, multiple units/same site

- Recommend combining all units on site in a single population from which to sample for multi-unit sites where the material and environment combinations are identical.
- This is consistent with the proposed treatment of corrective action applicability to all units if one unit identifies the need for periodic inspections.
- Recommend that any addition inspections be performed based on inspection results. Multiple unit stations will need to consider corrective actions at each unit.
- Recommend considering this multiple unit sample population approach for other one-time inspection AMPs such as XI.M33 Selective Leaching, and XI.M35 ASME Code Class 1 Small Bore Piping.

XI.M32-3, lines 14-15, Element 4

A representative sample size is 20 percent of the population or a maximum of 25 components at each unit or station of similar units.

- **Markup:** A representative sample 15 size is 20 percent of the population or a maximum of 25 components at each unit <u>or station of similar units</u>.

XI.M32-3, lines 32-30, Element 4

The following new statement should be deleted; this AMP has no AMR lines for inspections/air environments.

- "When using this AMP to conduct one-time inspections of aluminum piping, piping components and tanks exposed to air, [...] and temper designation. Grouping of air environments consistent with the Detection of Aging Effects program element of GALL-SLR Report AMP XI.M38 is acceptable".
- The One-Time Inspection AMP does not include inspections in air environments.
- **Markup:** ~~When using this AMP to conduct one-time inspections of aluminum piping, piping components and tanks exposed to air, aluminum structures and components (SCs)~~ [...] ~~Grouping of air environments consistent with the Detection of Aging Effects program element of GALL-SLR Report AMP XI.M38 is acceptable.~~

XI.M32–4, Element 4; delete erosion from Table

Delete erosion from Table XI.M32-1.

- There are no AMR line items for managing erosion in the One-Time Inspection program.

XI.M32–4, Element 4; revise Table to allow visual inspections with caveat,

Table XI.M32-1 requires volumetric examination for the identification of long-term loss of material due to general corrosion.

- Visual inspection should be allowed with the caveat that should evidence of degradation be observed visually, a volumetric examination shall be performed.
- **Markup**:

Table XI.M32-1. Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component			
Aging Effect	**Aging Mechanism**	**Parameter(s) Monitored**	**Inspection Method**[2]
[...]			
~~Loss of Material~~	~~Erosion~~	~~Surface Condition or Wall Thickness~~	~~Visual (e.g., VT-3) or Volumetric (e.g., UT)~~

XI.M33 Selective Leaching

XI.M33-2, Lines 9-12, Element 2

Comment: Element 2 states that employing chemistry controls that are consistent with 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."

- The EPRI Closed Cooling Water Chemistry Guideline, which is referenced in AMP XI.M21A as acceptable water chemistry controls, does not control dissolved oxygen in closed cooling water systems unless hydrazine chemistry is used.
- Most closed cooling water systems do not control dissolved oxygen in the system or in the makeup water to the system, and air can enter via vents in the surge tanks.
- Some corrosion inhibitors used in closed cooling water systems are oxidizers or require dissolved oxygen in order to maximize their effectiveness. While dissolved oxygen is minimized in the PWR secondary cycle, it is not in most closed cooling water systems.
- **Recommendation:** Revise the sentence to read that chemistry control can be used to control pH, concentration of corrosive contaminants, or minimize dissolved oxygen.
- Markup: [...]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~~ or minimize dissolved oxygen

XI.M33-3, line 9, Element 4 concerning destructive examinations

Recommend that the two mandatory destructive examinations noted in element 4 (page XI.M33-3 line 9) in each 10 year period in each material and environment population at each unit be reduced to one mandatory destructive examination for each population less than 100 components.

- This is based on 3% of 3 times (for three inspection periods) the inspection pool for a single period.
- Current sampling will result in oversampling of small-quantity material/ environment populations. For example, using 2 samples in each 10 year period will result in 6 samples. For a small population of twelve components, that is 50% of the population that will be replaced due to destructive examinations.
- **Markup:** [...] 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 for sample populations with greater than 100 total susceptible components. ~~at each unit~~. When there are less than 100 total susceptible components in a sample population, one destructive examination will be performed will be performed for that population. Otherwise, [...]

XI.M33-3, line 22, Element 4 concerning destructive examinations

Recommend a similar reduction in element 4 (page XI.M33-3 line 22) for mandatory destructive examinations in two unit sites for each population at each unit of less than 50 components, such that there is a total of 100 components between the two units.

- **Markup:** For multi-unit sites where [...]. For two unit sites <u>with greater than 50 total susceptible components in a sample population at each unit</u>, eight visual and mechanical inspections and two destructive examinations are conducted at each unit. <u>For two unit sites with less than 50 total susceptible components in a sample population at each unit, one destructive examination will be performed for that sample population.</u> For three unit sites, [...]

XI.M35 ASME Code Class 1 Small-Bore Piping

XI.M35-1 through 3, all lines

The GALL2 version recognizes that applicability could be system-oriented (as set forth in the GALL2 Program Description section). However the GALL-SLR version has removed this system aspect, and implies that inspections must look at all components lumped together. The system orientation (especially systems with known plant or industry OE) of GALL2 should be retained.

- Under GALL2, a one-time inspection could show that many systems do not have an issue while perhaps a specific system or systems may have problems (for which a plant-specific program could then be implemented to monitor components in those systems).
- The GALL-SLR version implies that all systems are lumped together, and an issue in one system could drive unnecessary periodic inspections in many unaffected systems.
- GALL-SLR should contain language (or more clarification) so that applicants are not driven to do inspections where there is no history or indications of the particular socket or butt-weld internal cracking, or where past actions have totally mitigated it as borne out by absence of further failure at those locations.

XI.M35-3, lines 9-16, Operating Experience

Non-representative operating experience does not illustrate the need for AMP. OE that accurately portrays the issue should be used. Also, no justification is provided to show the need of periodic monitoring.

- One cited LER, 50-317/2012-002, is not representative of the issue since it involves ¾" tubing and was the result of a missing vertical support (construction error). This AMP is for piping NPS 1" through 4" and aging-related mechanisms.
- The GALL-SLR should use OE that accurately reflects the issue(s) at hand.
- Furthermore, if periodic inspections are being emphasized, then OE should be presented that reflects a need to perform periodic inspections; this LER was resolvable by ultimately installing the missing support. The AMP does not present any justification for advocating use of periodic inspections as a condition monitoring activity.

XI.M35-5, move Table XI.M35-1 to better location

This Table should be moved to be before the References.

XI.M35-5, Table XI.M35-1 Notes, Note 3

Add statement to Note 3 that repaired or redesigned welds demonstrating no additional failures should be placed into Category A.

- As shown below in Table markup.

XI.M35-5, Table XI.M35-1, wording for Note 4

The following wording should be added to Note 4 to table XI.M35-1 in order to be consistent with wording in Element 4:

- "Other factors, such as plant-specific and industry operating experience, accessibility, and personnel exposure, can also be considered to select the most appropriate locations for the examinations."
- **Markup:** (4) The welds to be examined are selected from locations that are determined to be the most risk significant and most susceptible to cracking. <u>Other factors, such as plant-specific and industry operating experience, accessibility, and personnel exposure, can also be considered in selecting the most appropriate locations for the examinations</u>.

XI.M35-5, Table XI.M35-1, Category B, change comment

With respect to Category B, the recommendation to inspect 10% (up 25) socket welds and butt welds may result in unnecessary inspections and destructive examinations of new welds, and thus run counter to the CAP and nullify QA as applied to this instance. Consider the following example:

- If the Category A inspections find cracking in a socket weld then the site's corrective action program would require a root cause determination and an extent of condition evaluation. The extent of condition evaluation could result in the identification of a subgroup of the socket weld population that potentially could be designated as Category B or C.
- A portion of these welds, possibly all, may need to be removed, redesigned, reconfigured, and installed based on the root cause determination. These welds would become Category B.
- The Category B requirements in table XI.M35-1 would require UT examination of these new welds (if UT techniques are available) or destructive inspection. This could place the site in the position of destructively examining new socket welds that have been redesigned to avoid the identified root cause.
- For Category B welds (welds that have been redesigned) the program should credit the corrective action program to correct the root cause. These welds, once corrected, should be placed back into the Category A weld population. Therefore, it is recommended that the Category B in table XI.M35-1 should be removed.
- If this Comment is not accepted, then please provide the flexibility for disposition of category B based on OE: that this table would allow flexibility, similar to that which is in GALL Rev. 2, that if OE searches of mitigated welds in category B show no additional failures for a 30 year period after the repair, then those welds can be reclassified as Category A.

o XI.M35-5 -- Markup for Table XI.M35-1, Category B and Notes 3 & 4 comments above

Table XI.M35-1 Examinations

Category	Plant Operating Experience	Mitigation	Examination Schedule	Sample Size	Examination Method
A	No age-related cracking (1) (2)	Not applicable	One-time: completed within 6 years prior to the start of the subsequent period of extended operation	Full penetration (butt) welds: 3% of total population per unit, up to 10 (4) Partial penetration (socket) welds: 3% of total population per unit, up to 10 (4)	Volumetric or destructive (5) (6)
~~B~~	~~Age-related cracking (2)~~	~~Yes (3)~~	~~One-time:~~ ~~completed within 6 years prior to the start of the subsequent period of extended operation~~	~~Full penetration (butt) welds: 10% of total population per unit, up to 25 (4)~~ ~~Partial penetration (socket) welds: 10% of total population per unit, up to 25 (4)~~	~~Volumetric or destructive (5) (6)~~
C	Age-related cracking (2)	No	Periodic: first examination completed within the 6 years prior to the start of the subsequent period of extended operation with subsequent examinations every 10 years thereafter	Full penetration (butt) welds: 10% of total population per unit, up to 25 (4) Partial penetration (socket) welds: 10% of total population per unit, up to 25 (4)	Volumetric or destructive (5) (6)

NOTES:
(1) Must have no history of age-related cracking.
(2) Age-related cracking includes piping leaks or other flaws where fatigue or stress corrosion cracking are contributing factors.
(3) Actions must have been taken to mitigate the cause of the cracking. These actions, such as design changes, would generally go beyond typical repair or replacement activities. If welds that have been redesigned or repaired demonstrate no additional failures, then these welds may be placed into Category A.
(4) The welds to be examined are selected from locations that are determined to be the most risk significant and most susceptible to cracking. Other factors, such as plant-specific and industry operating experience, accessibility, and personnel exposure, can also be considered in selecting the most appropriate locations for the examinations.
(5) Volumetric examinations must employ techniques that have been demonstrated to be capable of detecting flaws and discontinuities in the examination volume of interest.
(6) Each partial penetration (socket) weld subject to destructive examination may be credited twice towards the total number of examinations.

XI.M36 External Surfaces Monitoring of Mechanical Components

XI.M36 – 1, lines 8-10, Program Description "fouling" listed twice.

Fouling is listed twice as an aging effect in the 3rd sentence. Delete first instance of fouling

- **Markup:** The program manages aging effects through visual inspection of external surfaces for evidence of loss of material, cracking, ~~fouling,~~ changes in material properties, reduced thermal insulation resistance, and reduction of heat transfer due to fouling.

XI.M36 – 1, lines 22-26, Element 3:

Revise element 3, insufficient details given.

- AMP has a new requirement "Periodic visual inspections or surface examinations are conducted on SS and aluminum to manage cracking. 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."
- There is no detail on how this is to be demonstrated. Is this through the use of OE on past visual examinations? The use of OE to confirm that visual inspections are adequate is an acceptable way for demonstration.
- Revise to add the words "through the review of OE" after "demonstrated" to provide guidance for the demonstration required.
- **Markup:** Periodic surface examinations are conducted if this program is being used to manage cracking in SS or aluminum components. Visual inspections for leakage or surface cracks are an acceptable alternative to conducting surface examinations to detect cracking if it has been demonstrated <u>through the review of OE</u> that cracks will be detected prior to challenging the structural integrity or intended function of the component.

XI.M36-2, line 28, Element 3, regarding "surface discontinuities"

Change "surface discontinuities and imperfections" to "Corrosion and surface imperfections".

- Basis: The primary purpose of this program is to look for corrosion. The term "surface discontinuities" does not accurately describe corrosion.
- **Markup:** <u>Corrosion and s</u>~~S~~urface ~~discontinuities and~~ imperfections...

XI.M36-3 Lines 13-15, Element 4 editorial comment

First sentence is missing the word "to".

- **Markup:** This program manages the aging effects of loss of material, cracking, changes in material properties using visual inspection, reduced thermal insulation resistance, and reduction of heat transfer due <u>to</u> fouling.

XI.M36-3 Line 31, Element 4, periodic surface examinations

Remove recommendation for periodic surface examinations from these paragraphs.

- o Surface examinations are impractical for system engineer walkdowns and opportunistic surface inspections. OE with code inspections and research in progress has demonstrated adequacy of visual inspections to detect cracking.
- o **Markup:** ~~Periodic visual inspections or surface examinations are conducted on SS and aluminum to manage cracking. 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.~~

XI.M36 – 4, lines 37-40, Element 4(a), alternatives to removing insulation

The two alternatives to removing insulation in 4(a) after the initial inspection should clarify that the referenced observations are from the first inspection.

- o Clarification is needed that referenced observations are from the first inspection of piping external surfaces and not observations during the current inspection.
- o **Markup:** (i) No loss of material due to general, pitting, or crevice corrosion beyond that which could have been present during initial construction is observed during <u>the first inspection</u> and
  (ii) No evidence of SCC is observed during <u>the first inspection</u>.

XI.M36 – 5, lines 37-40, Element 6

Revise the element 6 new acceptance criterion statement of "Where possible, acceptance criteria are quantitative" to "Quantitative acceptance criteria are preferred"

- o So that it doesn't preclude the use of qualitative criteria in cases where both are possible but quantitative is much more difficult to achieve.
- o As currently written the statement doesn't allow qualitative if quantitative can be performed.
- o **Markup:** [...] Acceptance criteria, which permit degradation, are based on maintaining the intended function(s) under all CLB design loads. The evaluation projects the degree of observed degradation to the end of the subsequent period of extended operation or the next scheduled inspection, whichever is shorter. ~~Where possible, acceptance criteria are q~~Quantitative <u>acceptance criteria are preferred</u> (e.g., minimum wall thickness, percent shrinkage allowed in an elastomeric seal). Where qualitative acceptance criteria [...]

XI.M36-5, Element 6, acceptance criteria

Quantitative acceptance criteria are preferred and should be related to the surface condition. For example, acceptance criteria should be related to the surface condition such as ~~no abnormal surface irregularities,~~ no visible loss of material greater than 1/10 of an inch due to corrosion, ~~no degraded protective coating~~, no crack-like indications, and no indications of recent leakage.

- Acceptance criteria should be associated with the parameters monitored or inspected and with the methods identified in detection of aging effects. Prior to initiating corrective actions, additional evaluations may be specified when acceptance criteria are not met.

XI.M37 Flux Thimble Tube Inspection

XI.M37-1, lines 21-28, Elements 3 and 4

Change “during the period of extended operation” to “during the <u>subsequent</u> period of operation” to be consistent with other AMPs.

- Editorial suggestion.

XI. M38 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

XI.M38-1, second paragraph lines 18-20, Program Description

For clarity, state that loss of material is an aging effect managed by this program.

- Basis: A new sentence is being added to this paragraph via this revision that states that this program may also be used to manage cracking. However, the existing text has not yet stated that the program is monitoring for loss of material. For clarity, this should be stated.
- **Markup:** The program includes visual inspections to ensure that existing environmental conditions are not causing ~~material~~ degradation <u>due to loss of material</u> that could result in loss of a component's intended functions.

XI. M38 – 2, lines 29-30, Element 3

Revise element 3 to insert "Additional aging indicators include" just before the last three items which are not related to loss of material as described, but are related to other aging effects such as fouling and cracking.

- **Markup:** <u>Additional aging indicators include</u> (insert this new line)
    - Debris from the air environment accumulating on heat exchanger tube surfaces (reduction of heat transfer due to fouling)
    - Surface examinations for the detection of cracks on the surfaces of SS and aluminum components exposed to air and aqueous solutions containing halides
    - Leakage for detection of cracks on the surfaces of SS and aluminum components exposed to air and aqueous solutions containing halides.

XI.M38-2, line 27, Element 3, surface discontinuities

Change "surface discontinuities and imperfections" to "Corrosion and surface imperfections".

- Basis: The primary purpose of this program is to look for corrosion. The term "surface discontinuities" does not accurately describe corrosion.
- **Markup:** • <u>Corrosion and s</u>~~S~~urface ~~discontinuities and~~ imperfections

XI.M38 – 2, lines 21-25, Element 3, insufficient details given

Revise element 3,.

- AMP has a new requirement "Periodic surface examinations are conducted if this program is being used to manage cracking in SS or aluminum components. Visual inspections for leakage or surface cracks are an acceptable alternative to conducting surface examinations to detect cracking if it has been demonstrated that cracks will be detected prior to challenging the structural integrity or intended function of the component.

- There is no detail on how this is to be demonstrated. Is this through the use of OE on past visual examinations? The use of OE to confirm that visual inspections are adequate is an acceptable way for demonstration.
- Revise to add the words "through the review of OE" after "demonstrated" to provide guidance for the demonstration required.
- **Markup:** Periodic surface examinations are conducted if this program is being used to manage cracking in SS or aluminum components. Visual inspections for leakage or surface cracks are an acceptable alternative to conducting surface examinations to detect cracking if it has been demonstrated through the review of OE that cracks will be detected prior to challenging the structural integrity or intended function of the component.

XI.M38 -3, lines 1-2, Element 3

At the top of page XI.M38-3, this item should not be bulleted.

- Editorial

XI.M38-4 Line 13-ff, Element 4

Remove recommendation for periodic surface examinations from these paragraphs.

- Surface examinations are impractical for system engineer walkdowns and opportunistic surface inspections. OE with code inspections and research in progress has demonstrated adequacy of visual inspections to detect cracking.
- **Markup:** ~~Periodic visual inspections or surface examinations are conducted on SS and aluminum to manage cracking. 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.~~

XI.M38-4, lines 26-27, Element 4, third paragraph

Clarify the word "accessible".

- Basis: The intent of this paragraph may be confusing without this clarification.
- **Markup:** To determine the condition of internal surfaces of buried and underground piping, inspections of the interior surfaces of accessible (i.e., above ground) piping may be credited if the accessible and buried or underground component material, environment, and aging effects are similar.

XI.M38 – 6 Element 6

Revise element 6 new acceptance criteria of "Where possible, acceptance criteria are quantitative" to "Quantitative acceptance criteria are preferred" such that is doesn't preclude the use of qualitative criteria in cases where both are possible but quantitative is much more difficult to achieve. As currently written it wouldn't allow qualitative if quantitative can be performed.

- **Markup (Element 6):** For each component and aging effect combination, [...] The evaluation projects the degree of observed degradation to the end of the subsequent period of extended operation or the next scheduled inspection, whichever is shorter. ~~Where possible, acceptance criteria are~~ ~~q~~<u>Q</u>uantitative <u>acceptance criteria are preferred</u> (e.g., minimum wall thickness, percent shrinkage allowed in an elastomeric seal). Where qualitative acceptance [...].

XI.M38-5, lines 15-29, Element 6

Acceptance criteria should be related to the surface condition since this program inspects surfaces for evidence of degradation.

- For example, acceptance criteria should be similar to criteria like no abnormal surface irregularities, no visible loss of material due to corrosion, no degraded protective coating, no crack-like indications, and no indications of recent leakage.
- Acceptance criteria should be associated with program elements' aspects: the parameters monitored or inspected and the methods identified in detection of aging effects. Corrective actions should identify the additional evaluations that should take place following not meeting acceptance criteria.

XI.M38-4, lines 26-33, Element 4

Delete paragraph and replace.

- **Markup - delete**: ~~To determine the condition of internal surfaces of buried and underground piping, inspections of the interior surfaces of accessible piping may be credited if the accessible and buried or underground component material, environment, and aging effects are similar. When inspections of the interior surfaces of accessible components with similar material, environment, and aging effects as the interior surfaces of buried or underground piping are not conducted, the sample population will be inspected using volumetric or internal visual inspections capable of detecting loss of material on the internal surfaces of the buried or underground piping.~~
- **Replace with:** If accessible portions of buried or underground components have similar material, environment, and aging effects as the inaccessible buried or underground components, then inspections of the interior surfaces of accessible components may be credited. If not, then the sample population will be inspected using volumetric or internal visual inspections capable of detecting loss of material on the internal surfaces of the inaccessible buried or underground piping.

XI.M39 LUBRICATING OIL ANALYSIS

XI. M39 – 1, lines 39-42, Element 4

In Detection of aging effects the use of the One Time Inspection (OTI) program to confirm effectiveness of this program is inconsistent with other programs that credit it.

- The AMP doesn't explicitly mention OTI, yet states "In certain cases, as identified by the AMR Items in this GALL-SLR Report, inspection of selected components is to be undertaken to verify the effectiveness of the program and to ensure that significant degradation is not occurring and that the component intended function is maintained during the subsequent period of extended operation." All AMR lines in the GALL-SLR that reference also specify the use of XI.M32 One-time Inspection to verify effectiveness of XI.M39 Lubricating Oil Analysis Program.
- Change to "Prior to the subsequent period of extended operation, a one-time inspection (i.e., GALL-SLR Report AMP XI.M32) of selected components exposed to lubricating oils is performed to verify the effectiveness of the Lubricating Oil Analysis program."
- **Markup- delete:** ~~In certain cases, as identified by the AMR Items in this GALL-SLR Report, inspection of selected components is to be undertaken to verify the effectiveness of the program and to ensure that significant degradation is not occurring and that the component intended function is maintained during the subsequent period of extended operation.~~
- **Replace with:** <u>Prior to the subsequent period of extended operation, a one-time inspection (i.e., GALL-SLR Report AMP XI.M32) of selected components exposed to lubricating oil is performed to verify the effectiveness of the Lubricating Oil Analysis program.</u>

XI.M40 Monitoring of Neutron-Absorbing Materials Other Than Boraflex

XI. M40 – 1, lines 6-8, Program Description contains information out of place.

In the Program Description the sentence "Information Notice (IN) 2009-26, Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool, discusses the degradation of Carborundum as well as the deformation of Boral panels in spent fuel pools."

- This is not appropriate for a program description as it is OE and should be in the OE section.
- **Markup:** (Program Description) Many neutron-absorbing materials are used in spent fuel pools. This aging management program (AMP) addresses aging management of spent fuel pools that use materials other than Boraflex, such as Boral, Metamic, boron steel, and Carborundum. ~~Information Notice (IN) 2009-26, Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool, discusses the degradation of Carborundum as well as the deformation of Boral panels in spent fuel pools.~~ GALL-SLR Report AMP XI.M22, "Boraflex Monitoring," addresses aging management of spent fuel pools that use Boraflex as the neutron-absorbing material. When a spent fuel pool criticality analysis credits both Boraflex and materials other than Boraflex, the guidance in both AMPs XI.M22 and XI.M40 applies.
- **Relocated to:** (10, Operating Experience) Applicants for license renewal reference plant-specific operating experience and industry experience to provide reasonable assurance that the program is able to detect degradation of the neutron absorbing material in the applicant's spent fuel pool. Some of the industry operating experience that should be included is listed below and <u>discussed in Information Notice (IN) 2009-26, Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool</u>: [...]

XI. M40 – 1, lines 39-41, Element 4

A new requirement of "The maximum interval between inspections for polymer-based materials (e.g., Carborundum, Tetrabor), regardless of operating experience, should not exceed 5 years." has been added without any basis being provided. This needs to be revised.

- There is no basis for the need for inspections more frequent than every 10 years unless existing program OE indicates a need for a shorter interval.
- A review of OE for carborundum found no OE justifying this change. It did find a commitment at a utility that "sample coupons will be removed and inspected on a 10-year interval, implemented on a staggered basis with the BADGER testing, such that either neutron attenuation testing (BADGER) or sample coupon testing will occur approximately every 5 years. This program only performs the inspections and testing every 10 years based on plant OE, not every 5 years.
- **Markup:** The loss of material and the degradation of neutron absorbing material capacity are determined through coupon and/or direct in-situ testing. Such testing should include [...] experience by the licensee. The maximum interval between inspections for polymer-based materials (e.g., Carborundum, Tetrabor), ~~regardless of operating experience, should not exceed 5 years. The maximum interval between inspections for~~ <u>and</u> nonpolymer-based materials

[(e.g., Boral, Metamic, Boralcan, borated stainless steel (SS)], regardless of operating experience, should not exceed 10 years.

XI.M42 Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks

XI.M42-1, lines 23-32, Element 1, inconsistent standards applied to tanks.

The proposed AMP wording states: *"The aging effects associated with fire water tank internal coatings/linings are managed by Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) aging management program (AMP) XI.M27, "Fire Water System," instead of this AMP. However, where the fire water storage tank internals are coated, the Fire Water System Program and Final Safety Analysis Report (FSAR) Summary Description of the Program should be enhanced to include the recommendations associated with training and qualification of personnel and the "corrective actions" program element. The Fire Water System Program should also be enhanced to include the recommendations from the "acceptance criteria" program element."*

- This wording indicates that the aging management of internally coated fire water storage tanks would be in accordance with XI.M27, Fire Water System". This is consistent with LR-ISG-2013-01 section VI.a.ii.
- However, this guidance is contradicted by SLR GALL line items VII.G.A.414 and VII.G.A.416 in which the aging of internally coated tanks is managed by XI.M42.
- **Markup:** For changes to the Table AMR items deleting the "tanks," see below.

XI.M42-3, line 8, Element 4

Add a qualifier that baseline inspections are only required for sites that have no already performed those inspections

- For sites that have completed baseline inspections already, their periodic inspections have already been defined.
- **Markup:** (Element 4) **Detection of Aging Effects**: <u>If a baseline has not been previously established, b</u>~~B~~aseline coating/lining inspections occur in the 10-year period prior to the subsequent period of extended operation.

- **Markup:** Proposed markup for Table VII

M	VII.G.A-414	3.3-1, 139	Piping, piping components, heat exchangers~~,~~ ~~tanks~~ with internal coatings/linings	Any material with an internal coating/lining	Closed-cycle cooling water, raw water, treated water, treated borated water, lubricating oil, waste water	Loss of material due to general, pitting, crevice corrosion, MIC; fouling that leads to corrosion; cracking due to stress corrosion cracking	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No
M	VII.G.A-416	3.3-1, 138	Piping, piping components, heat exchangers~~,~~ ~~tanks~~ with internal coatings/linings	Any material with an internal coating/lining	Closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil, fuel oil	Loss of coating or lining integrity due to blistering, cracking, flaking, peeling, delamination, rusting, physical damage, spalling for cementitious coatings/linings	AMP XI.M42, "Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks"	No

Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR

Summary for XI-M38,

> The row for XI.M38, Inspection of Internal Surfaces In Miscellaneous Piping And Ducting Components, states "This program consists of visual inspections of all accessible internal surfaces of metallic piping, piping components, ducting, heat exchanger components, polymeric and elastomeric components, and other components that are exposed to environments of uncontrolled indoor air, outdoor air, air with borated water leakage, condensation, moist air, diesel exhaust, and any water environment other than open-cycle cooling water, closed-cycle cooling water, and fire water."

- Open-cycle cooling water, closed-cycle cooling water, and fire water are not water environments. The proper terms are treated water and raw water. This program manages components exposed to a raw water environment. Needs to be revised to be consistent with the program description in XI.M38.
- **Markup:** See the below table change.

XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	This program is a condition monitoring program that manages loss of material, cracking, and hardening and loss of strength of polymeric materials. This program consists of visual inspections of all accessible internal surfaces of metallic piping, piping components, ducting, heat exchanger components, polymeric and elastomeric components, and other components that are exposed to environments of uncontrolled indoor air, outdoor air, air with borated water. leakage, condensation, moist air, diesel exhaust, and any water environment other than open-cycle cooling water, [age-managed by Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report aging management program (AMP) XI.M20], closed treated water system, (age-managed by GALL-SLR Report AMP XI.M21A), and fire water system (age-managed by GALL-SLR Report AMP XI.M27). ~~closed-cycle cooling water, and fire water~~. Elastomers exposed to open-cycle, closed-cycle cooling water, and fire water are managed by this program. These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. At a minimum, in each 10-year period during the period of extended operation a representative sample of 20 percent of the population (defined as components having the same combination of material, environment, and aging effect) or a maximum of 25 components per population is inspected.	Program is implemented 6 months before the subsequent period of extended operation and inspections begin during the subsequent period of extended operation	GALL V / SRP3.2 GALL VII / SRP3.3 GALL VIII / SRP

Summary for XI.M42

In the SAR supplement XI.01 row for XI.M42 Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks, the following acceptance criteria was added to what was in ISG-2013-01. "Peeling and delamination is not acceptable. Blisters are evaluated by a coatings specialist with the blisters being surrounded by sound material and with the size and frequency not increasing. Minor cracks in cementitious coatings are acceptable provided there is no evidence of debonding. All other degraded conditions are evaluated by a coatings specialist."

- This is only part of the acceptance criteria in XI.M42 and may or may not be appropriate for all applicants. Recommend removing.
- **Markup:** See the below table change.

XI.M42	Internal Coatings/Linings for In Scope Piping, Piping Components, Heat Exchangers, and Tanks	This program is a condition monitoring program that manages degradation of coatings/linings that can lead to loss of material of base materials and downstream effects such as reduction in flow, reduction in pressure or reduction in heat transfer when coatings/linings become debris. This program manages these aging effects by conducting periodic visual inspections of all coatings/linings applied to the internal surfaces of in-scope components exposed to closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil or fuel oil where loss of coating or lining integrity could impact the component's or downstream component's current licensing basis intended function(s). For tanks and heat exchangers all accessible surfaces are inspected. Piping inspections are sampling-based. The training and qualification of individuals involved in coating/lining inspections of noncementitious coatings/linings are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard. For cementitious coatings, training and qualifications are based on an appropriate combination of education and experience related to inspecting concrete surfaces. ~~Peeling and delamination is not acceptable. Blisters are evaluated by a coatings specialist with the blisters being surrounded by sound material and with the size and frequency not increasing. Minor cracks in cementitious coatings are acceptable provided there is no evidence of debonding.~~ All other degraded conditions are evaluated by a coatings specialist. For coated/lined surfaces determined to not meet the acceptance criteria, physical testing is performed where physically possible (i.e., sufficient room to conduct testing) in conjunction with repair or replacement of the coating/lining.	Program is implemented no later than six months before the subsequent period of extended operation and inspections begin no later than the last refueling outage before the subsequent period of extended operation	GALL V / SRP 3.2 GALL VII / SRP 3.3 GALL VIII / SRP 3.4

Attachment 5

AMP XI.M31
Reactor Vessel Material Surveillance
Comments

XI.M31 Reactor Vessel Material Surveillance

Description of Change/Comment and Justification
(Note; "XI.M31-x" refers to a page number in GALL-SLR)

XI.M31-1, 3-7 Program Description
The opening sentence seems to imply all beltline materials with projected fluence greater than 10^{17} n/cm^2 need to be monitored per 10CFR50 Appendix H.

- o 10CFR50 Appendix H says all RVs with fluence exceeding 10^{17} n/cm^2 need to have a surveillance program not all materials.
- o Plants can monitor all these materials, but cannot test or irradiate them all since some are not available either in unirradiated or irradiated condition.
- o Recommend adding the words "that contains a representative subset of those materials".

XI.M31-1, 10 Program Description:

- o A capsule holder within reactor vessel may be located in a low lead factor region (i.e., < 1.0), therefore a capsule located in such a holder will not "lead" the vessel. Requiring all capsules to lead the RV would be an increase in regulatory requirements.
- o Recommend adding "typically" after "surveillance capsules".

XI.M31-1, 16, XI.M31-1, 29, and XI.M31-2, 7 Program Description:
States that program must comply with ASTM E185-82.

- o Many programs were built to an earlier version of E185 and cannot practically comply with the E185-82 version.
- o 10CFR50 Appendix H is being updated to reference the latest version of the applicable ASTM standards.
- o Recommend stating that the surveillance program must comply with 10CFR50 Appendix H.

XI. M31 – 1 Program Description:

Line 26 (et al) The requirement of testing a capsule with a neutron fluence of 1 to 1.25 times the projected peak vessel neutron fluence at the end of the subsequent period of extended operation may be too restrictive for plants that are in an integrated surveillance program since plants with different operating history can be associated with a tested capsule. It is suggested that the requirement be maintained at 1 to 2 times the peak projected fluence.

- o Further irradiation beyond the peak projected fluence at the end of the subsequent period of extend operation should be bounding, therefore there appears to be no value in capping it at 1.25 times.

XI. M31 – 1 line 25, and M31-3 lines 11-12

GALL, Revision 2 states that "<u>Additional capsules may also be needed</u> for the period of extended operation for this alternative."

However, GALL for SLR states that "<u>This program includes removal and testing of at least one capsule</u> during the subsequent period of extended operation..."

- This change indicates a firm position of the NRC that at least one capsule will be tested in the SLR period whereas the previous position was that it was a possibility that one may be needed. The absolute need for testing of additional capsules in the SLR period is not substantiated.
- Many plants will have tested all of their capsules by the end of the first license renewal period. PWR plants are likely to have 5 or 6 capsules with substantial lead factors that enabled the already pulled capsules to provide data at fluence values in excess of SLR peak values.
- The GALL SLR requirement will result in these plants inserting another capsule during the SLR period. This capsule will result in one additional data point that is already within the range of fluence values already provided by the existing surveillance results.
- One additional data point, when 5 or 6 data points are already available, is very unlikely to have any discernable effect on chemistry factors or embrittlement trend observations. For weld heats that are present in multiple reactors, in excess of 10 data points may already exist. This even further negates the value of testing additional capsules.
- Insertion of a capsule is high expense and is not without risk but would offer little technical benefit and negligible improvement in safety.
- It is agreed that a capsule should be within the surveillance program that provides data at a fluence value representative of end of operating period conditions. There are some plants that do not have a capsule currently in their program that would provide data at end of SLR fluence values. In these cases, an additional capsule may be needed.

XI.M31-1, Line 25 and XI.M31-3, Lines 11-12,

Two further recommendations on the above topic:

- Remove "during the subsequent period of extended operation."
- Recommend adding "If a capsule with recommended fluence has already been tested, then additional testing is not required."

XI.M31-1 line 26, M31-3 line 13, and M31-4 line 37

GALL, Revision 2 states that "The program withdraws one capsule at an outage in which the capsule receives a neutron fluence of <u>between one and two times</u> the peak reactor vessel wall neutron fluence at the end of the period of extended operation..."

However, the proposed GALL for SLR states "This program includes removal and testing of at least one capsule...with a neutron fluence of the capsule <u>between one and one and one quarter (1.25) times</u> the projected peak neutron fluence..." Several reasons indicate that this should be changed:

- No apparent basis is given for this "tightening" of the target fluence range for the end of the period of operation.
- Operation for an additional 20 years should not necessitate tighter tolerance in fluence exposure for the highest fluence capsule.

- The latest industry consensus standard ASTM Standard, E2215, was developed with extended operation being considered, and this standard retains a target of between one and two times end of life fluence.
- The embrittlement curve flattens out at high fluence, therefore meaningful metallurgical data can be obtained with a fluence higher than 1.25x.
- The limitation for having fluence 1-1.25 the projected vessel fluence is too burdensome for plant operations. If a rule of thumb for plant calculated fluence is +/- 20%, then more leeway needs to be granted for capsule fluence value (recommend keeping up to 2 times SLR fluence).
- Irradiation embrittlement is primarily a fluence driven effect. The latest version of ASTM E900 identifies an embrittlement trend curve that has no consideration of flux effects. As such, time effects for surveillance data are of very minor significance. <u>Many plants have a capsule that provide fluence data that is representative of SLR conditions but was withdrawn prior to the SLR period. This data should not be discredited</u> strictly because it did not have the same time exposure as a capsule pulled within the SLR period.
- For plants with remaining capsules at higher lead factors, waiting and pulling an existing capsule in the SLR period will likely cause the capsule to have a fluence higher than 1.25, or even 2 times, the peak vessel fluence. It may be that by the time a plant makes the decision to pursue SLR, the 1.25 fluence target for the remaining capsule may have been exceeded.

XI.M31-1, Line 26, XI.M31-3, Line 13 and XI-M31-4, Line 37,

Recommends the capsule fluence be between 1 and 1.25 of the SLR peak RV fluence.

- The lead factors for some remaining capsules in some plant designs are near or below 1.
- Without significant effort, these capsules cannot be used to meet the above requirement, even if moved to a higher lead factor location; some of these capsules cannot catch-up in time to reach the SLR peak fluence.
- Embrittlement beyond 0.9 peak fluence to the peak fluence is not expected to be any different than below this point. The data to this point can be used to establish the trend per 10CFR50.61 with extrapolation to the projected peak vessel neutron fluence.
- A small extrapolation is reasonable considering that no unexpected embrittlement behavior has been identified in the extensive U.S. embrittlement data to fluences that exceed the projected SLR peak values.
- The plants with low lead factors, in general, have lower peak fluences relative to other U.S. operating plant designs.
- The fluence at the 1/4T location used for P-T curves is about two-thirds the peak ID fluence; therefore a value of 90% of the peak would still exceed the P-T curve fluence.
- The projected peak fluence data is relevant to PTS values (PWRs). The 1X requirement could be imposed for RPV materials in the surveillance program which are close to the PTS screening limit, while relaxed for surveillance materials where there is ample margin to PTS screening limits. 28°F is

recommended since this is the larger embrittlement uncertainty identified in 10CFR50.61.

- An allowable lower fluence threshold would also allow plants with a low lead factor to produce measured data sooner. Therefore, if unexpected embrittlement is encountered, the plant can make adjustments to address earlier in the SLR operational period.
- Recommend the following: "For PWRs this program includes removal and testing of at least one capsule with a neutron fluence of the capsule between one and two times the projected peak vessel neutron fluence at the end of the subsequent period of extended operation. However, for plants with an SLR capsule with a lead factor of 1.2 or less and that have a margin to the PTS screening criteria greater than 28°F for RPV materials in the surveillance program, the SLR capsule fluence can have a fluence as low as 0.9 times the projected peak vessel neutron fluence."

XI.M31-1, line 29

The wording may be confused with an SRP plant-specific aging management program. Proposed wording below is consistent with the rest of the AMP.

- Third paragraph under Program Description (line 29): As an alternative to a ~~plant-specific~~ surveillance program complying with...

XI.M31-1, M31-2 and M31-3, etc., various lines re: capsule withdrawal schedule:

It is unclear whether NRC approval of changes to the capsule testing schedule would need to be obtained prior to the submittal of the subsequent license renewal application (SLRA) or as part of the application. There is a risk that the proposed testing schedule used to support the SLRA is not approved.

Note: the next five comments are followed by a consolidated AMP mark-up for them.

Description of Change and Justification:

XI. M31 – 1 Lines 10-11 - Program Description:

In the Program Description, the sentence beginning with "because of the resulting lead factors" could be misleading. Some capsule lead factors are less than one. Therefore, they may not receive equivalent neutron fluence before the location on the inner surface of the vessel that receives the highest fluence.

- Revise to say "Surveillance capsules with a lead factor greater than one receive equivalent neutron fluence exposures earlier than the inner surface of the reactor vessel."

XI. M31 – 1 lines 7, 10 et al Program Description/ Evaluation and Technical Basis

The program uses the terms "capsules" and "specimens." Capsules are housed in surveillance capsule specimen holders or baskets. The capsules contain the surveillance specimens.

- The usage of these terms should be reviewed to ensure their proper usage.

XI. M31 – 1, lines 15-28, Program Description

The second paragraph indicates that standby capsules needed for the Appendix H program should be reinserted so that appropriate lead factors are maintained. Lead factors are fixed based on geometry.

- This sentence should be revised to say "...these should be reinserted in a location with an appropriate lead factor such that test results will bound the desired operating period."

XI. M31 – 1, lines 35-37, Program Description

The program description refers to "...sufficient material data and dosimetry to (a) monitor irradiation embrittlement to neutron fluence greater than the projected fluence at the end of the subsequent period of extended operation,..." This sentence is more complex than necessary.

- It should be clarified to say "sufficient material data and dosimetry to (a) assess irradiation embrittlement at the end of the subsequent period of extended operation,..."

XI. M31–1, Lines 38-40

GALL-SLR states "If surveillance capsules are not withdrawn during the subsequent period of extended operation, provisions are made to perform dosimetry monitoring." Industry recommends that this statement be revised to state that the presence of an in-vessel standby capsule, coupled with use of an approved fluence prediction model consistent with RG 1.190 requirements, satisfies the need for dosimetry and fluence monitoring.

XI.M31-1, lines 41-42 And XI.M31-3, lines 2-3,

The measurements are specific to Charpy V-notch 30 ft-lb transition temperature and upper-shelf energy.

- Charpy is an indirect approximation of fracture toughness. Fracture toughness measurements provide the best understanding of the RPV integrity and embrittlement. If the utility wants to make the scientifically better measure (T_0 per ASTM E1921 or upper-shelf J-R curve per ASTM E1820), they should be allowed (in fact encouraged) to.
- Recommend that irradiated T_0 and upper-shelf J-R curve measurements can optionally be measured.

XI. M31 – 2, lines 8-10, Program Description

The program description refers to "the conversion of standby capsules into the Appendix H program..." Capsules can be incorporated into the program, but they can't literally be converted into a program.

- Simplify the sentence to say "Any changes to the capsule withdrawal schedule, including the extension of the surveillance program for the period of extended operation, must be approved..."

AMP Mark-up: Program Description

Appendix H of Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix H requires implementation of a reactor vessel material surveillance program to monitor the changes in fracture toughness to the ferritic reactor vessel beltline materials which are projected to receive a peak neutron fluence at the end of the design life of the vessel exceeding 10^{17} n/cm^2 [E >1MeV]. The surveillance capsules must be located near the inside vessel wall in the beltline region so that the material specimens duplicate, to the extent practical~~greatest degree possible~~, the neutron spectrum, temperature history, and maximum neutron fluence experienced at the reactor vessel's inner surface. ~~Because of the resulting lead factors,~~ Surveillance capsules with a lead factor greater than one receive equivalent neutron fluence exposures earlier than the inner surface of the reactor vessel. This allows surveillance capsules to be withdrawn prior to the inner surface receiving an equivalent neutron fluence and therefore test results may bound the corresponding operating period in the capsule withdrawal schedule.

The surveillance program must comply with ASTM International (formerly American Society for Testing and Materials) Standard Practice E 185-82, as incorporated by reference in 10 CFR Part 50, Appendix H. Because the withdrawal schedule in Table 1 of ASTM E 185-82 is based on plant operation during the original 40-year license term, standby capsules may need to be incorporated into the Appendix H program to ensure appropriate monitoring during the subsequent period of extended operation. Surveillance capsules are designed and located to permit insertion of replacement capsules. If standby capsules will be incorporated into the Appendix H program for the subsequent period of extended operation and have been removed from the reactor vessel, these should be reinserted in a location with an ~~so that~~ appropriate lead factor~~s are maintained and~~ such that test results will bound the ~~corresponding~~ desired operating period. This program includes removal and testing of at least one capsule during the subsequent period of extended operation, with a neutron fluence of the capsule between one and one and one quarter (1.25) times the projected peak vessel neutron fluence at the end of the subsequent period of extended operation.

As an alternative to a plant-specific surveillance program complying with ASTM E 185-82, an integrated surveillance program (ISP) may be considered for a set of reactors that have similar design and operating features, in accordance with 10 CFR Part 50, Appendix H, Paragraph III.C. The plant-specific implementation of the ISP is consistent with the latest version of the ISP plan that has received approval by the U.S. Nuclear Regulatory Commission (NRC) for the subsequent period of extended operation.

The objective of this Reactor Vessel Material Surveillance program is to provide sufficient material data and dosimetry to (a) ~~monitor~~ assess irradiation embrittlement ~~to neutron fluence greater than the projected fluence~~ at the end of the subsequent period of extended operation, and (b) provide adequate dosimetry monitoring during the operational period. If surveillance capsules are not withdrawn during the subsequent period of extended operation, provisions are made to perform dosimetry monitoring.

The program ~~is a condition monitoring program that~~ measures the increase in Charpy V-notch 30 foot-pound (ft-lb) transition temperature and the drop in the upper shelf energy (USE) as a function of neutron fluence and irradiation temperature. The data from this surveillance program are ~~used to monitor neutron irradiation embrittlement of the reactor vessel, and are~~ inputs to the neutron embrittlement time-limited aging analyses ~~analysis~~ (TLAAs) described in Section 4.2 of the Standard Review Plan for Subsequent License Renewal (SRP-SLR). The Reactor Vessel Material Surveillance program is also used in conjunction with AMP X.M2, "Neutron Fluence Monitoring," which monitors neutron fluence for reactor vessel (RV) components and reactor vessel internal (RVI) components.

In accordance with 10 CFR Part 50, Appendix H, all surveillance capsules, including those previously removed from the reactor vessel, must meet the test procedures and reporting requirements of ASTM E 185-82, to the extent practicable, for the configuration of the specimens in the capsule. Any changes to the capsule withdrawal schedule, including the ~~conversion of standby capsules into the Appendix H program and~~ extension of the surveillance program for the ~~subsequent~~ period of extended operation, must be approved by the NRC prior to implementation, in accordance with 10 CFR Part 50, Appendix H, Paragraph III.B.3. Standby capsules placed in storage (e.g., removed from the reactor vessel) are maintained for possible future insertion.

XI. M31 – 2 Line 20, Scope of Program

Currently, ASTM E185 and 10CFR50 Appendix H monitor embrittlement of a vessel that exceeds 10^{17} n/cm^2 via a surveillance program for materials that were predicted to be limiting at the time of vessel construction; it is not required to have the actual limiting materials in the surveillance program. The Scope statement here says "Materials originally monitored within the licensee's existing 10 CFR Part 50, Appendix H, materials surveillance program will continue to serve as the basis for the reactor vessel surveillance aging management program (AMP) unless safety considerations for the term of the subsequent period of extended operation would require the monitoring of additional or alternative materials." Several comments:

- What are "safety considerations", how will they be determined, and when will they be determined? Could NRC Staff decide, after a plant enters SLR, that a material must be monitored in the surveillance program? It would not be possible to fabricate specimens, build and insert a capsule and achieve required fluence targets before the end of SLR in that case; would the plant have to shut down?
- No such safety considerations have ever been identified. It is inconceivable that monitoring a different or additional material would ever be necessary for safety reasons; current embrittlement trend correlations are adequate for predicting embrittlement behavior of all vessel materials. **This provision for a possible need to monitor alternate materials is unnecessary and should be deleted.**

XI.M31-2, line 28, Scope of Program

- A utility may choose to monitor materials which are limiting regarding RPV operation or safety. These may or may not be materials which were originally included in the program.
- Recommend replacing "will" with "typically".

XI.M31-2, line 25, Scope of Program

10^{17} n/cm^2 comes from Appendix H where it says that RVs with this fluence need a surveillance program. This limit has been extended as a default value for sufficient fluence for which embrittlement effects must be considered.

- This fluence is a good approximate limit below which significant embrittlement is not expected.
- TLR-RES/DE/CIB-2013-01 offers an alternate limit: "*the mean value of $\Delta T30$ estimated using an ETC* [embrittlement trend curve] *acceptable to the staff is less than 25°F at EOL. The estimate of $\Delta T30$ at EOL shall be made using best-estimate chemistry values.*" This is also a good approximate limit commensurate with the magnitude in the uncertainty of the embrittlement prediction models.
- Recommend inserting "or as recommended in TLR-RES/DE/CIB-2013-01".

Note: the next comment is followed by its AMP mark-up

<u>Description of Change and Justification:</u>

XI. M31 – 2, lines 38-39, Parameters Monitored or Inspected

This program element says the program monitors reduction of fracture toughness. Reduction of fracture toughness can be assessed, but cannot be monitored. The actual parameters monitored in this program are the parameters monitored during the testing of the surveillance specimens and the neutron dosimetry materials. We believe that would be parameters measured in the Charpy testing and the properties of the dosimetry used to determine fluence. Calculations of capsule and vessel wall fluence, while important, do not constitute parameters monitored in the program. This and much of the other discussion has nothing to do with parameters monitored.

AMP Mark-up: Parameters Monitored or Inspected

3. Parameters Monitored or Inspected:
The program ~~monitors~~ assesses reduction of fracture toughness of reactor vessel beltline materials due to neutron irradiation embrittlement, through the periodic ~~testing~~ monitoring of properties of material specimens ~~at different intervals~~ that have been irradiated in ~~the~~ surveillance capsules ~~that are a part of the program~~. The program also monitors long term operating conditions of the reactor vessel (i.e., vessel beltline operating temperature and neutron fluence) that could affect neutron irradiation embrittlement of the reactor vessel.

The program uses two parameters to monitor the effects of neutron irradiation: (a) the increase in the Charpy V-notch 30 ft-lb transition temperature and (b) the drop in the Charpy V-notch USE. The program uses neutron dosimeters to benchmark neutron fluence calculations. Low melting point elements or low melting point eutectic alloys may be used as a check on peak specimen irradiation temperature. Results from these temperature monitors are used to ensure that the exposure temperature of the surveillance capsule is consistent with the reactor vessel beltline operating temperature. ~~The Charpy V-notch specimens, neutron dosimeters, and temperature monitors are placed in capsules that are located within the reactor vessel; the capsules are withdrawn periodically to monitor the reduction in fracture toughness due to neutron irradiation.~~

~~This program includes removal and testing of at least one capsule during the subsequent period of extended operation, with a neutron fluence of the capsule between one and one and one quarter (1.25) times the projected peak vessel neutron fluence subsequent period of extended operation. Test results are required to be reported consistent with the requirements of 10 CFR Part 50, Appendix H.~~

~~Because the degree of neutron irradiation embrittlement is a function of the neutron fluence, calculations of the capsule fluence and the reactor vessel wall fluence are important parts of the program. The methods used to determine both capsule and reactor vessel wall fluence values are consistent with Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," as described in AMP X.M2, "Neutron Fluence Monitoring."~~

~~This program uses separate dosimeter capsules or ex-vessel dosimeters to monitor neutron fluence independent of the specimen capsules if there are no capsules installed in the reactor vessel.~~

XI.M31-2 and M31-5,

Many plants will need to build reconstituted capsules for SLR to conform to GALL-SLR. The draft GALL-SLR provides no guidance for the material specimen contents of the reconstituted capsules.

- It is recommended that the reconstituted capsules include base metal and weld materials and that HAZ specimens should not be required.

Note: the next three comments are followed by a consolidated AMP mark-up for them.
Description of Change and Justification:

XI. M31 – 3, lines 28-30, Detection of Aging Effects

The first paragraph refers to Element 3 as describing methods used to monitor irradiation embrittlement. This seems inappropriate as Detection of Aging Effects seems the correct program element to describe methods used for monitoring in the AMP.

XI. M31 – 4, lines 1-7, Detection of Aging Effects

Third paragraph indicates that a plant participating in an ISP is required by Appendix H to institute "a supplemental neutron monitoring program." It is not clear from the words in Appendix H that a supplemental neutron monitoring program is required in order to have an adequate dosimetry program. It would be good to include a definition of "supplemental neutron monitoring program" or to provide a reference to a regulatory standard or guideline that defines this.

XI.M31-2, lines 8-13, Detection of Aging Effects

Recommend a statement be added regarding periodic monitoring.
By design, the surveillance capsule dosimetry is withdrawn infrequently. Periodic measurements will help to confirm continued accuracy of the neutron fluence calculations. ASTM E2956-14 "Standard Guide for Monitoring the Neutron Exposure of LWR Reactor Pressure Vessels" should be referenced.

AMP Mark-up: Detection of Aging Effects

4. Detection of Aging Effects:
Reactor vessel materials are monitored by a surveillance program in which surveillance capsules are withdrawn from the reactor vessel and tested in accordance with the requirements of 10 CFR Part 50, Appendix H. The ASTM standards referenced in Appendix H describe the methods used to monitor irradiation embrittlement ~~(as described in Element 3, above)~~, selection of materials, and the withdrawal schedule for capsules. Because the withdrawal schedule in Table 1 of ASTM E185-82 is based on plant operation during the original 40-year license term, standby capsules may need to be ~~converted to testing program capsules~~ <u>tested</u> within a withdrawal schedule that <u>considers</u> ~~covers~~ the subsequent period of extended operation.

Alternatively, an ISP for the subsequent period of extended operation may be considered for a set of reactors that have similar design and operating features in accordance with 10 CFR Part 50, Appendix H, Paragraph III.C. For an ISP, in some cases the plant Reactor Vessel Material Surveillance Program may result in no surveillance capsules being irradiated in the plant's reactor vessel, with the plant relying on data from testing of the ISP capsules from the host plants of the capsules. Additional surveillance capsules may also be needed for the subsequent period of extended operation for an ISP. For ISPs, the plant-specific implementation of the ISP in the Reactor Vessel Material Surveillance program is maintained consistent with the latest version of the ISP plan that has received approval by the NRC for the subsequent period of extended operation.

If all surveillance capsules have been removed and tested, a plant may seek membership in an ISP. In addition, ~~the plant institutes a supplemental neutron monitoring program,~~ to meet the requirement of 10 CFR Part 50, Appendix H, III.C.1.b, ~~that~~ each reactor in an ISP must have ~~has~~ an adequate dosimetry program. Alternatively, this program can propose implementation of in-vessel irradiation of capsule (s) with reconstituted specimens from previously tested capsules ~~and~~ accompanied by appropriate ~~and~~ neutron monitoring.

If no invessel surveillance capsules are available, an alternative neutron monitoring program uses alternative dosimetry, either from invessel dosimetry capsules or ex-vessel capsules, to monitor neutron fluence during the subsequent period of extended operation. Guidance for performing periodic measurements to confirm the continued accuracy of the neutron transport calculations and neutron fluence projections can be found in ASTM E2956-14, "Standard Guide for Monitoring the Neutron Exposure of LWR Reactor Pressure Vessel." The methods used in this alternative neutron monitoring program-are consistent with RG 1.190, including appropriate benchmarking, as described in-AMP X.M2, "Neutron Fluence Monitoring."

XI.M31-3, lines 30-31, Detection of Aging Effects,,

- With approval of the first license renewal, few plants retain the original withdrawal schedule.
- Recommend rewording of sentence as follows: "The current withdrawal should be re-evaluated and standby capsules may need to be converted to testing program capsules within a withdrawal schedule that covers the subsequent period of extended operation."

XI.M31-4, lines 31-35, re "peak reactor vessel wall neutron fluence"

Peak wall fluence is not relevant for BWRs since they do not need to comply with the PTS Rule. The 1/4T fluence is the location of concern for BWRs.

- The SLR capsule fluence specification for BWRs should be based on 1/4T fluence, not peak RPV wall fluence.

XI.M31-4, Lines 40-45,

For an already withdrawn capsule, recommending reporting of results per 10CFR50 Appendix H has been interpreted to require reporting within 1 year of renewed license

- The data is not needed or useful as long as the RPV fluence has not exceeded a previous capsule measurement.
- Recommend changing to allow reporting any time prior to entering SLR operating period as long as previous capsule results have already been reported for a fluence greater than 60 year RPV fluence.

XI. M31 – 1, Lines 21-24,

These lines state that if standby capsules are going to be included and are not in the vessel, they shall be reinserted. However, on page XI.M31-4 (lines 40-45) it states that if a capsule has already been pulled and has enough fluence it can be tested without inserting it back into the vessel.

- These statements seem to conflict.

XI. M31 – 5 Element 5, lines 32-37

GALL-SLR: "If the plant uses an embrittlement trend curve (ETC) to determine embrittlement (such as those of RG 1.99, Rev. 2, 10 CFR 50.61, and 10 CFR 50.61a), the program ensures that the operating conditions for the reactor vessel beltline are within the applicability limits of the embrittlement trend curve with respect to parameters such as irradiation temperature, neutron fluence, and flux, or provides technical justification for exceeding these applicability limits."

- **This provision modifies the requirements of 10CFR50.61 and should be deleted**. 10 CFR 50.61 specifies the ETC to be used without consideration of several of the parameters discussed above. It is inappropriate for this guidance to modify the requirements given in 10CFR50.61.

XI.M31-5, Element 5

The GALL-SLR would require a program to have both an SLR capsule and a contingency capsule (in case the SLR capsule test results are not valid). This results in some plants having to add two capsules for SLR.

- This is an onerous requirement with negligible safety benefit, especially for plants that have already tested all capsules and will need to build new capsules. Experience does not support the proposed requirement for a contingency capsule.
- Recommend adding ", if available," after "additional capsules".

XI. M31 – 5 Lines 23

- No criteria are provided.
- Recommend adding at the end "to reestablish the program."

XI. M31 – 5 Lines 27 and 33,

- Use of "latest version" will ensure the language does not become outdated should RG 1.99 be revised.
- Recommend changing "Rev. 2" to "latest version".

XI. M31 – 6 Lines 34-36,

This part states "This program is informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience, as discussed in Appendix B of the GALL-SLR Report."

- COMMENT: What constitutes a "systematic and ongoing review"? This appears vague and not defined.

Note: the next comment is followed by an AMP mark-up for it.

Description of Change and Justification:

XI. M31 – 6, lines 1-17, Corrective Actions

This program element begins with discussion of results that do not meet the acceptance criteria. However, according to the acceptance criteria program element, there are no specific acceptance criteria that apply to the surveillance data. Corrective actions and parameters monitored and inspected discuss operating temperature, but acceptance criteria don't address operating temperature.

- There should be a clear relationship between parameters monitored, monitoring method, and acceptance criteria.

AMP Mark-up: Corrective Actions

7. Corrective Actions:
~~Results that do not meet the acceptance criteria~~ Nonconforming program activities or results are addressed as conditions adverse to quality or significant conditions adverse to quality 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 components (SCs) within the scope of this program.

Since the data from this program are used for reactor vessel embrittlement projections to comply with regulations (e.g., 10 CFR Part 50, Appendix G, requirements, and 10 CFR 50.61 or 10 CFR 50.61a limits) through the ~~subsequent~~ period of extended operation, corrective actions would be necessary if these requirements are not satisfied, or if this program fails to comply with Appendix H of 10 CFR Part 50. If plant operating characteristics exceed the operating restrictions identified previously, such as a lower reactor vessel operating temperature or a higher fluence, this program provides that the impact of actual plant operation characteristics on the extent of reactor vessel embrittlement is evaluated, and the NRC is notified.

XI. M31 – (various) Various places referring to ISP(s)

The requirements for Integrated Surveillance Programs (ISPs) outlined in XI.M31 are confusing. If an ISP has been reviewed and approved for the Subsequent License Renewal period per 10 CFR 50 Appendix H, and a plant is licensed to participate in that ISP, then guidance in a regulatory guide is not relevant. Therefore, "ISP" should be deleted from the following sentence under "Monitoring and Trending".

- "The plant-specific surveillance program ~~or ISP~~ has at least one capsule that will attain projected neutron fluence equal to or exceeding the peak reactor vessel wall neutron fluence at the end of the subsequent period of extended operation."

Attachment 6

NUREG-2191 and NUREG-2192
Structural Comments

Comments Included:

GALL-SLR Chapter II and III – SLR-SRP Chapter 3.5

GALL-SLR Chapter IX

SLR-SRP Section 3.5 Further Evaluations

-	3.5.2.2.2.6 and 3.5.3.2.2.6 Irradiation of Concrete
-	3.5.3.2.1.6 Cracking Due to Stress Corrosion Cracking
-	3.5.3.2.1.8, 3.5.3.2.2.1.2 and 3.5.3.2.2.3.2 Reaction With Aggregates
X.S1	Concrete Containment Unbonded Tendon Prestress
XI.S1	ASME Section XI, Subsection IWE
XI.S2	ASME Section XI, Subsection IWL
XI.S3	ASME Section XI, Subsection IWF
XI.S4	10 CFR 50, Appendix J
XI.S5	Masonry Walls
XI.S6	Structures Monitoring
XI.S7	Inspection of Water-Control Structures Associated With Nuclear Power Plants

SLR-SRP Table 3.5-1 and GALL Chapter II and III Line items - Comments with Plant Specific Programs and Exception for AMPs

SLR-SRP Table 3.5-1 Aging Management of Containments, Structures, and Component Supports			
#	**Location of Change**	**Description of Change**	**Justification For Change**
Generic	SLR-SRP Table 3.5-1	As written, four (4) new Plant Specific AMPs required in SLR GALL for freeze-thaw, leaching and carbonation, and reaction with aggregates mechanisms for inaccessible concrete, and increased temperatures for concrete. IWL and SMP AMPs are adequate for these aging effects-	As stated below Plant specific evaluations including, where required, any additional program activities, should be included as part of the existing applicable AMP (i.e. XI.S2 or XI.S6) instead of creating a separate program. No OE justifies separate Plant Specific AMPs for inaccessible areas for these mechanisms and no OE justifies excavation and examination of the outside concrete wall surfaces for mechanisms such as freeze-thaw, leaching and carbonation, or reaction with aggregates, or high interior surface concrete temperatures. We are unclear on acceptable options for such "Plant Specific AMPs" and this results in regulatory uncertainty.
1	SLR-SRP Table 3.5-1 item 3	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for reduction of strength and modulus of elasticity due to elevated temperature with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of a Plant Specific AMP. (See markup in Attachment 1)	Plant specific evaluations, when required, should be included as part of the applicable AMP (XI.S2 or XI.S6) instead of creating a separate program. The components in question would remain within the scope of the original AMP for managing aging effects outside of those requiring plant specific evaluations, so additional or modified inspection activities would likely be performed in conjunction with normal examinations. Recognizing this in the SRP, AMRs, and AMPs would provide the same enhanced inspections while minimizing duplications and reducing the need to address

			inconsistencies with GALL E Notes.
2	SLR-SRP Table 3.5-1 item 11	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 3 above. Generic Comment for below grade Freeze-Thaw: There is no operating experience which would indicate that freeze thaw damage is a significant concern for inaccessible below grade concrete at nuclear power plants. Accessible concrete just above grade, or at other above grade locations, subject to wetting and temperatures below freezing should see significantly more freeze-thaw cycles than below grade concrete and therefore should be considered as a leading indicator of the condition below grade concrete for this mechanism. Additionally, the soil / backfill will act as an insulating moderating influence to reduce and limit the number of cycles just below grade compared to those experienced above grade, such that, little to no freeze thaw damage will take place beyond several inches just below the surface of the soil. Uninsulated reinforced concrete at a nuclear plant would have a thermal gradient from about 75F inside the power plant to whatever equilibrium temperature is reached on the outside skin subject to some insulating properties of unsaturated soil/backfill. The SRP 3.5.3.2.1.7 paragraph includes an appropriate statement indicating that absence of freeze-thaw damage in accessible concrete should preclude the need for a plant specific program for inaccessible concrete. This accessible concrete threshold condition should be more widely applied regardless of the concrete air content and should be applied as a threshold for plant specific evaluations and any potential plant

			specific additions to existing aging management programs. In any case, examination and assessment of accessible concrete using the existing AMP is sufficient basis to also address inaccessible concrete.
3	SLR-SRP Table 3.5-1 item 12	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 3above. Generic Comment for cracking due to reaction with aggregates: Considering SLR plants are over 40 years of age and AAR, if potentially significant, would manifest significant concrete growth e.g. reduced seismic gaps, movement/changes at doors/penetrations, and additionally any such reactions should be nearly complete/complete well before the start of the second license renewal period of extended operation. Consider possible alternatives such as one time inspections/evaluations. For example if a petrographic examination finds that Akali- Silica Reaction is present but limited such that only a small percentage of the fine aggregate is reactive; it is possible that there will be no concrete damage, no resultant cracking, no growth or expansion, no effect on the physical properties of the concrete, and therefore there will be no potential for structurally significant degradation and no potential adverse effect on the intended function of the structure. Operating Experience for the only nuclear plant with potentially significant ASR identified in NRC Information Notice 2011-20 has performed examinations and evaluations with information obtained from the accessible sides of the concrete and has not found it necessary or helpful to excavate and perform a plant specific inspection program of the inaccessible areas. In

			any case, examination and assessment of accessible concrete using the existing AMP is sufficient basis to also evaluate and address inaccessible concrete.
4	SLR-SRP Table 3.5-1 item 14	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 3 above. <u>Generic comment regarding leaching and inaccessible areas</u>: Operating experience has shown that leaching has not been a major or even a significant structural concern in NPP structures approaching 40 years of operation. GALL limits leaching to a water flowing environment and defines water flowing as flowing water that is continually refreshed. EPRI TR-103842 rev. 1, section 4.1.2 states that leaching action of water can only occur if water passes through the concrete; water that merely passes over the surface of the concrete will not cause significant leaching. ACI 224.1R-07 para. 1.3.5 states that cracks transverse to reinforcement do not usually cause continuing corrosion of reinforcement, as the exposed portion of the bar at a crack acts as an anode, such that at early stages local corrosion occurs, however since oxygen and moisture is not supplied to the same or connected bars then the corrosion process is self-sealing. ACI 349.3R-02 para 4.2.8 indicates leaching occurs at locations of high moisture penetration and flow, such as cracks, and cites research indicating leaching effect depth of 3 mm to 9 mm for increase in porosity. Based on the above, examination from the accessible side where water is infiltrating is sufficient to assess any potential concerns from leaching for both the accessible side and the inaccessible side of the concrete. In any case, examination and

			assessment of accessible concrete using the existing AMP is sufficient basis to also evaluate and address inaccessible concrete.
5	SLR-SRP Table 3.5-1 item 42	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	Plant specific evaluations, when required, should be included as part of the applicable AMP (XI.S6) instead of creating a separate program. The components in question would remain within the scope of the original AMP for managing aging effects outside of those requiring plant specific evaluations, so additional or modified inspection activities would likely be performed in conjunction with normal examinations. Recognizing this in the SRP, AMRs, and AMPs would provide the same enhanced inspections while minimizing duplications and reducing the need to address inconsistencies with GALL E notes. See also above Generic Comments for the applicable mechanism.
6	SLR-SRP Table 3.5-1 item 43	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 42 above and generic comment on cracking due to expansion from reaction with aggregates.
7	SLR-SRP Table 3.5-1 item 47	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 42 and generic comment for this mechanism
8	SLR-SRP Table 3.5-1 item 48	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for reduction of strength and modulus of elasticity due to elevated temperature	See Justification for SLR-SRP Table 3.5-1 item 42 above.

		with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	
9	SLR-SRP Table 3.5-1 item 49	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 42 above, and generic comment for this mechanism.
10	SLR-SRP Table 3.5-1 item 50	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 42 above and generic comment for this mechanism.
11	SLR-SRP Table 3.5-1 item 51	Revise the SRP Table 1's and GALL AMR line items to evaluate concrete for increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 1)	See Justification for SLR-SRP Table 3.5-1 item 42 above, and generic comment for this mechanism.

SLR-GALL CHAPTER II CONTAINMENT STRUCTURES			
#	Location of Change	Description of Change	Justification For Change
1	SLR-GALL items II.A1.CP-34 II.B1.2.CP-57 II.B2.2.CP-57 II.B3.1.CP-65 II.B3.2.CP-108	Revise the GALL AMR line items to evaluate concrete for reduction of strength and modulus of elasticity due to elevated temperature with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 2)	Plant specific evaluations, when required, should be included as part of the applicable AMP (XI.S2 or XI.S6) instead of creating a separate program. The components in question would remain within the scope of the original AMP for managing aging effects outside of those requiring plant specific evaluations, so additional or modified inspection activities would likely be performed in conjunction with normal examinations. Recognizing this in the SRP, AMRs, and AMPs would provide the same enhanced inspections while minimizing duplications and reducing the need to address inconsistencies with GALL (Note E).
2	SLR-GALL items II.A1.CP-147 II.A2.CP-70 II.B3.2.CP-135	Revise the GALL AMR line items to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 2)	See SLR-GALL Chapter II #1
3	SLR-GALL items II.A1.CP-67 II.A2.CP-104 II.B1.2.CP-99 II.B2.2.CP-99 II.B3.1.CP-83 II.B3.2.CP-121	Revise the GALL AMR line items to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 2)	See SLR-GALL Chapter II #1
4	SLR-GALL items II.A1.CP-102	Revise the GALL AMR line items to evaluate concrete for increase in porosity and permeability;	See SLR-GALL Chapter II #1

	II.A2.CP-53 II.B1.2.CP-110 II.B2.2.CP-110 II.B3.1.CP-53 II.B3.2.CP-122	loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 2)	

SLR-GALL CHAPTER II CONTAINMENT STRUCTURES and SLR-GALL CHAPTER III STRUCTURES AND COMPONENT SUPPORTS			
#	**Location of Change**	**Description of Change**	**Justification For Change**
1	GALL Ch. II and III –Generic Comment	Not all previously identified line item needs were addressed i.e. concrete exposed to raw water, and SL 1 Coating exposed to treated water.	No line item exists for reinforced concrete material exposed to a raw water environment. This material and environment combination is applicable to intake structures/ultimate heat sinks, etc at virtually all plants. Similarly no line item exists for Service Level 1 Coatings exposed to a treated water environment; this material/environment combination is applicable to many containments and BWR tori and suppression pool components. NEI letter to NRC dated 08-06-14 contained this comment.
2	GALL Ch II and III and Programs, various locations	Previously offered efficiency recommendations appear not to have been addressed. NEI letter attachment to NRC dated 08-06-14 recommended combining and simplifying/reducing the number of line items. It also recommended combining several programs such as Masonry Walls and RG 1.127 and Overhead Handling with the Structures Monitoring Program. In addition, the X.S1 AMP (...Tendon Prestress) could also logically be combined with the XI.S2 (IWL) AMP.	See NEI to NRC letter and attachments dated 08-06-14

SLR-GALL CHAPTER III STRUCTURES AND COMPONENT SUPPORTS			
#	Location of Change	Description of Change	Justification For Change
1	SLR-GALL items III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108	Revise the GALL AMR line items to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	Plant specific evaluations, when required, should be included as part of the applicable AMP (XI.S6) instead of creating a separate program. The components in question would remain within the scope of the original AMP for managing aging effects outside of those requiring plant specific evaluations, so additional or modified inspection activities would likely be performed in conjunction with normal examinations. Recognizing this in the SRP, AMRs, and AMPs would provide the same enhanced inspections while minimizing duplications and reducing the need to address inconsistencies with GALL (Note E).
2	SLR-GALL items III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204 III.A5.TP-204 III.A7.TP-204 III.A8.TP-204 III.A9.TP-204	Revise the GALL AMR line items to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1
3	SLR-GALL items III.A1.TP-67 III.A2.TP-67 III.A3.TP-67 III.A4.TP-305 III.A5.TP-67 III.A7.TP-67 III.A8.TP-67 III.A9.TP-67	Revise the GALL AMR line items to evaluate concrete for increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1

4	SLR-GALL items III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114 III.A5.TP-114	Revise the GALL AMR line items to evaluate concrete for reduction of strength and modulus of elasticity due to elevated temperature with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1
5	SLR-GALL item III.A6.TP-110	Revise the SRP Table 1's and GALL AMR line item to evaluate concrete for loss of material (spalling, scaling) and cracking due to freeze-thaw with XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1
6	SLR-GALL item III.A6.TP-220	Revise the SRP Table 1's and GALL AMR line item to evaluate concrete for cracking due to expansion from reaction with aggregates with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1
7	SLR-GALL item III.A6.TP-109	Revise the SRP Table 1's and GALL AMR line item to evaluate concrete for increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation with AMP XI.S6, "Structures Monitoring" instead of Plant Specific AMP. (See markup in Attachment 3)	See SLR-GALL Chapter III #1
8	SLR-GALL item III.B1.1.TP-41	Line item III.B1.1.TP-41 should contain the same exclusionary note regarding ASTM A325, F1852, and ASTM A490 bolts as line item III.A3.TP-300 and line item III.B2.TP-300.	These changes should be made for consistency with the referenced line items, and for consistency with our comments on AMP XI.S3 regarding such bolts. In addition, such changes should be made for consistency with previous comments and dispositions as documented in NUREG 1950 for such bolts, as well as, per comments provided in NEI Letters to NRC dated 08-06-14 and 06-04-15 on this topic. The SCC

			aging mechanism is not applicable for a given same bolting material (ASTM A325 or A490) in the same environment (air-indoor uncontrolled or air-outdoor) with the same structural support application and intended function. The support classification is (such as ASME Class I or any other classification) has no bearing on the applicability or not, of SCC to a given particular material and environment and intended function combination.
9	SLR-GALL item III.B4.TP-44	Line item III.B4.TP-44 incorrectly refers to the XI.S3 AMP rather than the XI.S6 AMP.	Table B4 addresses component supports which are not ASME Class 1, 2, 3 or MC piping or component supports and are therefore not within the scope of the ASTM Section XI, Subsection IWF program. None of the other line items in this table reference the XI.S3 program.
10	SLR-GALL Ch. III, Table B5	Table B5 still exists but all line items have been deleted.	It is unknown whether this deletion was purposeful or an editorial omission. If purposeful, the table and all references to it should also be deleted and possibly some rationale or note should be added to address these changes.

Attachment 1
Mark-ups Showing Changes to the SLR-SRP Table 3.5-1
(Additions shown in underline, deletions shown in strike-through)

Table 3.5-1. Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

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	3	BWR/PWR	Concrete: dome; wall; basemat; ring girders; buttresses, concrete: containment; wall; basemat, concrete: basemat, concrete fill-in annulus	Reduction of strength and modulus of elasticity due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.2)	II.A1.CP-34 II.B1.2.CP-57 II.B2.2.CP-57 II.B3.1.CP-65 II.B3.2.CP-108
M	11	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Loss of material (spalling, scaling) and cracking due to freezethaw	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.7)	II.A1.CP-147 II.A2.CP-70 II.B3.2.CP-135
M	1	BWR/PW	Concrete	Cracking due to	~~Plant-specific~~	Yes (SRP-	II.A1.CP-67

	2	R	(inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment, concrete fill-in annulus	expansion from reaction with aggregates	~~aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	SLR Section 3.5.2.2.1.8)	II.A2.CP-104 II.B1.2.CP-99 II.B2.2.CP-99 II.B3.1.CP-83 II.B3.2.CP-121
M	1 4	BWR/PW R	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.1.9)	II.A1.CP-102 II.A2.CP-53 II.B1.2.CP-110 II.B2.2.CP-110 II.B3.1.CP-53 II.B3.2.CP-122
M	4 2	BWR/PW R	Groups 1-3, 5, 7- 9: concrete (inaccessible areas): foundation	Loss of material (spalling, scaling) and cracking due to freezethaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.1)	III.A1.TP-108 III.A2.TP-108 III.A3.TP-108 III.A5.TP-108 III.A7.TP-108 III.A8.TP-108 III.A9.TP-108
M	4 3	BWR/PW R	All Groups except Group 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.2)	III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204 III.A5.TP-204 III.A7.TP-204 III.A8.TP-204

							III.A9.TP-204
M	47	BWR/PWR	Groups 1-5, 7-9: concrete (inaccessible areas): exterior above and below-grade; foundation	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.1.4)	III.A1.TP-67 III.A2.TP-67 III.A3.TP-67 III.A4.TP-305 III.A5.TP-67 III.A7.TP-67 III.A8.TP-67 III.A9.TP-67
M	48	BWR/PWR	Groups 1-5: concrete: all	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.2)	III.A1.TP-114 III.A2.TP-114 III.A3.TP-114 III.A4.TP-114 III.A5.TP-114
M	49	BWR/PWR	Groups 6 - concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.3.1)	III.A6.TP-110
M	50	BWR/PWR	Groups 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.3.2)	III.A6.TP-220
M	51	BWR/PWR	Groups 6: concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes (SRP-SLR Section 3.5.2.2.2.3.3)	III.A6.TP-109

Attachment 2
Mark-ups Showing Changes to the SLR-GALL Chapter II
(Additions shown in underline, deletions shown in strike-through)

Chapter II Containment Structures								
New (N), Modified (M), Deleted (D) Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
M	II.A1.CP-34	3.5-1, 3	Concrete: dome; wall; basemat; ring girders; buttresses	Concrete	Air – indoor uncontrolled, air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B1.2.CP-57	3.5-1, 3	Concrete: containment; wall; basemat	Concrete	Air – indoor Uncontrolled, air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B2.2.CP-57	3.5-1, 3	Concrete: containment; wall; basemat	Concrete	Air – indoor uncontrolled, air –	Reduction of strength and modulus due to elevated	~~Plant-specific aging management program~~ AMP	Yes

					outdoor	temperature (>150°F general; >200°F local)	XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	
M	II.B3.1.CP-65	3.5-1, 3	Concrete: Basemat, concrete fill-in annulus	Concrete	Air – indoor uncontrolled, air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B3.2.CP-108	3.5-1, 3	Concrete: dome; wall; basemat	Concrete	Air – indoor uncontrolled, air – outdoor	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.A1.CP-147	3.5-1, 11	Concrete (inaccessible areas): dome; wall; basemat; ring	Concrete	Air – outdoor, ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL"	Yes

			girders; buttresses				and/or AMP XI.S6, "Structures Monitoring"	
M	II.A2.CP-70	3.5-1, 11	Concrete (inaccessible areas): basemat	Concrete	Air – outdoor, ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B3.2.CP-135	3.5-1, 11	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Air – outdoor, ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.A1.CP-67	3.5-1, 12	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures	Yes

							Monitoring"	
M	II.A2.CP-104	3.5-1, 12	Concrete (inaccessible areas): basemat;	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B1.2.CP-99	3.5-1, 12	Concrete (inaccessible areas): containment; wall; basemat;	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B2.2.CP-99	3.5-1, 12	Concrete (inaccessible areas): containment; wall; basemat;	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B3.1.CP-83	3.5-1, 12	Concrete (inaccessibl	Concret e	Any environment	Cracking due to expansion from	~~Plant-specific aging~~	Yes

			e areas): basemat, concrete fill-in annulus			reaction with aggregates	~~management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	
M	II.B3.2.CP-121	3.5-1, 12	Concrete (inaccessible areas): dome; wall; basemat;	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.A1.CP-102	3.5-1, 14	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.A2.CP-53	3.5-1, 14	Concrete (inaccessible areas): basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of	~~Plant-specific aging management program~~ AMP XI.S2, "ASME	Yes

						calcium hydroxide and carbonation	Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	
M	II.B1.2.CP-110	3.5-1, 14	Concrete (inaccessible areas): containment; wall; basemat;	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B2.2.CP-110	3.5-1, 14	Concrete (inaccessible areas): containment; wall; basemat;	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes
M	II.B3.1.CP-53	3.5-1, 14	Concrete (inaccessible areas): basemat;	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP	Yes

							XI.S6, "Structures Monitoring"	
M	II.B3.2.CP-122	3.5-1, 14	Concrete (inaccessible areas): dome; wall; basemat	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S2, "ASME Section XI, Subsection IWL" and/or AMP XI.S6, "Structures Monitoring"	Yes

Attachment 3
Mark-ups Showing Changes to the SLR-GALL Chapter III
(Additions shown in underline, deletions shown in strike-through)

Chapter III Structures and Component Supports								
New (N), Modified (M), Deleted (D) Item	**Item**	**SRP Item (Table, ID)**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/Mechanism**	**Aging Management Program (AMP)/TLAA**	**Further Evaluation**
M	III.A1.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ <u>AMP XI.S6, "Structures Monitoring"</u>	Yes
M	III.A2.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ <u>AMP XI.S6, "Structures Monitoring"</u>	Yes
M	III.A3.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ <u>AMP XI.S6, "Structures Monitoring"</u>	Yes
M	III.A5.TP-108	3.5-1, 42	Concrete (inaccessible areas):	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~	Yes

			foundation				AMP XI.S6, "Structures Monitoring"	
M	III.A7.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A8.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A9.TP-108	3.5-1, 42	Concrete (inaccessible areas): foundation	Concrete	Air – outdoor, Ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A1.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A2.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6,	Yes

							"Structures Monitoring"	
M	III.A3.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A4.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A5.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A7.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A8.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures	Yes

							Monitoring"	
M	III.A9.TP-204	3.5-1, 43	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A1.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A2.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A3.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A4.TP-305	3.5-1, 47	Concrete	Concret	Water –	Increase in	~~Plant-specific~~	Yes

			(inaccessible areas): exterior above- and below-grade; foundation	e	flowing	porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~aging management program~~ AMP XI.S6, "Structures Monitoring"	
M	III.A5.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A7.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A8.TP-67	3.5-1, 47	Concrete (inaccessible areas): exterior above- and below-grade; foundation	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A9.TP-67	3.5-1, 47	Concrete	Concret	Water –	Increase in	~~Plant-specific~~	Yes

			(inaccessible areas): exterior above- and below-grade; foundation	e	flowing	porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~aging management program~~ AMP XI.S6, "Structures Monitoring"	
M	III.A1.TP-114	3.5-1, 48	Concrete: all	Concrete	Air – indoor uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A2.TP-114	3.5-1, 48	Concrete: all	Concrete	Air – indoor uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A3.TP-114	3.5-1, 48	Concrete: all	Concrete	Air – indoor uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A4.TP-114	3.5-1, 48	Concrete: all	Concrete	Air – indoor uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes

M	III.A5.TP-114	3.5-1, 48	Concrete: all	Concrete	Air – indoor uncontrolled	Reduction of strength and modulus due to elevated temperature (>150°F general; >200°F local)	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A6.TP-110	3.5-1, 49	Concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Concrete	Air – outdoor, ground water/soil	Loss of material (spalling, scaling) and cracking due to freeze-thaw	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A6.TP-220	3.5-1, 50	Concrete (inaccessible areas): all	Concrete	Any environment	Cracking due to expansion from reaction with aggregates	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes
M	III.A6.TP-109	3.5-1, 51	Concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Concrete	Water – flowing	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	~~Plant-specific aging management program~~ AMP XI.S6, "Structures Monitoring"	Yes

GALL-SLR Chapter IX Comments

IX.B Use of Terms for Structures and Components

Description of Change and Justification (Basis)

1. The term and usage added to this document, page IX B-2 and IX B-3, for "Inaccessible Areas of Structural Components for non-ASME structural AMPs" should be deleted. It is new and not needed. There is no similar definition for ASME AMPs. This addition with the wording chosen in context of the sentence statement could lead to regulatory uncertainty and questions such as do coatings have to be removed, etc.

   No Markup is provided as the recommendation is to delete this unnecessary definition.

IX.F Significant Aging Mechanisms

Description of Change and Justification (Basis):-

1. Term and Usage in this document, page IX F-4: Please leave intact the Term "Deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)". The definition "Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects" is used throughout GALL-SLR, but lacks an associated Term. Furthermore, the term and its described usage are useful for the means of appropriately addressing aging of seals, gaskets, and moisture barriers.

Markup: Page IX F-4

IX.F Use of Terms for Aging Mechanisms	
Term	**Usage in this document**
Deterioration of seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)	~~Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants) are subject to loss of sealing and leakage due to containment caused by aging degradation of these components.~~ Loss of sealing due to wear, damage, erosion, tear, surface cracks, other defects.

SLR-SRP Section 3.5, Subsections SRP 3.5.2.2.2.6, and 3.5.3.2.2.6 (FE Irradiation of Concrete)			
#	**Location of Change**	**Description of Change**	**Justification For Change**
	SLR-SRP Pages 3.5-6, -7, and -15; SRP Sections 3.5.2.2.2.6, and 3.5.3.2.2.6	The recommendation should not be as prescriptive. It is recommended that plant specific concrete fluence calculations should not necessarily be required for all plants since options including allowing consideration of industry (EPRI) evaluations of this aging effect, as well as, bounding screening evaluations such as for BWR's will be available. An EPRI research Report on this topic is scheduled to be published in 2016. Internal concrete heating due to neutron or gamma radiation should not be included in the further evaluation for this aging effect.	This potential aging effect is unlikely to impact BWRs, and may only impact portion of PWR fleet (approximately 11 plants) based on EPRI and DOE research and recent presentations. These plant specific calculations or evaluations have already been provided by EPRI. BWR reactor shield or sacrificial shield concrete is based on shielding (not for strength, as concrete is encased in thick structural steel plates) and BWR reactor vessel pedestal structure concrete and the reactor cavity above the BWR containment head (mentioned elsewhere) are located such that high fluence levels should not be a factor. An EPRI research Report on this topic is scheduled to be published in 2016. Internal heating due to neutron or gamma radiation is a more immediate (small) potential temperature effect (as opposed to the long term fluence aging mechanism that may only affect some plants beyond 60 years) and it should not be an aging mechanism to be addressed, since it is not a current CLB issue. (See EPRI Report TR 3002002676 for additional information)

Attachment 1
Mark-ups Showing Changes to the SRP 3.5.2.2.2.6, and 3.5.3.2.2.6 (Additions shown in underline)

SRP 3.5.2.2.2.6, and 3.5.3.2.2.6, pages Page 3.5-6, -7, and -14

Further evaluation is recommended of a plant-specific program or program addition to manage reduction of strength, loss of mechanical properties, and of concrete due to irradiation in certain PWR and possibly BWR Group 4 concrete structures, exposed to high levels of neutron and gamma radiation. These structures include the reactor (primary/biological) shield wall~~, the~~ or sacrificial shield wall, and the reactor vessel support/pedestal structure. The irradiation mechanism consists of radiation interactions with the material ~~and heating~~ due to absorption of radiation energy ~~at the operating temperature experienced~~ by the concrete. The intensity of radiation is typically characterized by the measure of its field or fluence. ~~Both neutron and gamma radiation produce internal heating from absorption of radiation energy and, a~~At high fluence levels, changes in microstructure and certain mechanical properties of concrete (e.g., compressive strength, tensile strength, modulus of elasticity) from radiation interactions with the material are possible. Limited data are available in the open literature related to the effects and significance of radiation fluences (neutron and gamma radiation) on intended functions of concrete structures, especially for conditions (dose, temperature, etc.) representative of existing LWR plants. However, based on literature review of existing research, fluence limits of 1×10^{19} neutrons/cm2 neutron radiation and 1 × 108 Gy [1×10^{10} rad] gamma dose are considered *conservative radiation exposure levels beyond which concrete material properties may begin to degrade markedly.*

Plant-specific calculations/analyses should be performed to identify the neutron (fluence cutoff energy E > 0.1 MeV) and gamma fields that develop in any portion of the concrete structures of interest at 80 years of operation and compare them to the above threshold limits, unless the unit type can be screened as not subject to such high fluence effects or unless the concrete is primarily for shielding and steel shells are provided for strength as in typical BWR Bio-Shield designs . The impact of any plant-specific operating experience of concrete irradiation effects on intended functions are evaluated. The reviewer reviews these analyses, operating experience and supporting technical basis (e.g., calculations, test data, industry research, plant specific evaluations) on a case-by-case basis. Higher fluence or dose levels may be allowed in the concrete if tests and/or calculations are provided to evaluate the reduction in strength and/or change in mechanical properties of concrete, if any, from those fluence levels and the effects are applied to the design calculations. The reviewer confirms that the applicant's discussion in the SLRA indicates that the affected PWR and BWR concrete components are not exposed to neutron and gamma radiation fluence levels that exceed the threshold limits, or are otherwise evaluated, for example, that the concrete is primarily for shielding such as in a BWR Bio-shield . The reviewer also confirms that the impact of any plant-specific operating experience of concrete irradiation degradation on intended functions is addressed. If the limits are exceeded, the technical basis (i.e., tests and/or calculations/evaluations) provided by the applicant to justify higher fluence or dose limits is reviewed. Otherwise, the applicant's proposed plant-specific program or program addition or plant specific evaluation and the supporting technical basis is reviewed to ensure that the effects of irradiation on the concrete components will be adequately managed during the subsequent period of extended operation.

SLR-SRP Section 3.5, Subsections SRP 3.5.3.2.1.6, Cracking Due to Stress Corrosion Cracking			
#	**Location of Change**	**Description of Change**	**Justification For Change**
	SLR-SRP Pages 3.5-10, SRP Section 3.5.3.2.1.6	See Comment 3 on XI.S1 AMP. Only require supplemental surface examinations at penetrations and bellows without fatigue analyses.	Surface examinations (dye-penetrant examinations) of stainless steel and dissimilar metal welds of penetration sleeves are not required by the ASME Section XI, Subsection IWE Code or 10 CFR 50.55a. The 1992 ASME Code edition Subsection IWE required surface examination of dissimilar metal welds only, not stainless steel sleeves, etc. This previous requirement from the 1992 Edition of the code was eliminated from the 1998 version of the code Subsection IWE, and was evaluated and accepted by NRC as documented in the "Resolution of Public Comments Subsection IWE" based on a lack of any particular problem with stainless steel to low carbon welds in other systems in the plants. 10 CFR50.55a(b)(2)(x)(C) issued at that time made the examination of pressure retaining welds and pressure retaining dissimilar metal welds optional. Since there has been no additional applicable Operating Experience identified or cited to require surface examination for any of these components excepting possibly bellows, these

			recommendations should be eliminated or at least made applicable only to components subject to cyclic loading without a CLB fatigue analysis with the optional provision to use Appendix J examination as an alternative to surface examination as per NUREG-1801 recommendations.

Attachment 4
Mark-ups Showing Changes to the SRP 3.5.3.2.1.6 (Additions shown in underline)

SRP 3.5.3.2.1.6, Page 3.5-10

3.5.3.2.1.6 Cracking Due to Stress Corrosion Cracking
Further evaluation is recommended of programs to manage cracking due to SCC for SS penetration sleeves, dissimilar metal welds, and penetration bellows in all types of PWR and BWR containments <u>when conditions such as a corrosive environment are present</u>. ~~Transgranular stress corrosion cracking (TGSCC) is a concern for dissimilar metal welds.~~ In the case of bellows assemblies, SCC may cause aging effects ~~particularly~~ if the material is not shielded from a corrosive environment. Containment inservice inspection (ISI) IWE <u>(such as only VT-3)</u> ~~and leak rate testing~~ may not be sufficient to detect cracks~~, especially for dissimilar metal welds~~. Additional appropriate examinations to detect SCC in <u>2-ply</u> bellows assemblies ~~and dissimilar metal welds~~ are recommended <u>when a corrosive environment is present or a CLB fatigue analysis does not exist</u>~~to address this issue~~. The reviewer reviews and evaluates the applicant's <u>evaluation and any</u> proposed program~~s~~ <u>addition</u> to confirm that adequate inspection methods will be implemented <u>where necessary</u> to ensure that cracks are detected.

Note: It is also recommended that corresponding changes be made to 3.5.2.2.1.6 to eliminate mention of dissimilar metal welds from the last sentence.

SLR-SRP Section 3.5, Subsections SRP 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2 (FE Reaction with Aggregates)			
#	**Location of Change**	**Description of Change**	**Justification For Change**
	SLR-SRP Pages 3.5-11, -12, -13, -14; SRP Sections 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2	There is a need to add a significance threshold to the FE Review Procedures for Cracking due to Reaction with Aggregates (SRP 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2). These sections should have wording such as in 3.5.2.2.1.8, "is not significant if it is demonstrated that the in-place concrete can perform its intended function" or if it is determined that AAR "in accessible areas has no impact on the intended function of the concrete structure" (as per for leaching in SRP 3.5.3.2.1.9), then No Plant Specific evaluation or AMP is required.	Added wording is necessary to add a significance threshold and to be consistent with other SRP review procedures referenced i.e. SRP 3.5.2.2.1.8, and 3.5.3.2.1.9. Considering SLR plants are over 40 years and AAR, if potentially significant, would manifest significant concrete growth e.g. reduced seismic gaps, movement/changes at doors/penetrations, and any reactions should be nearly complete/complete – consider possible alternatives such as one time inspections/evaluations. For example if petrographic examination finds that Akali- Silica Reaction is present but limited such that only a small percentage of the fine aggregate is reactive; it is possible that there will be no concrete damage, no resultant cracking, no growth or expansion, no effect on the physical properties of the concrete, and therefore there will be no potential for structurally significant degradation and no potential adverse effect on the intended function of the structure. Recommend that the wording "an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas is adequately managed", should be reworded clarifying that inspection of accessible areas is adequate for managing inaccessible areas. No OE warrants doing anything different or focused on inaccessible

			areas. The relevant Operating Experience for the only nuclear plant with potentially significant ASR identified in NRC Information Notice 2011-20 has performed examinations and evaluations with information obtained from the accessible sides of the concrete and has not found it necessary or helpful to excavate and perform an inspection program of the inaccessible areas as per SRP 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2 wording that "an effective inspection program has been developed and implemented to ensure that this aging effect in inaccessible areas is adequately managed".

Attachment 5
Mark-ups Showing Changes to the SRP 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2
(Additions shown in underline)

SRP 3.5.3.2.1.8, 3.5.3.2.2.1.2, and 3.5.3.2.2.3.2 , pages Page 3.5-11, -12, -13, -14

Further evaluation is recommended of programs to manage cracking due to expansion and reaction with aggregates in inaccessible areas of concrete elements of PWR and BWR concrete and steel containments. A plant-specific evaluation and possible additions to an AMP ~~is~~ may be necessary if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or (2) visual inspections of accessible concrete have identified indications of aggregate reactions, such as "map" or "patterned" cracking or the presence of reaction byproducts (e.g., alkali-silica gel). The reviewer confirms that the applicant has not identified one of the above conditions, or that it has been demonstrated or determined that reaction with aggregates in accessible areas is not significant as it has no impact on the intended function of the concrete structure. Otherwise, the reviewer reviews the applicant's proposed additions to the AMP or plant specific evaluation to verify that, where appropriate, an effective evaluation, monitoring or inspection program has been developed and implemented to ensure that this aging effect ~~in inaccessible areas~~ is adequately managed monitored or evaluated.

SLR-SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR			
#	Location of Change	Description of Change	Justification For Change
1	XI.S1- IWE program (from pages 3.0-45 & 46)	1. Leak rate testing should be deleted. 2. References to liner bulges should be deleted. 3. The additional supplemental surface examinations need more detail. 4. Generic requirements for volumetric examinations of areas only accessible from one side should be deleted. 5. The statement about surface examination of structural bolting should be deleted.	1. The Appendix J program addresses leak rate testing. The IWE mentions leak rate testing where visual or surface examinations may not be adequate but does not contain the same level of detail as the Appendix J program. 2. See other comments for more detailed justification. In general, liner bulges are a normal result of a liner plate and there is no OE to indicate that liner bulges are an indication of corrosion. 3. It appears that some words were missing. 4. See other comments for more detailed justification. In general, this is beyond the Code, there is no relevant OE to justify this additional work. 5. This appears to be in error, as volumetric examination has been recommended to detect cracking where applicable of structural bolting, surface examination (PT or MT) is impractical for threaded areas and would require removal of bolts, also too much detail for AMP summary.
2	XI.S2- IWL program (from pages 3.0-46)	1. Change RG 1.35 to RG 1.35.1. 2. Note that ACI 349.3R Chapter 5 is a criteria to determine the level of evaluation required for examination results.	1. Lift off forces are calculated using RG 1.35.1 (refer to the GALL table for consistency). 2. See other comments for more detailed justification. In general, ACI 349.3R Chapter 5 is an evaluation criteria.
3	XI.S3- IWF program (from pages 3.0-46)	1. Delete the addition of 5% more supports to the scope of the program. 2. Add a clarification that volumetric examination of A325 and A490 bolts for cracking is not required.	1. See other comments for more detailed justification. In general, this is beyond the scope of the ASME Code, Section XI and 10 CFR 50.55a, and there is no relevant OE to justify this additional requirement. 2. See other comments for more detailed justification. In general, these bolt materials are carbon steel bolting materials not susceptible to SCC.

SLR-SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR			
4	XI.S6- Structures Monitoring (from page 3.0-47)	1. Delete the reference to coatings. 2. Delete excessive detail with respect to recording results.	1. This comment is addressed in more detail under other comments for the AMP. In general, the condition provides little useful information regarding the underlying coating, except potentially for coating blisters due to corrosion of carbon steel. 2. This comment is addressed in more detail under other comments for the AMP. In general, the requirement is too broad to apply quantitative measurements and trending to all applicable parameters monitored or inspected since not all parameters lend themselves to quantitative measurements and not all parameters can be usefully trended.
5	XI.S7- Inspection of Water-Control Structures Associated with Nuclear Power Plants (from page 3.0-47 and 48)	Delete the phrase "for all applicable parameters monitored or inspected".	This comment is addressed in more detail under other comments for the AMP. In general, the requirement is too broad to apply to quantitative measurements to all applicable parameters monitored or inspected since not all parameters lend themselves to quantitative measurements and not all parameters can be usefully trended.
6	XI.S8- Protective Coating Monitoring and Maintenance (from page 3.0-48)	Delete information referring to design purposes of Service Level 1 protective coatings.	The design purposes of coatings with respect to potential corrosion protection or decontamination are not relevant for this aging management program, which is intended to post-accident operability of ECCS. Other sections of the UFSAR would be the appropriate place to address the design purposes of the coatings, if necessary and accurate. This section is intended to describe aging management programs, not the design purposes of coatings.
7	X.S1- Concrete Containment Tendon Prestress (from pages 3.0- 50 & 51)	Allow for corrective actions to maintain the minimum required prestressing force.	Containment tendon prestress force monitoring programs allow and require corrective actions to maintain the minimum required prestress force, as required. The programs are not limited to only analytical justification of the trend line.

Attachment 6
Mark-up Changes to the SLR-SRP Table 3.0-1
(Strikethrough for deletions and underline for additions)

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL- SLR Report and SRP-SLR Chapter**
XI.S1 (from pages 3.0-45 & 46)	ASME Section XI, Subsection IWE Inservice Inspection (IWE)	This program is in accordance with ASME Section XI, Subsection IWE, consistent with 10 CFR 50.55a "Codes and standards," with supplemental recommendations. The AMP includes periodic visual, surface, and volumetric examinations, ~~and leak rate testing,~~ where applicable, of metallic pressure-retaining components of steel containments and concrete containments for signs of degradation, damage, irregularities ~~including liner plate bulges~~, and for coated areas distress of the underlying metal shell or liner, and corrective actions. Acceptability of inaccessible areas of steel containment shell or concrete containment steel liner is evaluated when conditions found in accessible areas, indicate the presence of, or could result in, flaws or degradation in inaccessible areas. This program also includes aging management for the potential loss of material due to corrosion in the inaccessible areas of the BWR Mark I steel containment~~, and surface examination for the detection of cracking of structural bolting~~. In addition, the program includes supplemental surface or enhanced examinations to detect cracking for stainless steel portions of containment penetrations where there is no fatigue analysis ~~specific components [identify components], and supplemental volumetric examinations by sampling locations susceptible to loss of thickness due to corrosion of containment shell or liner that is~~	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL- SLR Report and SRP-SLR Chapter**
		~~inaccessible from one side~~. Inspection results are compared with prior recorded results in acceptance of components for continued service.		
XI.S2 (from page 3.0- 46)	ASME Section XI, Subsection IWL Inservice Inspection (IWL)	This program consists of (a) periodic visual inspection of concrete surfaces for reinforced and pre-stressed concrete containments, (b) periodic visual inspection and sample tendon testing of un-bonded post-tensioning systems for pre-stressed concrete containments for signs of degradation, assessment of damage, and corrective actions, and testing of the tendon corrosion protection medium and free water. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1 ~~RG 1.35~~. The Subsection IWL requirements are supplemented to include quantitative acceptance criteria for evaluation of concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R.	SLR program is implemented prior to the subsequent period of extended operation.	GALL II / SRP 3.5
XI.S3 (from page 3.0- 46)	ASME Section XI, Subsection IWF Inservice inspection (IWF)	This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR Part 50.55a ASME Section XI, Subsection IWF program. ~~This includes inspections of an additional 5 percent of supports outside of the existing IWF sample population.~~ For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be performed to detect cracking in addition to the VT-3 examination.	SLR program is implemented prior to the subsequent period of extended operation.	GALL II / SRP 3.5 GALL III / SRP 3.5

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL- SLR Report and SRP-SLR Chapter**
		However, ASTM A325 and ASTM A490 bolts (or equivalent) used in civil and support structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications when used in support structures. If a component support does not exceed the acceptance standards of IWF-3400 but is electively repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.		

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL- SLR Report and SRP-SLR Chapter**
XI.S6 (from page 3.0- 47)	Structures Monitoring	This program consists of periodic visual inspection and monitoring the condition of concrete and steel structures, structural components, component supports, and structural commodities to ensure that aging degradation (such as those described in ACI 349.3R, ACI 201.1R, SEI/ASCE 11, and other documents) will be detected, the extent of degradation determined, evaluated, and corrective actions taken prior to loss of intended functions. Inspections also include seismic joint fillers, elastomeric materials; and steel edge supports and steel bracings associated with masonry walls, and periodic evaluation of groundwater chemistry and opportunistic inspections for the condition of below grade concrete~~, and of protective coatings for substrate materials~~. Quantitative results (measurements) and qualitative data from periodic inspections are trended for significant findings with photographs and surveys for the type, severity, extent, and progression of degradation. The acceptance criteria are derived from applicable consensus codes and standards. For concrete structures, the program includes personnel qualifications and quantitative acceptance criteria of ACI 349.3R.	SLR program is implemented prior to the subsequent period of extended operation.	GALL VII / SRP 3.3 GALL II / SRP 3.5 GALL III / SRP 3.5 GALL VI / SRP 3.6

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL- SLR Report and SRP-SLR Chapter**
XI.S7 (from page 3.0- 47 and 48)	Inspection of Water-Control Structures Associated with Nuclear Power Plants	This program consists of inspection and surveillance of raw-water control structures associated with emergency cooling systems or flood protection. The program also includes structural steel and structural bolting associated with water-control structures. In general, parameters monitored should be in accordance with Section C.2 of R.G. 1.127 and quantitative measurements should be recorded ~~for all applicable parameters monitored or inspected~~. Inspections should occur at least once every 5 years. Structures exposed to aggressive water require additional plant-specific investigation.	SLR program is implemented prior to the subsequent period of extended operation.	GALL III / SRP 3.5
XI.S8 (from page 3.0- 48)	Protective Coating Monitoring and Maintenance	This program ensures that a monitoring and maintenance program implemented in accordance with RG 1.54 is adequate for the subsequent period of extended operation. The program consists of guidance for selection, application, inspection, and maintenance of protective coatings~~. Maintenance of Service Level I coatings~~ applied to carbon steel and concrete surfaces inside containment (e.g., steel liner, steel containment shell, structural steel, supports, penetrations, and concrete walls and floors) ~~serve to prevent or minimize loss of material due to corrosion of carbon steel components and aids in decontamination~~. Degraded coatings in the containment are assessed periodically to ensure post-accident operability of the ECCS.	SLR program is implemented prior to the subsequent period of extended operation.	GALL III / SRP 3.5

SRP Table 3.0-1. FSAR Supplement for Aging Management of Applicable Systems for SLR				
AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL- SLR Report and SRP-SLR Chapter
X.S1 (from pages 3.0- 50 & 51)	Concrete Containment Tendon Prestress	The prestressing unbonded tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the unbonded tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force analysis and evaluation has been completed and determined to remain within allowable limits to the end of the subsequent period of extended operation, ~~and~~ or corrective actions implemented to ensure that the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.		

SLR-SRP Section 4.5			
#	**Location of Change**	**Description of Change**	**Justification For Change**
1	Tendon Prestress Analysis, Section 4.5.1, Page 4.5-1, lines 10 & 11	Clarify the OE references to no longer indicate that all OE shows a loss of prestress higher than predicted and refer to IN 99-10 that provides the background for the OE reference. The GALL description for the OE with respect to loss of tendon prestress in AMP X.S1, Element #10 should be used in order to be consistent.	Not all plants lost tendon prestress at a rate higher than predicted due to elevated temperatures, for reasons such as a lack of exposure to elevated temperatures higher than anticipated and the original model for loss of tendon prestress adequately accounted for any higher temperatures. The OE characterization does not reflect the current OE at operating plants where the loss of prestress is less than predicted. IN 99-10 refers to only a few plants within the early 20 years of initial operation. The predictions for loss of prestress have been corrected to reflect elevated temperatures, where needed, to accurately predict the loss of prestress. Loss of prestress at greater than predicted has not been the experience at most plants and is certainly not the experience of the such plants approaching the PEO. In any event, the rate of prestress loss, which decreases over time, will be very low during the period of SLR (years 60-80).

Attachment 7
Mark-up Changes to the SLR-SRP
(Strikethrough for deletions and underline for additions)

From SRP Page 4.5-1,

4.5.1 Areas of Review

The prestressing tendons in prestressed concrete containments undergo losses in prestressing forces with time due to creep and shrinkage of concrete and relaxation of the prestressing steel. During the design phase, engineers estimated these losses to the end of the prestressed containment operating life, normally 40 years. Operating experiences with the trend of prestressing forces indicate the prestressing tendons may lose their prestressing forces at a rate higher than predicted due to sustained high temperature. Thus, the applicant's plant-specific operating experience is reviewed and evaluated in detail for the subsequent period of extended operation. Applicable portions of the experience with prestressing systems described in NRC IN 99-10 could be useful. In addition, loss of prestress or reduction in tendon force can occur due to breakage of tendon wires or improper anchorages. Stress corrosion cracking (SCC) in individual tendons can also occur and contribute to the loss of tendon prestress if there is a susceptible material and environment combination. Moreover, consideration should be given to an increased tendon relaxation when replacing existing in service tendons with new. Thus, it is necessary to ensure that the applicant addresses existing Time Limited Aging Analyses (TLAAs) for the subsequent period of extended operation. Plant specific TLAAs regarding loss of prestress [e.g., predicted tendon prestress force lower limit–predicted lower limit (PLL), bonded tendons] are addressed and reviewed in Section 4.7, "Other Plant-Specific Time-Limited Aging Analyses."

SLR GALL X.S1 Concrete Containment Unbonded Tendon Prestress

Description of Change and Justification (Basis):-

Elements 5 and 6, pages X.S1-1 and X.S1-2: The new SLR GALL recommendation/requirement for creation of a group PLL line and comparison of the group trend lines to a PLL line is not required by code, not supported by operating experience, and the ability to effectively implement this concept is questionable, and the value of such a comparison is not readily apparent. Comparison of individual tendon lift off forces to individual tendon PLL values and MRV is required by the IWL code. Given that the construction of the lines is based on a bilinear function that is meant to approximate a phenomenon that can be considered to follow a diffusion equation, i.e., a curve that asymptotically approaches zero change, and that the majority of prestress losses occur in the first 5 years, the crossing of PLL and regression analysis trending lines between 60-80 years is much less important than projecting the regression analysis trend line versus the MRV line, as is required by the Code. We agree that a comparison to the PLL is very important early in plant life, but consider that such PLL comparison is not as important once we are in years 60-80 where the loss of prestress is approaching zero. The recommendation for creation of and comparison of the group trend lines to a PLL line is not required by code and is of questionable value. Once in SLR the rate of prestress loss will be very small and will likely be less than the ability to effectively measure the loss of prestress. The additional work to take the existing predicted lower limit values calculated for each individual tendon at various points in time and plot them and develop a group PLL (Trend) Line is an exercise of questionable value the need for which is not supported by operating experience and is not required by the IWL code. A previous comment on this topic was included in the attachment to NEI Letter to NRC dated 06-04-15. It is recommended that this PLL line recommendation/requirement be eliminated from the draft SLR GALL X.S1 AMP and associated sections of the GALL Table X-01 program description and SRP Table 3.0-1 Table for X.S1 and for SRP 4.5. Note that this comment was previously made in the attachment to NEI Letter to NRC dated 08-06-14.

Markup pages X.S1-1 and X.S1-2

5. ***Monitoring and Trending***: ~~In addition to Subsection IWL examination requirements, the estimated and all~~ Measured prestressing forces up to the current examination are plotted against time. The ~~predicted lower limit (PLL) line, MRV, and~~ trend lines are developed for each tendon group examined, for the subsequent period of extended operation. The trend line represents the general variation of prestressing forces with time based on the actual measured forces in individual tendons of the specific tendon group. The trend line for each tendon group is constructed by regression analysis of all measured prestressing forces in individual tendons of that group obtained from all previous examinations. The ~~PLL line, MRV, and~~ trend line for each tendon group are projected to the end of the subsequent period of extended operation. The trend lines are updated at each scheduled examination and compared with the MRV (Minimum Required Value).
6. Acceptance Criteria: The prestressing force trend line (constructed as indicated in the Monitoring and Trending program element) for each tendon group must indicate that existing prestressing forces in the concrete containment tendon would not fall below the ~~appropriate MRV prior to the next scheduled examination. If the trend line crosses the~~

~~PLL line, its cause should be determined, evaluated and corrected. The trend line crossing the PLL line is an indication that the existing prestressing forces in concrete containment could fall below the MRV~~. Any indication in the trend line that the overall prestressing force in any tendon group(s) could potentially fall below the MRV during the subsequent period of extended operation is evaluated, the cause(s) is/are documented, and corrective action(s) is/are performed in a timely manner.

XI.S1 ASME Section XI, Subsection IWE

__Description of Change and Justification:__

1) **Emphasis on UT of Containment shell or liner surfaces inaccessible from one side and not subject to degradation – Recommend requiring no additional UT examinations beyond what is code required and per 10CFR50.55a for steel liners.**

Page # XI.S1-1, lines 29-32, Program Description; **Page #** XI.S1-4, lines 8-15, Element # 4, Detection

Description of Change:
Delete volumetric examination of metal shell or liner surfaces that are inaccessible from one side.

Basis:
The recommendations for UT of liner areas accessible from one side are beyond the ASME B&PV Section XI, Subsection IWE Code and 10CFR50.55a requirements and there is no Operating Experience to justify the additional examinations on either a one-time or a continuous basis.

IWE-3511.3 Ultrasonic Examination -
Subsection IWE requires ultrasonic thickness measurements in two cases:

1. When an area subject to Augmented Examination in accordance with IWE-1240 is accessible from one-side only (IWE-2500(b)(2)).
2. To determine the minimum wall thickness of an area after degradation has been detected, if specified as a result of the engineering evaluation of the degraded area, as required by IWE-3200.

The requirement for augmented examinations includes findings of actual losses and does not include locations or configurations which could only potentially be subject to losses. In cases where corrosion is sufficient to result in material loss and the liner is accessible from one side, determination of liner thickness is appropriate and in accordance with the code. IWE 2420(d) only requires successive examinations until one re-examination in the next period determines that the condition has remained unchanged. It does not require augmented examinations forever.

It should also be noted that revision 3 of the Subsection IWE Commentary (2007) on page 17 regarding IWE-2500(b)(2) discussed that there had been some confusion as to whether earlier editions of the code or addenda required performance of ultrasonic thickness measurements whenever either side of a component was inaccessible whether or not the inaccessible side was subject to conditions which warrant augmented examination. The IWE Commentary stated "This was clearly not the intent, and this requirement was clarified in the 2001 Edition."

The international experience cited as suggesting the presence of concrete voids as a possible concern for liner corrosion, consists of a single isolated incidence of leakage adjacent to an electrical penetration, early in the operating history of the Barseback-2 nuclear plant (which along with Barseback-1 has a unique containment liner configuration in the industry) as a result of poorly consolidated concrete and voids. Additionally, investigations and examinations were conducted at Barseback-1 at various penetrations with similar concrete consolidation and void issues. There was no corrosion found such that an unidentified construction difference or issue concurrent with the identified poorly consolidated concrete that was deemed causative.

In fact, based on industry operating experience, as documented in NRC sponsored report "Sandia Report SAND2010-8718 Nuclear Containment Steel Liner Corrosion Workshop: Final Summary and Recommendation Report" for Nuclear Plants in the USA, corrosion starting from the concrete side of the liner and corroding through to the interior surface of the liner has only been discovered as a result of foreign material being left in place during original construction. In addition, the Sandia report also states: "Tolerances issues with the liner are not considered significant since bulges in the liner between anchors are acceptable in design and do not impact liner structural performance." and "Liner bulges would be identified through visual inspections, but occurrence of liner bulges would likely be from sources other than corrosion (e.g., pre-stressed containment with internal heating that expands the liner between anchorage locations)."

A US nuclear power plant has had a multiple occurrences of through wall corrosion due to construction errors where organic material was left against the liner committed to performance of a number of random UT examinations (25). The recent results of those UT examinations did not find loss of material due to corrosion occurring on the concrete side of the liner at those locations.

The industry operating experience and plant specific information and operating experience support a conclusion that corrosion will not occur on the concrete side of the containment liner as a result of bulges or water infiltrating the concrete. Therefore, corrosion of the outside or concrete side of the liner is not expected.

Steel liner corrosion from the concrete side of concrete containments where corrosion resulted in through-wall liner holes were due to latent construction errors such as organic material left against the liner. These construction errors were limited in number, apparently did not occur at most plants, and are not being created over time. Considering the history of the operating experience, corrosion rates found and the thicknesses of the liners, all of the potential construction errors would have revealed themselves before the start of the period of extended operation (beyond 40 years), which is well before the start of second license renewal (SLR), 60 years after construction.

Therefore, there is no relevant operating experience or technical basis to recommend or require additional UT examinations beyond those required by the code and 10CFR 50.55a for steel liners during second license renewal (SLR).

Besides the cost to identify the areas of the containment shell and liner surfaces inaccessible from one side, perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the areas involved.

By the time of SLR, the areas of the containment shell and liner surfaces inaccessible from one side will have been in place for 60 years, so volumetric examination of areas of the containment shell and liner surfaces inaccessible from one side is expected to provide negligible benefits with regards to aging management since there has been no relevant, plant specific OE to suggest a basis for such volumetric examinations.

2) **New requirements for Bulges in Liner – *Corrosion at liner bulges is not a relevant aging mechanism that requires consideration***

Page # XI.S1-3, lines 7 and 9, Element # 3, Parameters; **Page #** XI.S1-3, lines 38-39, Element # 4, Detection; **Page #** XI.S1-5, lines 25-26, Element # 6, Acceptance Criteria

Description of Change:
Delete requirements for examination of bulges.

Basis:
Bulges in steel liners of concrete containments are significantly different than blisters in the coating of the steel liner plates. The bulges or localized buckling of steel liners in concrete containments that have been identified at a number of plants are both anticipated and expected. Bond between the liner and concrete is not a design requirement and a separation of the liner from concrete is acceptable. Separation of liner from concrete surface can occur due to compressive strains induced due to various conditions including: expected creep and shrinkage of the concrete, dead loads, post-tensioning loads, and thermal loads. Deformations can also occur during construction due to welding of stiffeners and embedment plates to the liner. Liners have typically been surveyed after construction and such liner deformations which also may be termed as bulges or buckling have typically been found to be within allowable tolerances and also found within design tolerances for liner strain.

The reliability of repeated measurements of liner bulges is limited due to variability in relative displacements between the concrete shells and the liner. As a result, monitoring of bulge dimensions will result in no significant data that can be used to make decisions.

The international experience cited as suggesting the presence of concrete voids as a possible concern for liner corrosion, consists of a single isolated incidence of leakage adjacent to an electrical penetration, early in the operating history of the Barseback-2 nuclear plant (which along with Barseback-1 has a unique embedded containment liner configuration in the industry) as a result of poorly consolidated concrete and voids. Additionally, subsequent investigations and examinations were conducted at Barseback-1 at various penetrations with the same concrete consolidation and void issues. There was no corrosion found such that an unidentified construction difference or issue concurrent with the identified poorly consolidated concrete that was deemed causative. Coating blisters and through wall corrosion of steel liners have been due to construction errors that left organic material in concrete adjacent to the steel liner plates at a few plants. Based on timing of operating experience and liner thickness, corrosion due to organic material construction errors was and would be visually manifested as coating blisters well before first PEO (SAND2010-8718). Corrosion of the concrete side of liner resulting in significant loss of material will not occur except due to organic material left as a result of original construction errors. The above statements are also consistent with ML112070867 "Containment Liner Corrosion Operating Experience Summary Technical Letter Report – Revision 1" dated August 2, 2011. In fact, based on industry operating experience, as documented in NRC sponsored report "Sandia Report SAND2010-8718 Nuclear Containment Steel Liner Corrosion Workshop: Final Summary and Recommendation Report" for Nuclear Plants in the USA, corrosion starting from the concrete side of the liner and corroding through to the interior surface of the liner has only been discovered as a result of foreign material being left in place during original construction. In addition, the Sandia report also states: "Tolerances issues with the liner are not considered significant since bulges in the liner between anchors are acceptable in design and do not impact liner structural performance." and "Liner bulges would be identified through visual inspections, but occurrence of liner bulges would likely be from sources other than corrosion (e.g., pre-stressed containment with internal heating that expands the liner between anchorage locations)." Corrosion at liner bulges not a relevant aging mechanism for consideration. Operating experience does not indicate liner corrosion at the bulges where the liner separates from the concrete. Additionally, based on the age of our early plants, our industry operating experience demonstrates that loss of material due to corrosion at liner bulges is not a relevant aging mechanism that we need to consider. Coating blisters are explored as part of the current IWE program.

Besides the cost to identify the bulges, perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the areas involved.

By the time of SLR, the bulges of the liner will have been in place for 60 years, so examination of bulges is expected to provide negligible benefits with regards to aging management if there have has been no plant specific OE to suggest the bases for the examinations.

3) **New requirements for surface examination (dye-penetrant examinations) of SS and dissimilar welds of penetration sleeves apply regardless of whether subject to cyclic loading, or SCC, and regardless of whether CLB Fatigue analysis exists. The requirements refer to a superseded Code section that is inconsistent with the SLR GALL. The requirements appear to question the adequacy of the Appendix J CLB.**

Page # XI.S1-1, lines 29-31, Program Description; **Page #** XI.S1-3, lines 9-11, Element # 3, Parameters; **Page #** XI.S1-3, lines 42-43, Element # 4, Detection; **Page #** XI.S1-4, lines 1-15, Element # 4, Detection; **Page #** XI.S1-5, lines 21-22, Element # 6, Acceptance Criteria

Description of Change:

a. Only require supplemental surface examinations at penetrations and bellows without fatigue analyses.
b. Change the reference from "Table IWE-2500-1, Examination Category E-F, as specified in the 1995 edition with 1996 addenda of the ASME Code, Section XI, Subsection IWE" to "IWE-3200".
c. Refer to Appendix J pressure tests, which addressed in another GALL section, as in accordance with the CLB and do not require a justification of Appendix J testing as part of IWE.

Basis:

a. Primary Containment stainless steel penetration sleeves and/or dissimilar metal welds on penetration sleeves are sheltered and protected from a corrosive environment. Based on the industry operating experience reviews documented in NUREG-1801 Rev. 2 Section XI.S1, NRC Information Notice 92-20, NUREG/CR-6726, and NUREG-1950, Table IV-13, Comments 899 and 902; as well as in the DRAFT SLR GALL/SRP; industry OE has not identified cracking due to cyclic loads or SCC as a relevant aging effect for dissimilar metal welds or stainless steel containment penetration sleeves.

   Surface examinations (dye-penetrant examinations) are not required by IWE Code or 10 CFR 50.55a. The 1992 ASME Section XI, Subsection IWE Code required surface exams of dissimilar metal welds only – but the requirement was eliminated from Subsection IWE prior to the 1999 IWE implementation under 10 CFR 50.55a. The NRC agreed to the elimination of the surface examinations based on a lack of any OE for cracking with such welds and due to the expected dose that would be incurred to perform the surface examinations.

Most of the external surfaces of carbon steel penetration sleeves and also of stainless steel penetration sleeves, where stainless steel penetration sleeves exist, are embedded in the four to six foot thick concrete containment walls; the remainder of the external surface is subject to the air-indoor uncontrolled environment. 10 CFR 50 Appendix J, type B tests of such penetration sleeves are not required and not possible for the type of mechanical penetration sleeves which are open between the pipe and the penetration sleeve on one end.

Surface examinations (dye-penetrant examinations) of stainless steel and dissimilar metal welds of penetration sleeves are not required by the ASME Section XI, Subsection IWE Code or 10 CFR 50.55a. The 1992 ASME Code edition Subsection IWE required surface examination of dissimilar metal welds only, not stainless steel sleeves, etc. This previous requirement from the 1992 Edition of the code was eliminated from the 1998 version of the code Subsection IWE, prior to the 1999 IWE implementation under 10 CFR 50.55a, and was evaluated and accepted by NRC as documented in the "Resolution of Public Comments Subsection IWE". The NRC agreed to the elimination of the surface examinations of dissimilar metal welds based on a lack of relevant OE for cracking with such dissimilar metal welds in other similar systems and due to the expected dose that would be incurred to perform the surface examinations.

There has been no additional relevant Operating Experience identified or cited to require surface examination for any of these components. The cited OE possibly applies to bellows where corrosive contamination was likely present. Therefore, these recommendations should be eliminated or at least made applicable only to components subject to cyclic loading without a CLB fatigue analysis with the optional provision to use Appendix J examination as an alternative to surface examination as per NUREG-1801 recommendations.

Supplemental surface examinations of stainless steel and dissimilar metal welds of penetration sleeves and closures are: 1) not necessary because the required parameters for SCC are not present, 2) not required by code or 10 CFR 50.55a, and not recommended in NUREG-1801 AMP XI.S1 for penetration sleeve components subject to cyclic loading which have a current licensing basis fatigue analysis, and 3) are not possible for the major portion of such components due to the fact that stainless steel penetrations are embedded in the four to six foot thick concrete primary containment walls.

Surface examination of the subject penetration sleeve components subject to cyclic loading which have a current licensing basis fatigue analysis is not recommended or required by NUREG 1801 AMP XI.S1 and there is no apparent operating experience or technical basis for now requiring such additional periodic dye-penetrant surface examinations for subsequent or second license renewal. NRC previously concluded that inspections of dissimilar metal welds were not warranted. We believe that this conclusion still applies and also applies to stainless steel sleeves. No recent relevant OE has been identified or cited to change the previous NRC conclusion.

Therefore, such additional dye-penetrant surface examinations of stainless steel and dissimilar metal welds of penetration sleeves will be an additional expenditure of resources, with no sound basis and no apparent value added cost benefit basis. These recommendations should be eliminated or at least made applicable only to components subject to cyclic loading without a CLB fatigue analysis with the optional provision to use Appendix J examination as an alternative to surface examination as per NUREG 1801 recommendations.

b. Table IWE-2500-1, Examination Category E-F, as specified in the 1995 edition with 1996 addenda of the ASME Code, Section XI, Subsection IWE, note #4 for "Parts Examined" limits the surface examinations to disimilar metal welds subject to cyclic loads and thermal stresses during normal plant operations. This appears to contradict the first sentence that supplements the visual examinations with surface examinations at components that have no CLB fatigue analysis. In addition, the referenced table refers to figures and sections that no longer exist. Supplemental examinations, both surface and volumetric, are currently addressed in IWE-3200. The reference to the Table from 1995, if only intended to identify the scope, selection, and frequency, of the disimilar metal weld surface examinations is confusing since it addresses other aspects and results in regulatory uncertainty.

c. Pressure testing, in accordance with Appendix J requirements, is addressed under another GALL section and is addressed in-depth under the CLB. Requiring a justification of the pressure testing under the IWE section of GALL results in regulatory uncertainty regarding how these requirements could be met.

4) Discussion of Mark I containment monitoring and trending implies that GL 87-05 required UTs at all drywells. However, if the Mark 1 containment design had a sealed sandbed, the GL and CLB did not require UTs to be performed.

Page # XI.S1-4, line 41; Element # 5, Monitoring; **Page #** XI.S1-5, line 8; Element #5, Monitoring

Description of Change:

Note that UTs may not have been required as part of the original license bases or the license basis during PEO.

Basis:

GL 87-05 does not require UTs if the sand bed is sealed.
Plants with Mark 1 containments with renewed licenses before GALL revision 2, may not have performed UTs depending upon their OE and original license basis with respect to GL 87-05. With the current wording, an Exception is required to address the statement regarding past performance of UTs, since the past UTs were not required by GL 87-05 and the CLB for all Mark 1 containments.

5) **ASME subsection IWE-1240 only addresses areas subject to accelerated corrosion, i.e., areas where corrosion has been identified, and does not mention areas susceptible to accelerated corrosion.**

Page # XI.S1-3, line 35 Element # 4, Detection

Description of Change:

Delete "or susceptible" after "subject to".

Basis:

The current wording does not reflect the IWE-1240 text.
The current wording is subjective and liable to result in regulatory uncertainty since there is no standardized definition that can be used to establish areas susceptible to accelerated degradation.

Markup Page XI.S1-1

Program Description

10 CFR 50.55a imposes the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code[1], Section XI, Subsection IWE, for steel containments (Class MC) and steel liners for concrete containments (Class CC). The scope of Subsection IWE includes steel containment shells and their integral attachments, steel liners for concrete containments and their integral attachments, containment penetrations, hatches, airlocks, moisture barriers, and pressure-retaining bolting. The requirements of ASME Code, Section XI, Subsection IWE, with the additional requirements specified in 10 CFR 50.55a(b)(2), are supplemented herein to constitute an existing program applicable to managing aging of steel containments, steel liners of concrete containments, and other containment components for the subsequent period of extended operation.

The primary ISI method specified in IWE is visual examination (general visual, VT-3, VT-1). Limited volumetric examination (ultrasonic thickness measurement) and surface examination (e.g., liquid penetrant) may also be necessary in some instances to detect aging effects. IWE specifies acceptance criteria, corrective actions, and expansion of the inspection scope when degradation exceeding the acceptance criteria is found.

Subsection IWE requires examination of coatings that are intended to prevent corrosion. Aging management program (AMP) XI.S8 is a protective coating monitoring and maintenance program that is recommended to ensure emergency core cooling system (ECCS) operability, whether or not the GALL-SLR Report AMP XI.S8 is credited in GALL-SLR Report AMP XI.S1.

The program attributes are supplemented to incorporate aging management activities, recommended in the Final Interim Staff Guidance LR-ISG-2006-01, needed to address the potential loss of material due to corrosion in the inaccessible areas of the boiling water reactor (BWR) Mark I steel containment.

The attributes also are supplemented to recommend surface or augmented examination of two-ply bellows for detection of cracking described in the U.S. Nuclear Regulatory Commission (NRC) Information Notice (IN) 92-20, "Inadequate Local Leak Rate Testing," and to include preventive actions to ensure bolting integrity. ~~The program is also supplemented to perform surface examination of stainless steel (SS) and dissimilar metal welds of penetration sleeves, penetration bellows, vent line bellows; and volumetric examination of metal shell or liner surfaces that are inaccessible from one side, during each inspection interval.~~

Evaluation and Technical Basis

1. ***Scope of Program:*** The scope of this program addresses the pressure-retaining components of steel containments and steel liners of concrete containments specified in Subsection IWE-1000 and are supplemented to address aging management of potential corrosion in inaccessible areas of the drywell shell exterior of BWR Mark I steel containments. The components within the scope of Subsection IWE are Class Metal

<u>Markup Page XI.S1-3</u>

Section 2 of Research Council for Structural Connections (RCSC) publication "Specification for Structural Joints Using High-Strength Bolts," need to be considered.

3. ***Parameters Monitored or Inspected:*** Table IWE-2500-1 references the applicable sections in IWE-2300 and IWE-3500 that identify the parameters examined or monitored. Noncoated surfaces are examined for evidence of cracking, discoloration, wear, pitting, excessive corrosion, arc strikes, gouges, surface discontinuities, dents, ~~liner plate bulges,~~ and other signs of surface irregularities. Painted or coated surfaces, including those inside BWR suppression chambers, are examined for evidence of flaking, blistering, peeling, discoloration, ~~liner bulges, and~~ other signs of potential distress of the underlying metal shell or liner. Stainless steel (SS) **<u>penetration sleeves and dissimilar metal</u>** welds of penetration sleeves, penetration bellows, ~~and~~ vent line bellows~~; and~~, steel bellows components that are subject to cyclic loading but have no current licensing basis (CLB) fatigue analysis, are monitored for cracking. The moisture barriers are examined for wear, damage, erosion, tear, surface cracks, or other defects that permit intrusion of moisture in the inaccessible areas of the pressure retaining surfaces of the metal containment shell or liner. Pressure-retaining bolting is examined for loosening and material conditions that cause the bolted connection to affect either containment leak-tightness or structural integrity.

Subsequent license renewal applicants with BWR Mark I steel containments should periodically monitor the sand pocket area drains and/or the refueling seal drains for water leakage. The applicants should also ensure the drains are clear to prevent moisture levels associated with accelerated corrosion rates in the exterior portion of the drywell shell.

4. ***Detection of Aging Effects:*** The examination methods, frequency, and scope of examination specified in 10 CFR 50.55a and Subsection IWE ensure that aging effects are detected before they compromise the design-basis requirements. IWE-2500-1 and the requirements of 10 CFR 50.55a provide information regarding the examination categories, parts examined, and examination methods to be used to detect aging.

Regarding the extent of examination, all accessible surfaces receive at least a general visual examination as specified in Table IWE-2500-1 and the requirements of 10 CFR 50.55a. The acceptability of inaccessible areas of the steel containment shell or concrete containment steel liner is evaluated when conditions are found in accessible areas that could indicate the presence of, or could result in, flaws or degradation in such inaccessible areas. IWE-1240 requires augmented examinations (Examination Category E-C) of containment surface areas subject to ~~or susceptible to~~ accelerated degradation. A VT-1 visual examination is performed for areas accessible from both sides, and volumetric (ultrasonic thickness measurement) examination is performed for areas accessible from only one side. ~~Liner plate bulges should be evaluated for corrosion potential.~~

The requirements of ASME Section XI, Subsection IWE and 10 CFR 50.55a are supplemented to perform surface examination, in addition to visual examination, to detect cracking in ~~(a)~~ SS and dissimilar metal welds of penetration sleeves, penetration bellows, and vent line bellows~~;~~, and ~~(b)~~ steel bellows components that are subject to cyclic loading but have no CLB fatigue analysis. The supplemental surface examination of dissimilar metal welds may be performed in accordance with **IWE-3200** ~~Table IWE-2500-1, Examination Category E-F, as specified in the 1995 edition with 1996 addenda of the~~

Markup Page XI.S1-4

~~ASME Code, Section XI, Subsection IWE~~. ~~Components for which supplemental surface examination is not feasible are identified and appropriate~~ Appendix J leak rate tests (GALL-SLR Report AMP XI.S4) ~~justified to detect cracking~~ are conducted**, in accordance with the CLB,** in lieu of the supplemental surface examination. ~~For two-ply bellows of the type described in NRC IN 92-20 for which it is not possible to perform a valid local leak rate test, augmented examination using qualified enhanced techniques that can detect cracking is recommended.~~

~~The requirements of ASME Section XI, Subsection IWE and 10 CFR 50.55a are further supplemented to require volumetric examination of metal shell or liner surfaces that are inaccessible from one side, during each inspection interval. The supplemental examination consists of (1) a sample of one-foot square randomly selected locations and (2) a sample of one-foot square locations focused on areas most likely to experience degradation. The sample size, locations, frequency and schedule for each set of volumetric examinations should be determined on a plant-specific basis during each interval.~~

5. ***Monitoring and Trending:*** With the exception of inaccessible areas, all surfaces are monitored by virtue of the examination requirements on a scheduled basis.

IWE-2420 specifies that:

(a) The sequence of component examinations established during the first inspection interval shall be repeated during successive intervals, to the extent practical.

(b) When examination results require evaluation of flaws or areas of degradation in accordance with IWE-3000, and the component is acceptable for continued service, the areas containing such flaws or areas of degradation shall be reexamined during the next inspection period listed in the schedule of the inspection program of IWE-2411 or IWE-2412, in accordance with Table IWE-2500-1, Examination

Category E-C.

(c) When the reexaminations required by IWE-2420(b) reveal that the flaws or areas of degradation remain essentially unchanged for the next inspection period, these areas no longer require augmented examination in accordance with Table IWE-2500-1 and the regular inspection schedule is continued.

IWE-3120 requires examination results to be compared with recorded results of prior inservice examinations and evaluated for acceptance.

Applicants for subsequent license renewal (SLR) for plants with BWR Mark I containment should augment IWE monitoring and trending requirements to address inaccessible areas of the drywell. The applicant should consider the following recommended actions based on plant-specific operating experience.

(a) Develop a corrosion rate that can be inferred from past ultrasonic testing (UT) examinations**, if performed,** or establish a corrosion rate using samples in similar operating conditions, materials, and environments. If

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degradation has occurred, provide a technical basis using the developed or established corrosion rate to demonstrate that the drywell shell will have sufficient wall thickness to perform its intended function through the subsequent period of extended operation.

(b) Demonstrate that UT measurements performed in response to NRC Generic Letter (GL) 87-05, "Request for Additional Information Assessment of Licensee Measures to Mitigate and/or Identify Potential Degradation of Mark I Drywells**", if required,** did not show degradation inconsistent with the developed or established corrosion rate.

6. ***Acceptance Criteria:*** IWE-3000 provides acceptance standards for components of steel containments and liners of concrete containments. IWE-3410 refers to criteria to evaluate the acceptability of the containment components for service following the preservice examination and each inservice examination. Most of the acceptance standards rely on visual examinations. Areas that are suspect require an engineering evaluation or require correction by repair or replacement. For some examinations, such as augmented examinations, numerical values are specified for the acceptance standards. For the containment steel shell or liner, material loss locally exceeding 10 percent of the nominal containment wall thickness or material loss that is projected to

locally exceed 10 percent of the nominal containment wall thickness before the next examination are documented. Such areas are corrected by repair or replacement in accordance with IWE-3122 or accepted by engineering evaluation. Cracking of SS penetration sleeves, dissimilar metal welds of penetration sleeves, penetration bellows, ~~and~~ vent line bellows~~;~~, and steel bellows components that are subject to cyclic loading but have no CLB fatigue analysis is corrected by repair or replacement or accepted by engineering evaluation. ~~Where applicable, the program should establish quantitative acceptance criteria for containment liner bulges consistent with the CLB for the liner.~~

7. ***Corrective Actions:*** Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 components (SCs) within the scope of this program.

Subsection IWE states that components whose examination results indicate flaws or areas of degradation that do not meet the acceptance standards listed in IWE-3500 are acceptable if an engineering evaluation indicates that the flaw or area of degradation is nonstructural in nature or has no effect on the structural integrity of the containment. Components that do not meet the acceptance standards are subject to additional examination requirements, and the components are repaired or replaced to the extent necessary to meet the acceptance standards of IWE-3000. For repair of components within the scope of Subsection IWE, IWE-3124 states that repairs and reexaminations are to comply with IWA-4000. IWA-4000 provides repair specifications for pressure retaining components, including metal containments and metallic liners of concrete containments.

XI.S2 ASME Section XI, Subsection IWL

Description of Change and Justification:

1) **Boling should be Boiler on page XI.S2-1, line #4, in the Program Description**

2) **Plant specific evaluations, when required, should be included as part of the applicable AMP instead of creating a separate program.**

Page # XI.S2-1, after line 24, Program Description

Description of Change:
Revise Program Description to include plant-specific evaluations, when required, for concrete susceptible to freeze-thaw, leaching and carbonation, or reaction with aggregates mechanisms, or for increased temperatures of concrete structures. See items II.A1.CP-34 and II.A1.CP-147 as examples.

Basis:
The components in question would remain within the scope of the original AMP for managing aging effects outside of those requiring plant specific evaluations, so additional or modified inspection activities would likely be performed in conjunction with normal examinations. Recognizing this in the SRP, AMRs, and AMPs would provide the same enhanced inspections while minimizing duplications and reducing the need to address inconsistencies with GALL (Note E).

All of the concrete elements of the containments still have to be addressed as part of the IWL program in accordance with the ASME B&PV Section XI, Subsection IWL Code and 10CFR50.55a requirements for IWL. As currently written, there would be multiple programs, in addition to the IWL program, that would have to address aging effects of the containment concrete. This would unnecessarily complicate aging management activities and results in regulatory uncertainty regarding the content of these newly required, plant specific, aging management programs since the OE currently shows that the current IWL program requirements have been adequate to address containment concrete aging management activities. No relevant OE was identified to suggest that additional, long-term, on-going programs are required.

3) **Quantitative monitoring and trending requirements are too extensive to yield significant benefits for the additional costs incurred.**

Page # XI.S2-3, lines 5 to 9, Element # 5, Monitoring

Description of Change:
In the first paragraph of Element 5, reword the third sentence to add "qualitative data" (this would then be consistent with XI.S6) and replace "all" with "significant findings for".

Basis:
Recording and trending minor degradation is not necessary or effective in aging management of concrete. ACI 349.3R provides limits for categorizing degradation quantitatively and details further actions to be taken based on these limits. For aging effects that do not meet the minimum limits for which further action is required by ACI 349.3R, trending of size increases is not an effective aging management technique, e.g., shrinkage crack size or length. Degradation on this level must be recognized and addressed by qualified inspectors and evaluators. ACI 349.3R addresses this by specifying minimum qualifications for inspectors and evaluators.

The requirement to record and trend all data is unreasonable for every instance, however, miniscule and regardless of size. There will be considerable expense required to record and trend all individual indications, which cannot yield significant results since concrete exhibits minor imperfections as a result of original construction.

As currently worded, there is considerable uncertainty as to how compliance with this requirement could be demonstrated for a large structure, examined multiple times. It could be interpreted that each individual imperfection would have to be trended.

There is no Operating Experience to justify the additional level of precision of monitoring on either a one-time or a continuous basis.

This issue was previously identified as comment topic per 060415 NEI LTR.

It is unnecessary to specify recording, but we recommend recording and possibly photos only for more significant, indications greater than a certain size (such as ACI 349.3R Chapter 5 tier 2).

4) New requirements for IWL Concrete Acceptance Criteria now specified to be quantitative per ACI 349.3R Chapter 5

Page # XI.S2-3, lines 20-23, Element # 6, Acceptance Criteria

Description of Change:
The acceptance criteria wording should be changed to be more in alignment with the wording in the XI.S6 AMP Element 6 for consistency.

Basis:
ASME Code and previous revisions of GALL placed the responsibility for determination of acceptability and/or acceptance standard for containment structural concrete with the Responsible Engineer. However, the need for established quantitative acceptance criteria is recognized. It is recommended that the wording of this element be more consistent with the wording of XI.S6 element 6 for concrete inspections for consistency.

The ACI 349.3R evaluation criteria provides guidance on the level of engineering review and evaluation of examination results should be performed to determine whether the concrete condition is acceptable, whether additional examinations are required, or whether repairs are required.

5) Corrective actions are not consistent with respect to terminology regarding conditions to be addressed as adverse conditions.

Page # XI.S2-3, lines 35, Element # 7, Corrective Actions

Description of Change:
The requirements should reflect the difference between conditions recorded as part of the IWL program, which would not be in CAP, and conditions that require repair and additional examinations, which would be entered into CAP.

Basis:
As currently worded, the requirements in elements 5, 6, and 7, could be inferred to require that all examination results, which exceed an ACI 349.3R tier 1 criteria, be entered into the corrective action program. There is regulatory uncertainty as to how sites would enter the very large amount of information into CAP. This would be an undue additional burden with no benefits since the current requirements in the GALL already require that examination results be recorded and evaluated, with repairs made as required. IWL already provides requirements on how to address examination results, including evaluation, additional examinations, repairs, and reporting.

XI.S2 ASME SECTION XI, SUBSECTION IWL

Program Description

10 CFR 50.55a imposes the examination requirements of the American Society of Mechanical Engineers (ASME) ~~Boling~~ **Boiler** and Pressure Vessel (B&PV) Code, Section XI, Subsection IWL,[1] for reinforced and prestressed concrete containments (Class CC). The scope of IWL includes reinforced concrete and unbonded post-tensioning systems. ASME Code, Section XI, Subsection IWL and the additional requirements specified in 10 CFR 50.55a(b)(2) constitute an existing mandated program applicable to managing aging of containment reinforced concrete and unbonded post-tensioning systems, and supplemented herein, for subsequent license renewal (SLR). Containments with grouted tendons may require an additional plant-specific aging management program (AMP), based on the guidance in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.90, "Inservice Inspection of Prestressed Concrete Containment Structures with Grouted Tendons," to address the adequacy of prestressing forces.

The primary inspection method specified in IWL-2500 is visual examination, supplemented by testing. For prestressed containments, tendon wires are tested for yield strength, ultimate tensile strength, and elongation. Tendon corrosion protection medium is analyzed for alkalinity, water content, and soluble ion concentrations. The quantity of free water contained in the anchorage end cap and any free water that drains from tendons during the examination is documented. Samples of free water are analyzed for pH. Prestressing forces are measured in selected sample tendons. IWL specifies acceptance criteria, corrective actions, and expansion of the inspection scope when degradation exceeding the acceptance criteria is found.

The Code specifies augmented examination requirements following post-tensioning system repair/replacement activities.

Plant specific evaluations for concrete susceptible to freeze-thaw, leaching and carbonation, or reaction with aggregates mechanisms, or for increased temperatures of concrete structures are included in this AMP, if applicable.

Evaluation and Technical Basis

1. ***Scope of Program:*** Subsection IWL-1000 specifies the components of concrete containments within its scope. The components within the scope of Subsection IWL are reinforced concrete and unbonded post-tensioning systems of Class CC containments, as defined by CC-1000. The program also includes testing of the tendon corrosion protection medium and the pH of free water. Subsection IWL exempts from examination portions of the concrete containment that are inaccessible (e.g., concrete covered by liner, foundation material, or backfill or obstructed by adjacent structures or other components).

   10 CFR 50.55a(b)(2)(viii) and the 2009 and later editions/addenda of the Code specify additional requirements for inaccessible areas. The Code states that the licensee is to

evaluate the acceptability of concrete in inaccessible areas when conditions exist in accessible areas that could indicate the presence of or result in degradation to such inaccessible areas. Steel liners for concrete containments and their integral attachments

Markup Page XI.S2-3

5. ***Monitoring and Trending:*** Except in inaccessible areas, all concrete surfaces are monitored on a regular basis by virtue of the examination requirements. Inspection results are documented and compared to previous results to identify changes from prior inspections. Quantitative measurements **and qualitative data** are recorded and trended for ~~all~~ **significant findings for** applicable parameters monitored or inspected, and the use of photographs or surveys is recommended. Photography and its variations may be used to trend aging effects such as cracking, spalling, delamination, pop-outs, or other age-related concrete degradation as illustrated in ACI 201.1R. Photographic records may be used to document and trend the type, severity, extent and progression of degradation.

   For prestressed containments, trending of prestressing forces in tendons is required in accordance with the acceptance by examination criteria in IWL-3220. In addition to the random sampling used for tendon examination, one tendon of each type is selected from the first-year inspection sample and designated as a common tendon. Each common tendon is then examined during each inspection. Corrosion protection medium chemistry and free water pH are monitored for each examined tendon. This procedure provides monitoring and trending information over the life of the plant. 10 CFR 50.55a and Subsection IWL also require that prestressing forces in all inspection sample tendons be measured by lift-off or equivalent tests and compared with acceptance standards based on the predicted force for that type of tendon over its life.

6. ***Acceptance Criteria:*** IWL-3000 provides acceptance ~~criteria~~ **standards** for concrete containments. ~~In addition, this program includes~~ Quantitative acceptance criteria for concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R **are acceptable. Applicants who are not committed to ACI 349.3R and elect to use plant-specific criteria for concrete containment structures should describe the criteria and provide a technical basis for deviations from those in ACI 349.3R. Inspection results, based on the acceptance criteria selected, are evaluated by the Responsible Engineer to ensure that the need for corrective actions is identified before loss of intended functions. The Responsible Engineer determines whether there is any evidence of damage or degradation sufficient to warrant further evaluation, examination, or repair.**

   The acceptance standards for the unbonded post-tensioning system are quantitative in nature. For the post-tensioning system, quantitative acceptance criteria are given for tendon force and elongation, tendon wire or strand samples, and corrosion protection medium. Free water in the tendon anchorage areas is not acceptable, as specified in IWL-3221.3. If free water is found, the recommendations in Table IWL-2525-1 are

Markup Page XI.S2-3 (continued)

followed. 10 CFR 50.55a and Subsection IWL do not define the method for calculating predicted tendon prestressing forces for comparison to the measured tendon lift-off forces. The predicted tendon forces are calculated in accordance with RG 1.35.1, "Determining Prestressing Forces for Inspection of Prestressed Concrete Containments," which provides an acceptable methodology for use through the subsequent period of extended operation.

7. ***Corrective Actions:*** **Examination results** ~~Results that do not meet the acceptance criteria~~ **,which require repair or additional examinations as described in the paragraph below,** are addressed as conditions adverse to quality or significant conditions adverse to quality 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 components (SCs) within the scope of this program.

   Subsection IWL specifies that items for which examination results do not meet the acceptance standards are to be evaluated in accordance with IWL-3300, "Evaluation," and described in an engineering evaluation report. The report is to include an evaluation of whether the concrete containment is acceptable without

Page XI.S2-4 *(provided for reference to give context for the proposed change shown above)*

repair of the item and, if repair is required, the extent, method, and completion date of the repair or replacement. The report also identifies the cause of the condition and the extent, nature, and frequency of additional examinations. Subsection IWL also provides repair procedures to follow in IWL-4000. This includes requirements for the concrete repair, repair of reinforcing steel, and repair of the post-tensioning system.

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.

IWA-1400 specifies the preparation of plans, schedules, and inservice inspection (ISI) summary reports. In addition, written examination instructions and procedures, verification of qualification level of personnel who perform the examinations, and documentation of a QA program are specified. IWA-6000 specifically covers the preparation, submittal, and retention of records and reports.

XI.S3 ASME SECTION XI, SUBSECTION IWF

Description of Change and Justification:-

Page # XI.S3-1, Lines 7-10, "Program Description"

Description of Change:

Delete newly added sentence that refer to the IWL program and supplement requirements.

Justification:

Sentence refers to the wrong program and is redundant regarding supplement requirements.

Page # XI.S3-1, Lines 28-30, "Program Description"; **Page #** XI.S3-2, Lines 37-39, Element 4-Detection; **Page #** XI 01-45, IWF program; **SRP Page #** 3.0-46, IWF program

Description of Change:

Program Description- Delete newly added sentence that refers to randomly selected additional supports for each group of materials used and the environments to which they are exposed outside of the existing IWF sample population.

Element 4- Delete newly added clause in the 2nd sentence and new 3rd sentence that refer to randomly selected additional supports

Page # XI 01-47 and SRP Page # 3.0-47- Delete newly added sentence that refers to selected additional supports.

Justification:

This is beyond IWF Code requirements.

There is no relevant OE that was found as a basis for this new requirement.

Besides the cost to identify the new sample populations based upon materials and environments, randomly select the supports, perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the supports.

Class 3 supports are more numerous than Class 1 and Class 2 supports, and represent approximately one half of the total supports. Since 10% of the Class 3 supports are currently included within the scope of the examination sample, an additional 5% of the supports results in a 50% increase in the number of Class 3 supports to be examined, which is an almost 25% increase in the total number of supports to be examined. There is no relevant OE that has been found as a basis for such a large increase in scope, or for any increase in scope beyond the industry consensus IWF sampling scope.

Hundreds of supports are already examined per site. An increase of 5% is not statistically warranted and there is no technical basis for such a scope increase. The IWF Code section IWF-2430 contains requirements for "Additional Examinations" which detail scope increase requirements for examination of additional supports when flaws or relevant conditions exceeding acceptance standards are identified in the supports examined.

In addition, there are also other programs that perform general walkdowns in the affected areas that will identify changes in conditions such as significant losses of material which include plant tours by operations personnel, Boric Acid Corrosion area inspections, and External Surfaces inspections.

The original IWF program required periodic examinations of 100% of the supports and the requirement for 100% examination was abandoned. The sampling mentioned in lines 15-20 on page XI.S3-1 was developed due to the excessive costs and dose, and lack of OE that warranted a larger sample size.

By the time of SLR, the supports will have been in place for 60 years, with continuous performance of current IWF examinations, allowing for identification of problematic supports, so sample expansion is not required during SLR.

Page # XI.S3-1, Line 32, Element 1- Scope; **Page #** XI.S3-2, Line 36, Element 4- Detection

Description of Change:

Element 1- Restore the clause that limited the scope to supports not exempt from examination and delete the newly added, last sentence of the section that addresses inaccessible supports.

Element 4- Add clarification from Table IWF-2500-1 note regarding multiple components, other than piping, within a system of similar design, function, and service, that the supports of only one of the multiple components are required to be examined.

Justification:
This is beyond IWF Code requirements.

Supports are exempted from examination by the Code when the piping or components themselves are exempt from examination or if the supports are inaccessible (IWF-1230). If the piping or component is exempt from examination, examination of the previously exempt supports is expected to provide negligible benefits with regards to aging management. Note that the ASME section XI, IWB/IWC/IWD AMP does not add into scope the examination of exempt piping or components.

This is an examination program of accessible supports and there are no provisions in the current Code to address the evaluation of acceptability of inaccessible supports. This results in the potential for significant regulatory uncertainty during NRC inspections of this requirement.

There is no applicable OE that was found as a basis for this new requirement. Besides the cost to identify the supports that are exempt but accessible, perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the supports.

As an example of a similar requirement, the original IWF Code required removal of insulation to allow for examination of pipe clamps. This requirement to make the clamps accessible was subsequently deleted due to the excessive costs and dose, and lack of negative OE.

By the time of SLR, the supports will have been in place for 60 years, so inclusion of supports previously exempt from examination is expected to provide negligible benefits with regards to aging management.

Inaccessible component supports that support active components are indirectly monitored through the Maintenance Rule required vibration monitoring of the active components.

Page # XI.S3-1, Line 25, Program Description; XI.S3-1, Line 34, Element #1- Scope; XI.S3-2, Lines 7, Element 2- Preventive;

Description of Change:

Delete the requirement for actual measured yield strengths and change to expected yield strengths.

Justification:

Actual strengths may not have been required to be submitted with material deliveries for support bolts until late in the construction phases of the nuclear power plants as a result of Code changes and may not now be traceable to individual installed bolts at older plants. NUREG-1950 has an explanation of the OE regarding support bolts that does not involve a strict acceptance criteria at exactly 150 ksi.

Page # XI.S3-2, Line 21, Element 3- Parameters;

Description of Change:

Delete cracking of welds from the list of parameters.

Justification:

Cracking of welds is not included in the Code under IWF-3410.

Cracking of welds is not included under element #6.

There is no applicable OE that was found or cited as a basis for this new requirement.

The IWF program uses VT-3 examinations and is generally not credited with detecting cracks, even though ISI examiners would typically identify cracks in welds if observed. However, the visual acuity requirements are not currently consistent with other Code sections where cracks are detected visually.

Page # XI.S3-2, Lines 28 and 29, Element 3- Parameters;

Description of Change:

Delete "concrete around anchor bolts" is monitored for cracking from the list of parameters.

Justification:

Cracking in concrete is not included within the scope of IWF. Concrete examination qualification requirements and acceptance criteria are not addressed. This results in potential regulatory uncertainty with respect to future NRC inspections.

Cracking of concrete at anchors is not included under element #6.

There is no applicable OE that was found as a basis for this new requirement.

The IWF program uses VT-3 examinations and is generally not credited with detecting cracks in concrete, even though ISI examiners would typically identify significant cracks in concrete if observed.

Page # XI.S3-2, Line 26, Element 3- Parameters; **Page #** XI.S3-3, Line 6, Element 4- Detection

Description of Change:

Clarify that not all bolts for all supports require examination.

Justification:

As currently written, there is uncertainty between the statements that refer to supports within the sample population to be examined and statements regarding bolt examinations that are not limited with respect to scope of examination. This results in potential regulatory uncertainty.

The Code does not require inspection of all bolts.

There is no applicable OE that was found as a basis for this new requirement. Besides the cost to identify the new sample populations based upon materials and environments, randomly select the supports, perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the supports.

There are other programs that perform general walkdowns in the affected areas that identify changes in conditions and significant losses of materials such as plant tours by operations personnel, BAC, and External Surfaces.

The original IWF program required periodic examinations of 100% of the supports and the requirement for 100% examination was abandoned. The sampling mentioned in lines 15-20 on page XI.S3-1 was developed due to the excessive costs and dose, and lack of negative OE.

By the time of SLR, the supports will have been in place for 60 years, with continuous performance of current IWF examinations, allowing for identification of problematic supports, so sample expansion, which is not based upon plant specific OE or Code changes is not required during SLR.

Page # XI.S3-2, Line 30 and 31, Element 3- Parameters; **Page #** XI.S3-3, Lines 7-10, Element 4- Detection

Description of Change:
Element 3- Delete phrase referring to volumetric examination of A325 and A490 bolts. Add sentence from Structures Monitoring program that addresses OE for A325 and A490 bolts.
Element 4- Delete sentence referring to volumetric examination of A325 and A490 bolts.

Justification:
There is an inconsistency in addressing A325 and A490 bolts between XI.S3 and XI.S6 programs that was addressed in NUREG-1950, comment # 906.

There is no applicable OE that was found as a basis for this requirement. Besides the cost to identify the bolts and perform the examinations (which would include support functions such as scaffolding and radiation protection), there will be a significant dose involved, depending upon the supports.

Page # XI.S3-4, Lines 41, Element 10- Operating Experience;

Description of Change:
Refer to NUREG-1950, comment # 906, when characterizing the aging of bolts.

Justification:
Comments in NUREG-1950 address aging of bolts mentioned in the other documents.

Page # XI.S3-4, Lines 42 and 43, and XI.S3-5, Lines 1-3, Element 10- Operating Experience;

Description of Change:
Delete reference to IN 2009-04

Justification:
This OE refers to wear on the linkages and increased friction between the various moving parts and joints within the constant support, which are elements not within the scope of examination of passive components under SLR at one specific site with unusually high vibration.

Program Description

The 10 CFR 50.55a, imposes the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV),[1] Section XI, for Class 1, 2, 3, and metal containment (MC) piping and components and their associated supports. ISI of supports for ASME piping and components is addressed in Section XI, Subsection IWF. ~~ASME Code, Section XI, Subsection IWL and the additional requirements specified in 10 CFR 50.55a(b)(2) constitute an existing mandated program applicable to managing aging of containment reinforced concrete and unbonded post-tensioning systems, and supplemented by guidance herein, for subsequent license renewal (SLR).~~ This evaluation covers the 2004 edition of the ASME Code as approved in 10 CFR 50.55a. This program supplements ASME Code, Section XI, Subsection IWF, which constitutes an existing mandated program applicable to managing aging of ASME Class 1, 2, 3, and MC component supports for subsequent license renewal (SLR).

The scope of inspection for supports is based on sampling of the total support population. The sample size varies depending on the ASME Class. The largest sample size is specified for the most critical supports (ASME Class 1). The sample size decreases for the less critical supports (ASME Class 2 and 3). Discovery of support deficiencies during regularly scheduled inspections triggers an increase of the inspection scope in order to ensure that the full extent of deficiencies is identified. The primary inspection method employed is visual examination. Degradation that potentially compromises support function or load capacity is identified for evaluation. ASME Section XI, Subsection IWF specifies acceptance criteria and corrective actions. Supports requiring corrective actions are reexamined during the next inspection period.

The requirements of subsection IWF are supplemented to include monitoring of high- strength bolting (~~actual measured~~ expected yield strength greater than or equal to 150 kilo-pounds per square inch (ksi) or 1,034 megapascals (MPa) for cracking. This program emphasizes proper selection of bolting material, lubricants, and installation torque or tension to prevent or minimize loss of bolting preload and cracking of high-strength bolting. ~~This program includes inspections of randomly selected additional supports for each group of materials used and the environments to which they are exposed outside of the existing IWF sample population.~~

Evaluation and Technical Basis

1. ***Scope of Program:*** This program addresses ASME Class 1, 2, and 3 piping and component supports that are not exempt from examinations in accordance with IWF-1230 and MC component supports. The scope of the program includes support members, structural bolting, high-strength structural bolting (actual measured yield strength greater than or equal to 150 ksi or 1,034 MPa), anchor bolts, support anchorage to the building structure, accessible sliding surfaces, constant and variable load spring hangers, guides, stops, and vibration isolation elements. ~~The acceptability of inaccessible areas (e.g., portions of supports encased in concrete, buried underground, or encapsulated by guard pipe) is evaluated when~~

~~conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas.~~

2. ***Preventive Action:*** Operating experience and laboratory examinations show that the use of molybdenum disulfide (MoS_2) as a lubricant is a potential contributor to stress corrosion cracking (SCC), especially when applied to high-strength bolting. Thus, molybdenum disulfide and other lubricants containing sulfur should not be used. Preventive measures also include using bolting material that has ~~actual measured~~ expected yield strength less than 150 ksi or 1,034 MPa. Bolting replacement and maintenance activities include proper selection of bolting material and lubricants, and appropriate installation torque or tension, as recommended in Electric Power Research Institute (EPRI) documents (e.g., EPRI NP-5067 and EPRI TR-104213), American Society for Testing and Materials (ASTM) standards, and American Institute of Steel Construction (AISC) Specifications, as applicable. If bolting within the scope of the program consists of ASTM A325 and/or ASTM A490 bolts (including respective equivalent twist-off type ASTM F1852 and/or ASTM F2280 bolts), the preventive actions for storage, lubricant selection, and bolting and coating material selection discussed in Section 2 of Research Council for Structural Connections (RCSC) publication "Specification for Structural Joints Using High-Strength Bolts" need to be used.

3. ***Parameters Monitored or Inspected:*** The parameters monitored or inspected include corrosion; deformation; misalignment of supports; missing, detached, or loosened support items; ~~cracking of welds~~; improper clearances of guides and stops; and improper hot or cold settings of spring supports and constant load supports. Accessible areas of sliding surfaces are monitored for debris, dirt, or indications of excessive loss of material due to wear that could prevent or restrict sliding as intended in the design basis of the support. Elastomeric vibration isolation elements are monitored for cracking, loss of material, and hardening. ~~All bolting within the scope of the program is~~ Structural bolts are monitored for corrosion, loss of integrity of bolted connections due to self-loosening, and material conditions that can affect structural integrity. ~~In addition, the concrete around anchor bolts is monitored for cracking.~~ High strength bolting in sizes greater than 1 inch nominal diameter~~, including ASTM A325 and/or ASTM A490 bolts (including respective equivalent twist-off type ASTM F1852 and/or ASTM F2280 bolts),~~ should be monitored for SCC. (SCC). However, ASTM A325 and ASTM A490 bolts (or equivalent) used in civil and support structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications when used in support structures.

4. ***Detection of Aging Effects:*** The program requires that a sample of ASME Class 1, 2, and 3 piping supports that are not exempt from examination and 100 percent of supports other than piping supports (Class 1, 2, 3, and MC), be examined as specified in Table IWF-2500-1. For multiple components other than piping, within a system of similar design, function, and service, the supports of only one of the multiple components are required to be examined. The sample size examined for ASME Class 1, 2, and 3 piping and component supports is as specified in Table IWF-2500-1~~, plus an additional 5 percent of Class 1, 2, and 3 piping supports. The additional supports are randomly selected from the remaining population of IWF piping supports.~~ The extent, frequency, and examination methods are designed to detect, evaluate, or repair age-related degradation before there is a loss of component support intended function. The VT-3 examination method

specified by the program can reveal loss of material due to corrosion and wear, verification of clearances, settings, physical displacements, loose or missing parts, debris or dirt in accessible areas of the sliding surfaces, or loss of integrity at bolted connections. The VT-3 examination can also detect loss of material and cracking of elastomeric vibration isolation elements. Elastomeric vibration isolation elements should be felt to detect hardening if the vibration isolation function is suspect. IWF-3200 specifies that visual examinations that detect surface flaws which exceed acceptance criteria may be supplemented by either surface or volumetric examinations to determine the character of the flaw.

For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be performed to detect cracking in addition to the VT-3 examination for supports with high strength bolts in the sample. This volumetric examination may be waived with plant-specific justification. High-strength ASTM A325, and/or ASTM A490 bolting (including respective equivalent twist-off type ASTM F1852 and/or ASTM F2280 bolts), in sizes greater than 1 inch nominal diameter, within the scope of this program is ~~not~~ exempt from volumetric examination unless ~~additional justification is provided~~ plant specific OE has identified cracking of these bolt materials.

5. ***Monitoring and Trending:*** The ASME Class 1, 2, 3, and MC component supports are examined periodically, as specified in Table IWF-2500-1. As required by IWF-2420(a), the sequence of component support examinations established during the first inspection interval is repeated during each successive inspection interval, to the extent practical. Component supports whose examinations do not reveal unacceptable degradation are accepted for continued service. Verified changes of conditions from prior examination are recorded in accordance with IWA-6230. Component supports whose examinations reveal unacceptable conditions and are accepted for continued service by corrective measures or repair/replacement activity are reexamined during the next inspection period. When the reexamined component support no longer requires additional corrective measures during the next inspection period, the inspection schedule may revert to its regularly scheduled inspection. Examinations that reveal indications which exceed the acceptance standards and require corrective measures are extended to include additional examinations in accordance with IWF-2430. If a component support does not exceed the acceptance standards of IWF-3400 but is repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.

6. ***Acceptance Criteria:*** The acceptance standards for visual examination are specified in IWF-3400. IWF-3410(a) identifies the following conditions as unacceptable:

(a) Deformations or structural degradations of fasteners, springs, clamps, or other support items;
(b) Missing, detached, or loosened support items, including bolts and nuts;
(c) Arc strikes, weld spatter, paint, scoring, roughness, or general corrosion on close tolerance machined or sliding surfaces;
(d) Improper hot or cold positions of spring supports and constant load supports;
(e) Misalignment of supports; and
(f) Improper clearances of guides and stops.

Other unacceptable conditions include:

(a) Loss of material due to corrosion or wear

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10 *Operating Experience:* Degradation of threaded bolting and fasteners has occurred from boric acid corrosion, SCC, and fatigue loading U.S. Nuclear Regulatory Commission (NRC) Inspection and Enforcement (IE) Bulletin 82-02, “Degradation of Threaded Fasteners In the Reactor Coolant Pressure Boundary of PWR Plants,” NRC Generic Letter (GL) 91-17, “Generic Safety Issue 79, Bolting Degradation of Failure in Nuclear Power Plants”). <u>This potential bolting degradation was addressed in NUREG-1950 in comment # 906.</u> SCC has occurred in high-strength bolts used for nuclear steam supply system (NSSS) component supports (EPRI NP-5769). ~~NRC Information Notice (IN) 2009-04 describes deviations in the supporting forces of mechanical constant~~

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~~supports, from code allowable load deviation, due to age-related wear on the linkages and increased friction between the various moving parts and joints within the constant support, which can adversely affect the analyzed stresses of connected piping systems.~~

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

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XI.S3	ASME Section XI, Subsection IWF Inservice inspection (IWF)	This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR 50.55a ASME Section XI, Subsection IWF program. ~~This includes inspections of an additional 5 percent of supports outside of the existing IWF sample population.~~ For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination

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XI.S3	ASME Section XI, Subsection IWF Inservice inspection (IWF)	This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR Part 50.55a ASME Section XI, Subsection IWF program. ~~This includes inspections of an additional 5 percent of supports outside of the existing IWF sample population.~~ For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be performed to detect cracking in addition to the VT-3 examination. If a component support does not exceed the acceptance standards of IWF-3400 but is electively repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.

XI.S4 10 CFR Part 50, Appendix J

Description of Change and Justification (Basis):-

1. Program Description, page XI.S4-1: Clarify that Type B tests are not performed on components for which Type C tests are applicable.
2. Program Description, page XI.S4-1: Delete sentence discussing Type C testing being performed under a different AMP. GALL identifies AMPs other than Appendix J to manage the aging of pressure boundaries. NUREG-1801 Chapter V.C identifies aging management programs for mechanical containment isolation components. The introduction to NUREG-1801 Chapter V.C notes that containment isolation valves for in-scope systems are addressed in the appropriate Section in IV, VII and VIII. The listing of the mechanical containment isolation component AMPs by the Appendix J AMP would be redundant and unnecessary. Use of the process to identify redundant program testing/examination coverages was not intended by NEI 95-10 or 10 CFR 54.
3. Element 1, page XI.S4-2: Delete the requirement in AMP XI.S4 element 1 to identify other SLR AMPs for components that are not managed for aging by AMP XI.S4. For justification, see comment 2 above. (Comment was previously addressed as a comment in attachment to NEI Letter to NRC dated 06-04-15.)

Markup: Page XI.S4-1

XI.S4 10 CFR PART 50, APPENDIX J

Program Description

A typical primary reactor containment system consists of a containment structure containment), and a number of electrical, mechanical, equipment hatch, and personnel air lock penetrations. As described in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," (Appendix J) periodic containment leak rate tests are required to ensure that (a) leakage through these containments or systems and components penetrating these containments does not exceed allowable leakage rates specified in the Technical Specification (TS) and (b) integrity of the containment structure is maintained during its service life.

This aging management program (AMP) credits the existing program required by 10 CFR Part 50 Appendix J~~, and augments it to ensure that all containment pressure-retaining components are managed for age-related degradation~~.

Appendix J provides two options, Option A and Option B, to meet the requirements of a containment leak rate test (LRT) program. Option A is prescriptive with all testing performed on specified periodic intervals. Option B is a performance-based approach. The U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.163, "Performance-Based Containment Leak-Test Program" and Nuclear Energy Institute (NEI) 94-01, Industry Guideline for Implementing Performance-Based Option for 10 CFR Part 50, Appendix J, as approved by the NRC final safety evaluation for NEI 94-01, Revision 3, provide additional information regarding Option B. Three types of tests are performed under either Option A or Option B, or a mix as adopted by licensees on a voluntary basis.

Type A integrated leak rate tests (ILRTs) determine the overall containment integrated leakage rate, at the calculated peak containment internal pressure (Pa) related to the design basis loss of coolant accident (LOCA). Type B (containment penetration leak rate) tests detect local leaks and measure leakage across each pressure-containing or leakage-limiting boundary of containment penetrations for which Type C testing is not applicable. Type C (containment isolation valve leak rate) tests detect local leaks and measure leakage across containment isolation valves installed in containment penetrations or lines penetrating the containment. ~~If Type C tests are not performed under this program, they could be included under an Inservice Testing Program for systems containing the isolation valves [e.g., American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (NPPs) or ASME Code, Section XI, Division 1, Rules for inservice inspection (ISI) of NPP Components, incorporated by reference in 10 CFR 50.55a].~~ Appendix J requires a general visual inspection of the accessible interior and exterior surfaces of the containment structures and components (SCs) to be performed prior to any Type A test and at periodic intervals between tests based on the performance of the containment system. The visual inspections required by ASME Section XI, Subsection IWE and ASME Section XI, Subsection IWL are acceptable substitutes for the general visual inspection. The purpose of the Appendix J general visual inspection is to uncover any evidence of structural deterioration that may affect the containment structure leakage integrity or the performance of the Type A test.

Markup: Page XI.S4-2

Evaluation and Technical Basis

1. **Scope of Program:** The scope of the containment LRT program includes the containment system and related systems and components penetrating the containment pressure-retaining or leakage-limiting boundary. Containment pressure-retaining boundary components within the scope of subsequent license renewal (SLR) and excluded from Type B or C Appendix J testing must still be age-managed. Other programs may be credited for aging management of these components~~; however, the component and the proposed AMP should be clearly identified~~.

XI.S5 Masonry Walls

<u>Description of Change and Justification (Basis):-</u>

1. Element 4, page XI.S5-2: Use the 5 year frequency for all masonry walls. The new frequency requirement for inspection every 3 years for unbraced and unreinforced masonry walls is unsupported by operating experience and it is therefore unnecessary. In addition it is also unnecessarily prescriptive since the Element 4 sentence immediately following the subject 3 year frequency sentence notes that provisions exist for more frequent inspections based on the significance of observed conditions such as cracking, loss of material, or other degradation. (Comment was previously addressed as a comment in attachment to NEI Letter to NRC dated 06-04-15.) In addition, during a public meeting on this topic on February 19, 2016 the NRC representative stated that the draft change to the 3 year frequency was based on the 1 year preventative maintenance inspection (by maintenance personnel) recommendation in NCMA TEK 8-1A. NMCA TEK 8-1A (2004) is not a code or standard, but it is rather an informational series document detailing preventative maintenance recommendations to commercial facility owners. It is not applicable to nuclear power plants. However, on page 5 of the NCMA document it recommends "Masonry or building specialists should be consulted for a more thorough inspection every five years." The five year inspection frequency is consistent with our Structures Monitoring and Masonry Wall program inspections by trained and qualified personnel conducted every five years.
2. Element 6, page XI.S5-2: Remove the statement recommending inspection of safety related equipment near or adjacent to masonry walls as it is unclear as to purpose. Program elements 3 and 4 do not address these equipment inspections which are outside of the scope of the Masonry Walls Program and element 6 does not address acceptance criteria for such equipment inspections. The new recommendation or requirement in the Acceptance Criteria Element states: "Safety-related equipment near or adjacent to masonry walls should be inspected to ensure the affected masonry walls are being properly managed for aging." This statement does not make sense in the context of inspecting the nearby equipment rather than inspecting the subject walls. This appears to be a scoping methodology issue which would be inappropriate or unnecessary to include in an aging management program.
3. Generic Efficiency Comment - previously made: Consider combining the XI.S5 Masonry Walls and XI.S6 Structures Monitoring programs since masonry walls are a structural feature or structural component which is a subset of the other structural components which make up a given structure and since masonry walls are typically included in the existing Structures Monitoring programs and procedures of most plants. (Previous NEI comment included with NEI Letter to NRC dated 8-06-14 (No markup provided below)
4. Elements 5 and 6, page XI.S5-2: See also generic comment under IWL regarding monitoring and trending, and markup below. Measurement and recording dimensions and trending of visual indications however infinitesimal is not reasonable and provides no value. Similarly it is not reasonable or necessary to perform a formal technical evaluation to technically justify every indication however small or infinitesimal that can be observed. Trending is adequately performed by comparison to previous results, therefore the word trending can be replaced by the words comparison to previous results as also stated in these elements.

Markup: Page XI.S5-2

4. ***Detection of Aging Effects:*** Visual examination of the masonry walls by qualified inspection personnel is sufficient. In general, masonry walls are inspected every 5 years. ~~Walls that are both unreinforced and unbraced are inspected every 3 years.~~ Provisions exist for more frequent inspections in areas where significant loss of material, cracking, or other signs of degradation are observed to ensure there is no loss of intended function between inspections. In addition, masonry walls that are fire barriers are visually inspected in accordance with GALL-SLR Report AMP XI.M26. Steel elements of masonry walls are visually inspected under the scope of GALL-SLR Report AMP XI.S6.

5. ***Monitoring and Trending:*** Condition monitoring for evidence of shrinkage and/or separation and cracking of masonry is achieved by periodic examination. Inspection results are documented and compared to previous inspections to identify changes or trends in the condition of masonry walls. Crack widths and lengths, and gaps between supports and masonry walls, that approach or exceed evaluation criteria are measured and recorded and then compared to previous inspection results. ~~assessed for trends.~~ Degradation detected from monitoring is evaluated. Photographic records may be used to document and monitor ~~trend~~ the type, severity, extent and progression of degradation.

6. ***Acceptance Criteria:*** For each masonry wall, observed degradation (e.g., shrinkage and/or separation, cracking of masonry walls, cracking or loss of material at the mortar joints and gaps between the supports and masonry walls) are assessed against the evaluation basis to confirm the degradation has not invalidated the original evaluation assumptions or impacted the capability to perform the intended functions. Further evaluation is conducted to determine if corrective action is required when the degradation is determined to impact the intended function of the wall or invalidate its evaluation basis. ~~Safety-related equipment near or adjacent to masonry walls should be inspected to ensure the affected masonry walls are being properly managed for aging.~~ Degraded conditions that exceed evaluation criteria and are accepted without repair or other corrective actions are technically justified or supported by engineering evaluation.

XI.S6 Structures Monitoring

Description of Change and Justification (Basis):-

1. Program Description, page XI.S6-1 & Element 4, page XI.S6-3: Clarify the requirement for supplemental inspection of high-strength structural bolting to exclude ASTM A325 and ASTM A490 bolts (including equivalent twist-off type F1852 and F2280 bolts). This has been done at the end of Element 3 and similar wording is recommended here in Element 4. This will resolve the apparent contradiction between Elements 3 and 4.
2. Program Description, page XI.S6-1 & Element 3, page XI.S6-2: Coatings should not be monitored and inspected as part of this program, except when specifically relied upon to manage specific aging effects for specific structures in the scope of license renewal. The parameters described in Element #3 would generally not provide any indication of the underlying condition of the underlying material except for paint blisters in coatings on carbon steel that are caused by the build-up of corrosion products. Coatings are applied to many different types of materials, including non-ferrous materials, concrete, and masonry walls, where the coating condition will provide little, if any, indication of the underlying material. To include the monitoring and trending of all the various types of coatings applied to all underlying materials, in all structures within the scope of license renewal, is an undue burden that would not be used as a basis for evaluation of the underlying material. In addition, the monitoring would require the development of quantitative acceptance, for all of the various coating systems and applications on the various materials, environmental exposure conditions, and various structures, which are generally not developed since the coatings do not currently have an intended function.
3. Elements 3 and 4, pages XI.S6-2, -3, and -4: Delete requirement to monitor all through-wall leakage of groundwater for volume and chemistry. We are not aware of any OE where groundwater in-leakage has resulted in age related degradation that has resulted in a loss of intended function. Monitoring through-wall leakage of groundwater for volume and chemistry is not feasible in cases of slight seepage, or for cases of leakage from multiple sources either closely or widely spaced, or in cases of intermittent leakage. Under existing programs, any through-wall leakage or groundwater infiltration that is identified is evaluated to determine appropriate further actions. Existing programs include evaluation of leaching to determine if it has resulted in an increase in porosity and permeability sufficient to cause a structurally significant loss of strength. Potential effect of aggressive groundwater is also evaluated. Monitoring for volume and chemistry of leakage water is an option that may be included in these evaluations, if determined appropriate by engineering. However, at present there is no established information available for correlation or evaluation of any data obtained which could be used to assess the data and the concrete physical condition. Recommending and effectively requiring utilities to gather and evaluate such data results in regulatory uncertainty.
4. Element 4, page XI.S6-3: Delete requirement for seasonal variations in groundwater sampling. The recommendation for seasonal quarterly or semi-annual evaluations of ground water is too prescriptive on a generic basis and would not be necessary or effective. Seasonal variations may occur for specific plants, such as cold weather plants that utilize de-icing salts, but each plant should determine when and where to sample groundwater to assess any potential effect on in-scope structures. The existing 5 year frequency from NUREG 1801 should be maintained in the SLR GALL.
5. Element 4, page XI.S6-4: Delete requirement for inspecting inaccessible concrete structural elements exposed to aggressive groundwater/soil on an interval not to exceed 5 years. This is a prescriptive action that may be unnecessarily burdensome and appears to remove

engineering flexibility from the licensee. Other alternatives, such as core boring, examination of other buried/submerged concrete surfaces exposed to similar or more aggressive ground water, or analysis should also be considered. OE does not reflect the need for the new requirement to make inaccessible concrete accessible for inspection when exposed to aggressive groundwater. Also, much of the buried concrete is protected by water-proofing membranes that could easily be damaged during the excavation, leaving the concrete exposed to a harsher environment.

6. Element 5, page XI.S6-4: Limit recording and trending to significant findings for applicable parameters monitored or inspected. Recording and trending may be unreasonable for minor degradations.

7. Element 5, page XI.S6-4: Quantitative baseline inspection data should not need to be established prior to SLR. Prior to the GALL, revision 2, the recording of quantitative inspection data was not always a requirement at all of the plants granted renewed licenses for all parameters, components, and aging effects within the scope of the program. No relevant OE is cited as a basis to backfit this requirement for all plants for all parameters, components, and aging effects. This backfit is an undue burden to generically require that the baseline be developed prior to SLR for all plants for all parameters, components, and aging effects within the scope of the program. A need to develop baseline data prior to SLR could be verified during the RAI of the SLR process as a result of specific OE for specific plants, for specific parameters, components, and aging effects.

   Provide the option of crediting existing baseline inspections that meet the GALL SLR criteria. Plants that can show documented baseline inspection results that meet the new criteria should not have to repeat the baseline inspection.

8. Element 4, page XI.S6-3: The wording added for NDE should be clarified as it could be viewed as prescribing the use of any NDE that is appropriate, or conversely justifying why it is inappropriate to include the use of a certain NDE technique. These potential interpretations could also result in regulatory uncertainty. Structures Monitoring is a visual examination and monitoring program which could include the use of NDE (such as hammer sounding or other techniques) if and when determined necessary or useful by engineering. Visual inspection is also the primary method for concrete inspection under ACI 349.3R, supplemented by non-destructive examination, and invasive examination and testing if deemed necessary by engineering.

9. Element 7, page XI.S6-4: The requirements should reflect the difference between conditions recorded as part of the Structures Monitoring program, which would not be in CAP, and conditions that require repair or replacement, and additional examinations, which would be entered into CAP. Basis: As currently worded, the requirements in elements 3, 4, 5, 6, and 7, could be inferred to require that all examination results, such as those that exceed an ACI 349.3R tier 1 criteria or coating imperfections, be entered into the corrective action program. There is regulatory uncertainty as to how sites would enter the very large amount of information into CAP. This would be an undue additional burden with no benefits since the current requirements in the GALL already require that examination results be recorded and evaluated, with repairs made as required.

   Specifically for concrete, visual inspections of concrete are viewing the concrete cover of the structure. Concrete aging mechanisms visible in the concrete cover have a non-linear affect on containment intended functions. Examination results of small imperfections such as fine cracks, pop-outs, etc, of structures at least 60 year old, do not provide any information that directly relates to an impact on structural integrity until there is significant degradation, e.g., large spalls, cracks that exhibit the potential for displacement, and measurable corrosion of reinforcing steel, that can be repaired. As a result, small imperfections such as fine cracks, pop-outs, etc, of structures at least 60 year old cannot provide information that can be used to determine a significant impact on structural capacity or result in a change to aging management. Entering the CAP for insignificant imperfections of the concrete cover will result in an undue burden, while not providing relevant information that could be used to evaluate the integrity of the structures. A similar rationale applies to coating conditions.

Markup: Page XI.S6-1

Program Description

Implementation of structures monitoring under 10 CFR 50.65 (the Maintenance Rule) is addressed in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.160, and Nuclear Management and Resources Council (NUMARC) 93-01. These two documents and supplemental guidance herein provide guidance for development of licensee-specific programs to monitor the condition of structures and structural components within the scope of the license renewal rule, such that there is no loss of structure or structural component intended function.

The structures monitoring program consists primarily of periodic visual inspections by personnel qualified to monitor structures and components (SCs), ~~including protective coatings,~~ for applicable aging effects from degradation mechanisms, such as those described in the American Concrete Institute (ACI) Standards 349.3R, ACI 201.1R, and Structural Engineering Institute/American Society of Civil Engineers Standard (SEI/ASCE) 11. Visual inspections are supplemented with volumetric or surface examinations to detect stress corrosion cracking (SCC) in high-strength (actual measured yield strength greater than or equal to 150 thousand pound per square inch [ksi] or greater than or equal to 1,034 MPa) structural bolts greater than 1 inch [25 mm] in diameter. However, ASTM A325 and ASTM A490 bolts (or equivalent) used in civil structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications when used in civil structures. Identified aging effects are evaluated by qualified personnel using criteria derived from industry codes and standards contained in the plant current licensing bases, including ACI 349.3R, ACI 318, SEI/ASCE 11, and the American Institute of Steel Construction (AISC) specifications, as applicable.

The program includes preventive actions to ensure structural bolting integrity. The program also includes periodic sampling and testing of groundwater and the need to assess the impact of any changes in its chemistry on below grade concrete structures.

Plant specific evaluations for concrete susceptible to freeze-thaw, leaching and carbonation, or reaction with aggregates mechanisms, or for increased temperatures of concrete structures are included in this AMP, if applicable.

If protective coatings are relied upon to manage the effects of aging for any structures included in the scope of this aging management program (AMP), the structures monitoring program is to address protective coating monitoring and maintenance.

Markup: Page XI.S6-2 and -3

3. ***Parameters Monitored or Inspected***: For each structure/aging effect combination, the specific parameters monitored or inspected depend on the particular structure, SC, or commodity. Parameters monitored or inspected are commensurate with industry codes, standards, and guidelines and also consider industry and plant-specific operating experience. ACI 349.3R and SEI/ASCE 11 provide an acceptable basis for selection of parameters to be monitored or inspected for concrete and steel structural elements and for steel liners, joints, coatings, and waterproofing membranes (if applicable).

For concrete structures, parameters monitored include loss of material, cracking, increase in porosity and permeability, loss of strength, and reduction in concrete anchor capacity due to local concrete degradation. Steel SCs are monitored for loss of material due to corrosion. Structural steel bracing and edge supports associated with masonry walls are inspected for deflection or distortion, loose bolts, **and** loss of material due to corrosion~~, and coating degradation. Painted or coated areas are examined for evidence of flaking, blistering, cracking, peeling, delamination, discoloration, and other signs of distress that could indicate degradation of the underlying material~~.

Bolting within the scope of the program is monitored for loss of material, loose bolts, missing or loose nuts, and other conditions indicative of loss of preload. In addition, concrete around anchor bolts is monitored for cracking. High-strength structural bolts greater than 1 inch [25 mm] in diameter are monitored for stress corrosion cracking (SCC). However, ASTM A325 and ASTM A490 bolts (or equivalent) used in civil structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications when used in civil structures or structural supports.

Accessible sliding surfaces are monitored for indication of significant loss of material due to wear or corrosion, and for accumulation of debris or dirt. Elastomeric vibration isolators, structural sealants, and seismic joint fillers are monitored for cracking, loss of material, and hardening. Groundwater chemistry (pH, chlorides, and sulfates) is monitored periodically to assess its impact, if any, on below-grade concrete structures. ~~If through-wall leakage or groundwater infiltration is identified, leakage volumes and chemistry are monitored and trended for signs of concrete or steel reinforcement degradation.~~

If necessary for managing settlement and erosion of porous concrete subfoundations, the continued functionality of a site dewatering system is monitored.

Markup: Page XI.S6-3 and -4

4. ***Detection of Aging Effects***: Structures are monitored under this program using periodic visual inspection of each structure/aging effect combination by a qualified inspector to ensure that aging degradation will be detected and quantified before there is loss of intended function. It may be necessary to enhance or supplement visual inspections with nondestructive examination, destructive testing and/or analytical methods, based on the conditions observed or the parameter being monitored. Visual inspection of high-strength structural bolting greater than 1 inch [25 mm] in diameter is supplemented with volumetric or surface examinations to detect cracking. However, ASTM A325 and

ASTM A490 bolts (or equivalent) used in civil structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications, and supplemental inspections are not required. Visual inspection of elastomeric elements is supplemented by tactile inspection to detect hardening if the intended function is suspect. The inspection frequency depends on safety significance and the condition of the structure as specified in NRC RG 1.160. In general, all structures are monitored on an interval not to exceed 5 years. The program includes provisions for more frequent inspections based on an evaluation of the observed degradation. The responsible engineer for this program evaluates groundwater chemistry that ~~with a frequency that can identify potential seasonal variations (e.g., quarterly or semiannually). Groundwater~~ is sampled from a location that is representative of the groundwater in contact with structures within the scope of license renewal. Inspector qualifications should be consistent with industry guidelines and standards and guidelines for implementing the requirements of 10 CFR 50.65. Qualifications of inspection and evaluation personnel specified in ACI 349.3R are acceptable for inspection of concrete structures.

Indications of groundwater infiltration or through-concrete leakage are evaluated to determine the need for ~~should lead to~~ corrective actions. Corrective actions may include engineering evaluation, more frequent inspections, or destructive testing of affected concrete to validate existing concrete properties, including concrete pH levels. ~~When leakage volumes allow, corrective actions should include analysis of the leakage pH, along with mineral, chloride, sulfate and iron content in the water.~~

~~The program recommends the use of accepted~~ Visual inspection is the primary method for Structures Monitoring examinations, which may be supplemented by nondestructive examination (NDE) or invasive examination and testing if deemed necessary by engineering ~~techniques, when applicable, to supplement visual inspections.~~

The structures monitoring program addresses detection of aging affects for inaccessible, below-grade concrete structural elements. For plants with nonaggressive ground water/soil (pH > 5.5, chlorides < 500 ppm, or sulfates <1,500 ppm), the program recommends: (a) evaluating the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examining representative samples of the exposed portions of the below grade concrete, when excavated for any reason.

For plants with aggressive ground water/soil (pH < 5.5, chlorides > 500 ppm, or sulfates > 1,500 ppm) and/or where the concrete structural elements have experienced degradation, a plant-specific AMP evaluation or addition accounting for the extent of the degradation experienced should be implemented to manage the concrete aging during the period of extended operation. The plant-specific AMP activities may include~~s~~ evaluations or focused inspections of below-grade, accessible (leading indicator concrete) or inaccessible concrete structural elements exposed to aggressive groundwater/soil, on an interval to be determined by the responsible engineer based on site-specific conditions~~. not to exceed 5 years.~~

Markup: Page XI.S6-4

5. Monitoring and Trending: Results of periodic inspections are documented and compared to previous results to identify changes from prior inspections. Quantitative measurements and qualitative data are recorded and trended for ~~all~~ significant findings for applicable parameters monitored or inspected, and the use of photographs or surveys is encouraged. Photographic records may be used to document and trend the type, severity, extent and progression of degradation.

Quantitative baseline inspection data should be established per the acceptance criteria described herein ~~prior to the period of subsequent license renewal (SLR)~~. Previously performed baseline inspections that meet the quantitative acceptance criteria specified herein are acceptable in lieu of performing a new baseline inspection.

7. **Corrective Actions:** Evaluations are performed for any inspection results that do not satisfy established criteria. If the evaluation results indicate there is a need for a repair or replacement, *or further additional examinations*, corrective actions are initiated in accordance with the corrective action process. ~~Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality~~ 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 SCs within the scope of this program.

XI.S7 Inspection of Water-Control Structures Associated With Nuclear Power Plants

Description of Change and Justification (Basis):-

1. Program Description, page XI.S1: Plant specific evaluations for concrete susceptible to freeze-thaw, leaching and carbonation, aggregate reaction mechanisms, or increased temperatures of concrete structures are included in this AMP, if applicable. There is no reason to require a separate AMP for these aging effects that can be adequately assessed on the accessible side of inaccessible concrete by the XI.S7 AMP.

2. Element 4, page XI.S7-3: Remove requirement that RG 1.127 inspections be conducted under direction of licensed professional engineers as this requirement is unnecessarily limiting and not in alignment with RG 1.127. No operating experience or technical basis founded on aging lessons learned is cited for this change.

3. Element 4, page XI.S7-3: Remove the requirement for frequency of raw water and ground water chemistry evaluation to identify seasonal variations. This constitutes a significant frequency change and is unnecessarily prescriptive. See also comments on groundwater monitoring addressed for XI.S6.

4. Element 4, page XI.S7-3: The requirement for supplemental inspection of high-strength structural bolting should be clarified to exclude ASTM A325 and ASTM A490 bolts (including equivalent twist-off type F1852 and F2280 bolts). This has been done at the end of Element 3 and similar wording is recommended here in Element 4. This will resolve an apparent contradiction between Elements 3 and 4.

5. Element 4, pages XI.S7-3: The new requirements for inspection of submerged concrete subject to nonaggressive raw water or plant specific justification for acceptability of submerged concrete if inspections do not occur within the 5 year interval appears to be overly prescriptive and unnecessarily removes flexibility from the licensee. In addition, no OE has been identified that would require such examinations for all plants at that frequency.

6. Element 4, page XI.S7-3 to XI.S7-4: New requirements for inspection of submerged concrete subject to aggressive groundwater or aggressive raw water for inspection on interval not to exceed 5 years is overly prescriptive and unnecessarily removes flexibility from the licensee. Other options such as inspection of an accessible leading indicator, invasive sampling and testing or an evaluation should be as determined by the responsible engineer based on the plant specific conditions. OE does not reflect the need for the new requirement to make inaccessible concrete accessible for inspection when exposed to aggressive groundwater or raw water.

7. Element 5, page XI.S7-4: Revise the requirement for data recording to be less prescriptive and allow flexibility for site specific conditions and needs, measuring and recording all observed parameters regardless of size is not necessary, and does not add value. Limit recording and trending to significant findings for applicable parameters monitored or inspected. See comments on XI.S2 for this element.

8. Element 7, page XI.S7-4: Eliminate the prescriptive requirements associated with assessing groundwater infiltration or through-concrete leakage for aging effects to allow for site specific assessment. We are not aware of any OE where groundwater in-leakage has resulted in age related degradation that has resulted in a loss of intended function. Monitoring through-wall leakage of groundwater for volume and chemistry is not feasible in cases of slight seepage, or

for cases of leakage from multiple sources either closely or widely spaced, or in cases of intermittent leakage. Under existing programs, any through-wall leakage or groundwater infiltration that is identified is evaluated to determine appropriate further actions. Existing programs include evaluation of leaching to determine if it has resulted in an increase in porosity and permeability sufficient to cause a structurally significant loss of strength. Potential effect of aggressive groundwater is also evaluated. Monitoring for volume and chemistry of leakage water is an option that may be included in these evaluations, if determined appropriate by engineering. However, at present there is no established information available for correlation or evaluation of any data obtained which could be used to assess the data and the concrete physical condition. Recommending and effectively requiring utilities to gather and evaluate such data results in regulatory uncertainty.

9. Elements 1 and 3, Pages XI.S7-1 and 2.; Element 1 - Coatings should not be included in the scope of the XI.S7 Program. Coatings typically are not relied upon to prevent corrosion or protect concrete and as such coatings have typically not been in the scope of license renewal for XI.S7 structures. Element 3 – Specific coatings inspection parameters should be removed since it is the underlying material that is in scope and subject to evaluation.

10. Element 5 - Plants that have performed baseline or subsequent evaluations using quantitative acceptance criteria should not have to perform new baseline evaluations. Similarly early plants that may not have implemented quantitative acceptance or evaluation criteria for all parameters could add a program enhancement to add any necessary criteria and implement subsequent inspections to the new criteria during the subsequent period of extended operation.

Markup: Pages XI.S7-1 and XI.S7-3 to XI.S7-5

Page XI.S7-1

XI.S7 INSPECTION OF WATER-CONTROL STRUCTURES

ASSOCIATED WITH NUCLEAR POWER PLANTS

Program Description

This program describes an acceptable basis for developing an inservice inspection (ISI) and surveillance program for dams, slopes, canals, and other raw water-control structures associated with emergency cooling water systems or flood protection of nuclear power plants (NPPs). The program addresses age-related deterioration, degradation due to environmental conditions, and the effects of natural phenomena that may affect water-control structures. The program recognizes the importance of periodic monitoring and maintenance of water-control structures so that the consequences of age-related deterioration and degradation can be prevented or mitigated in a timely manner. Plant specific evaluations for concrete susceptible to freeze-thaw, leaching and carbonation, aggregate reaction mechanisms, or increased temperatures of concrete structures are included in this AMP, if applicable.

The U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.127, "Inspection of Water-Control Structures Associated with Nuclear Power Plants," provides additional detailed guidance for an inspection program for water-control structures, including guidance on engineering data compilation, inspection activities, technical evaluation, inspection frequency, and the content of inspection reports. NRC RG 1.127 delineates current NRC practice in evaluating ISI programs for water-control structures.

An aging management program (AMP) addressing water-control structures, commensurate with the program elements described below, is expected regardless of whether a plant is committed to NRC RG 1.127. Aging management of water-control structures and components (SCs) may be included in "Structures Monitoring" (GALL-SLR Report AMP XI.S6); however, details pertaining to water-control structures, as described herein, should be explicitly incorporated and identified in GALL-SLR Report AMP XI.S6 program attributes if this approach is taken. Attributes evaluated below do not include inspection of dams. For dam inspection and maintenance, programs under the regulatory jurisdiction of the Federal Energy Regulatory Commission (FERC) or the U.S. Army Corps of Engineers (USACE), continued through the subsequent period of extended operation, are adequate for the purpose of aging management. For programs not falling under the regulatory jurisdiction of FERC or the USACE the staff evaluates the effectiveness of the AMP based on compatibility to the common practices of the FERC and USACE programs.

Evaluation and Technical Basis

1. ***Scope of Program:*** The scope includes raw water-control structures associated with emergency cooling water systems or flood protection of NPPs. The water-control structures included in the program are concrete structures, embankment structures, spillway structures and outlet works, reservoirs, cooling water channels and canals, flood protection walls and gates, and intake and discharge structures. The scope of the program also includes structural steel, and high-strength structural bolting (actual measured yield strength greater than or equal to 150 kilo-pounds per square inch [150 ksi] or greater than or equal to 1,034 megapascals (MPa) associated with water-control structures, steel or wood piles and sheeting required for the stability of embankments and channel slopes, and miscellaneous steel, such as sluice gates and trash racks. ~~Associated coatings are also included as an indication of the condition of the underlying material.~~

Page XI.7-2

Parameters Monitored or Inspected: NRC RG 1.127 identifies parameters to be monitored and inspected for water-control structures.

Parameters to be monitored and inspected for concrete structures are those described in American Concrete Institute (ACI) 201.1R and ACI 349.3R. These include cracking, movements (e.g., settlement, heaving, and deflection), conditions at junctions with abutments and embankments, loss of material, increase in porosity and permeability, seepage, and leakage.

Parameters to be monitored and inspected for earthen embankment structures include settlement, depressions, sink holes, slope stability (e.g., irregularities in alignment and variances from originally constructed slopes), seepage, proper functioning of drainage systems, and degradation of slope protection features. Parameters monitored for channels and canals include erosion or degradation that may impose constraints on the function of the cooling system and present a potential hazard to the safety of the plant. Submerged emergency canals (e.g., artificially dredged canals at the river bed or the bottom of the reservoir) are monitored for sedimentation, debris, or instability of slopes that may impair the function of the canals under extreme low flow conditions.

Further details of parameters to be monitored and inspected for these and other water-control structures are specified in Section C of NRC RG 1.127.

Steel components are monitored for loss of material due to corrosion.

Painted or coated areas are examined for ~~evidence of flaking, blistering, cracking, peeling, delamination, discoloration, and other~~ signs of distress that could indicate degradation of the underlying material.

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Accessible sliding surfaces are monitored for indication of loss of material due to wear or corrosion, and accumulation of debris or dirt.

Wooden components are monitored for loss of material and change in material properties.

4. ***Detection of Aging Effects:*** Inspection of water-control structures is conducted under the direction of ~~licensed professional~~ qualified engineers experienced in the investigation, design, construction, and operation of these types of facilities. Qualifications of inspection and evaluation personnel specified in ACI 349.3R are acceptable for reinforced concrete water control structures. Visual inspections are primarily used to detect degradation of water-control structures. In some cases, instruments have been installed to measure the behavior of water-control structures. Available records and readings of installed instruments are to be reviewed to detect any unusual performance or distress that may be indicative of degradation. Periodic inspections are to be performed at least once every 5 years. This interval has been shown to be adequate to detect degradation of water-control structures before a loss of an intended function. The program includes provisions for increased inspection frequency based on an evaluation of the observed degradation. The program also includes provisions for special inspections immediately following the occurrence of significant natural phenomena, such as large floods, earthquakes, hurricanes, tornadoes, or intense local rainfalls. The responsible engineer for this program evaluates raw water and ground water chemistry for the potential to affect reinforced concrete on a 5 year frequency. ~~with a frequency that can identify potential seasonal variations (e.g. quarterly or semiannually)~~. Ground water is sampled from a location that is representative of the water in contact with structures within the scope of subsequent license renewal (SLR).

Visual inspection of high-strength (actual measured yield strength ≥ 150 ksi or 1,034 MPa) structural bolting greater than 1 inch [25 mm] in diameter is supplemented with volumetric or surface examinations to detect cracking, with the exception of ASTM A325 and ASTM A490 bolts (including equivalent twist-off type F1852 and F2280 bolts) used in civil structures and structural supports, which have not shown to be prone to SCC.

The program addresses detection of aging affects for inaccessible, below-grade, and submerged concrete structural elements. For plants with nonaggressive raw water and ground water/soil (pH > 5.5, chlorides < 500 parts per million [ppm], or sulfates < 1,500 ppm), the program includes (a) evaluation of the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examination of representative samples of the exposed portions of the below-grade concrete when excavated for any reason. Submerged concrete structures may be inspected during periods of low tide or when dewatered and accessible. ~~Plant-specific justification is provided in the subsequent license renewal application (SLRA) for the acceptability of submerged concrete if inspections do not occur within the 5 year interval.~~ Areas covered by silt, vegetation, or marine growth are not considered inaccessible and are cleaned and inspected in accordance with the standard inspection frequency. The need for inspection and the interval between inspections for submerged concrete is to be determined by the responsible engineer. This interval should be based on site specific conditions.

For plants with aggressive raw water (pH < 5.5, chlorides > 500 ppm, or sulfates > 1,500 ppm) or groundwater/soil and/or where the structural elements have experienced degradation, a plant-specific AMP accounting for the extent of the degradation experienced is implemented to manage aging during the subsequent period of extended operation. The plant-specific AMP evaluation or addition includes evaluation or inspections of below-grade, accessible (leading indicator concrete) or inaccessible structural elements exposed to aggressive raw water or aggressive ground water~~/soil.~~

Page XI.S7-4

on an interval ~~not to exceed 5 years, and submerged structural elements are visually inspected (e.g., dewatering, divers) at least once every 5 years.~~ to be determined by the responsible engineer. This interval should be based on site specific conditions.

5. ***Monitoring and Trending:*** Results of periodic inspections are documented and compared to previous results to identify changes from prior inspections. Quantitative measurements and qualitative data are recorded and trended for ~~all~~ significant findings for applicable parameters monitored or inspected, and the use of photographs or surveys is encouraged. Photographic records may be used to document and trend the type, severity, extent and progression of degradation.

Quantitative baseline inspection data should be established ~~per the acceptance criteria described herein prior to,~~ during the subsequent period of extended operation.

6. ***Acceptance Criteria:*** "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R provide acceptance criteria (including quantitative criteria) for concrete and specifies criteria for further evaluation. Although not required, plant-specific acceptance criteria based on Chapter 5 of ACI 349.3R are acceptable. Acceptance criteria for earthen structures, such as canals and embankments, are consistent with programs falling within the regulatory jurisdiction of the FERC or the USACE. Loose bolts and nuts, cracked high-strength bolts, and degradation of piles and sheeting are accepted by engineering evaluation or subject to corrective actions. Engineering evaluation is documented and based on codes, specifications, and standards such as AISC specifications, Structural Engineering Institute/American Society of Civil Engineers Standard (SEI/ ASCE) 11-99, "Guideline for Structural Condition Assessment of Existing Buildings," and those referenced in the plant's current licensing basis (CLB).

7. ***Corrective Actions:*** Results that do not meet the acceptance criteria are addressed as conditions adverse to quality or significant conditions adverse to quality 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 Generic Aging Lessons Learned for Subsequent License Renewal (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 SCs within the scope of this program.

When inspection findings indicate that significant changes have occurred, the conditions are to be evaluated. This includes a technical assessment of the causes of distress or abnormal conditions, an evaluation of the behavior or movement of the structure, and recommendations for remedial or mitigating measures. Indications of groundwater infiltration or through-concrete leakage are assessed for aging effects. This may include engineering evaluation, more frequent inspections, or destructive testing of affected concrete to validate existing concrete properties, including concrete pH levels. ~~When leakage volumes allow, assessments include analysis of the leakage pH, along with mineral, chloride, sulfate and iron content in the water.~~ The appropriate approach and response to groundwater assessment should be determined by the responsible engineer based on site specific conditions.

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

SLR-GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR			
#	**Location of Change**	**Description of Change**	**Justification For Change**
1	XI.S1- IWE program (from pages X1 01-44 & 45)	1. Leak rate testing should be deleted. 2. References to liner bulges should be deleted. 3. The additional supplemental surface examinations need more detail. 4. Generic requirements for volumetric examinations of areas only accessible from one side should be deleted. 5. The statement about surface examination of structural bolting should be deleted.	1. The Appendix J program addresses leak rate testing. The IWE mentions leak rate testing where visual or surface examinations may not be adequate but does not contain the same level of detail as the Appendix J program. 2. See other comments for more detailed justification. In general, liner bulges are a normal result of a liner plate and there is no OE to indicate that liner bulges are an indication of corrosion. 3. It appears that some words were missing. 4. See other comments for more detailed justification. In general, this is beyond the Code, there is no relevant OE to justify this additional work. 5. This appears to be in error, as volumetric examination has been recommended to detect cracking where applicable of structural bolting, surface examination (PT or MT) is impractical for threaded areas and would require removal of bolts, also too much detail for AMP summary.
2	XI.S2- IWL program (from pages X1 01-45)	1. Note that ACI 349.3R Chapter 5 is a criteria to determine the level of evaluation required for examination results.	1. See other comments for more detailed justification. In general, ACI 349.3R Chapter 5 is an evaluation criteria
3	XI.S3- IWF program	1. Delete the addition of 5% more supports to the scope of the program.	1. See other comments for more detailed justification. In general, this is beyond the scope

SLR-GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR			
	(from pages X1 01-45 & 46)	2. Add a clarification that volumetric examination of A325 and A490 bolts for cracking is not required.	of the ASME Code, Section XI and 10 CFR 50.55a, and there is no relevant OE to justify this additional requirement. 2. See other comments for more detailed justification. In general, these bolt materials are carbon steel bolting materials not susceptible to SCC.
4	XI.S6- Structures Monitoring (from pages X1 01-46 & 47)	1. Delete the reference to coatings. 2. Delete excessive detail with respect to recording results.	1. This comment is addressed in more detail under other comments for the AMP. In general, the condition provides little useful information regarding the underlying coating, except potentially for coating blisters due to corrosion of carbon steel. 2. This comment is addressed in more detail under other comments for the AMP. In general, the requirement is too broad to apply quantitative measurements and trending to all applicable parameters monitored or inspected since not all parameters lend themselves to quantitative measurements and not all parameters can be usefully trended.
5	XI.S7- Inspection of Water- Control Structures Associated with Nuclear Power Plants (from page X1 01-47)	Delete the phrase "for all applicable parameters monitored or inspected".	This comment is addressed in more detail under other comments for the AMP. In general, the requirement is too broad to apply to quantitative measurements to all applicable parameters monitored or inspected since not all parameters lend themselves to quantitative measurements and not all parameters can be usefully trended.

SLR-GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR			
6	XI.S8- Protective Coating Monitoring and Maintenance (from pages X1 01-47 & 48)	Delete information referring to design purposes of Service Level 1 protective coatings.	The design purposes of coatings with respect to potential corrosion protection or decontamination are not relevant for this aging management program, which is intended to post-accident operability of ECCS. The UFSAR would be the appropriate place to address the design purposes of the coatings. This section is intended to describe aging management programs, not the design purposes of coatings.
7	X.S1- Concrete Containment Tendon Prestress (from page X01-3)	Allow for corrective actions to maintain the minimum required prestressing force.	Containment tendon prestress force monitoring programs allow and require corrective actions to maintain the minimum required prestress force, as required. The programs are not limited to only analytical justification of the trend line.

Attachment 8
Mark-up Changes to the SLR-GALL
(Strikethrough for deletions and underline for additions)

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL-SLR Report and SRP- SLR Chapter**
XI.S1 (from pages X1 01-44 & 45)	ASME Section XI, Subsection IWE Inservice Inspection (IWE)	This program is in accordance with ASME Section XI, Subsection IWE, consistent with 10 CFR 50.55a "Codes and standards," with supplemental recommendations. The AMP includes periodic visual, surface, <u>and</u> volumetric examinations~~, and leak rate testing~~, where applicable, of metallic pressure-retaining components of steel containments and concrete containments for signs of degradation, damage, irregularities ~~including liner plate bulges~~, and for coated areas distress of the underlying metal shell or liner, and corrective actions. Acceptability of inaccessible areas of steel containment shell or concrete containment steel liner is evaluated when conditions found in accessible areas, indicate the presence of, or could result in, flaws or degradation in inaccessible areas. This program also includes aging management for the potential loss of material due to corrosion in the inaccessible areas of the BWR Mark I steel containment~~, and surface examination for the detection of cracking of structural bolting~~. In addition, the program includes supplemental surface or enhanced examinations to detect cracking for <u>stainless steel portions of containment penetrations where there is no fatigue analysis</u> ~~specific components [identify components], and supplemental volumetric examinations by sampling locations susceptible~~	SLR program is implemented prior to the subsequent Period of extended operation	GALL II / SRP 3.5

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP- SLR Chapter
		~~to loss of thickness due to corrosion of containment shell or liner that is inaccessible from one side~~. Inspection results are compared with prior recorded results in acceptance of components for continued service.		
XI.S2 (from page X1 01-45)	ASME Section XI, Subsection IWL Inservice Inspection (IWL)	This program consists of (a) periodic visual inspection of concrete surfaces for reinforced and pre-stressed concrete containments, (b) periodic visual inspection and sample tendon testing of un-bonded post-tensioning systems for pre-stressed concrete containments for signs of degradation, assessment of damage, and corrective actions, and testing of the tendon corrosion protection medium and free water. Measured tendon lift-off forces are compared to predicted tendon forces calculated in accordance with RG 1.35.1. The Subsection IWL requirements are supplemented to include quantitative acceptance criteria for <u>evaluation of</u> concrete surfaces based on the "Evaluation Criteria" provided in Chapter 5 of ACI 349.3R.	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5
XI.S3 (from pages X1 01-45 & 46)	ASME Section XI, Subsection IWF Inservice inspection (IWF)	This program consists of periodic visual examination of piping and component supports for signs of degradation, evaluation, and corrective actions. This program recommends additional inspections beyond the inspections required by the 10 CFR 50.55a ASME Section XI, Subsection IWF program. ~~This includes inspections of an additional 5 percent of supports outside of the existing IWF sample population.~~ For high-strength bolting in sizes greater than 1 inch nominal diameter, volumetric examination comparable to that of ASME Code Section XI, Table IWB-2500-1, Examination Category B-G-1 should be performed to	SLR program is implemented prior to the subsequent period of extended operation	GALL II / SRP 3.5 GALL III / SRP 3.5

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR

AMP	GALL-SLR Program	Description of Program	Implementation Schedule*	Applicable GALL-SLR Report and SRP- SLR Chapter
		detect cracking in addition to the VT-3 examination. <u>However, ASTM A325 and ASTM A490 bolts (or equivalent) used in civil and support structures have not been shown to be prone to SCC. Therefore, SCC potential need not be evaluated for high-strength bolts of those classifications when used in support structures.</u> If a component support does not exceed the acceptance standards of IWF-3400 but is electively repaired to as-new condition, the sample is increased or modified to include another support that is representative of the remaining population of supports that were not repaired.		

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL-SLR Report and SRP- SLR Chapter**
XI.S6 (from pages X1 01-46 & 47)	Structures Monitoring	This program consists of periodic visual inspection and monitoring the condition of concrete and steel structures, structural components, component supports, and structural commodities to ensure that aging degradation (such as those described in ACI 349.3R, ACI 201.1R, SEI/ASCE 11, and other documents) will be detected, the extent of degradation determined, evaluated, and corrective actions taken prior to loss of intended functions. Inspections also include seismic joint fillers, elastomeric materials; and steel edge supports and steel bracings associated with masonry walls, and periodic evaluation of groundwater chemistry and opportunistic inspections for the condition of below grade concrete~~, and of protective coatings for substrate materials~~. Quantitative results (measurements) and qualitative data from periodic inspections are trended <u>for significant findings</u> with photographs and surveys for the type, severity, extent, and progression of degradation. The acceptance criteria are derived from applicable consensus codes and standards. For concrete structures, the program includes personnel qualifications and quantitative acceptance criteria of ACI 349.3R.	SLR program is implemented prior to the subsequent period of extended operation	GALL VII / SRP 3.3 GALL II / SRP 3.5 GALL III / SRP 3.5 GALL VI / SRP 3.6

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL-SLR Report and SRP- SLR Chapter**
XI.S7 (from page X1 01-47)	Inspection of Water-Control Structures Associated with Nuclear Power Plants	This program consists of inspection and surveillance of raw- water control structures associated with emergency cooling systems or flood protection. The program also includes structural steel and structural bolting associated with water- control structures. In general, parameters monitored should be in accordance with Section C.2 of R.G. 1.127 and quantitative measurements should be recorded ~~for all applicable parameters monitored or inspected~~. Inspections should occur at least once every 5 years. Structures exposed to aggressive water require additional plant- specific investigation.	SLR program is implemented prior to the subsequent period of extended operation	GALL III / SRP 3.5

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL-SLR Report and SRP- SLR Chapter**
XI.S8 (from pages X1 01-47 & 48)	Protective Coating Monitoring and Maintenance	This program ensures that a monitoring and maintenance program implemented in accordance with RG 1.54 is adequate for the subsequent period of extended operation. The program consists of guidance for selection, application, inspection, and maintenance of protective coatings~~. Maintenance of Service Level I coatings~~ applied to carbon steel and concrete surfaces inside containment (e.g., steel liner, steel containment shell, structural steel, supports, penetrations, and concrete walls and floors) ~~serve to prevent or minimize loss of material due to corrosion of carbon steel components and aids in decontamination~~. Degraded coatings in the containment are assessed periodically to ensure post-accident operability of the ECCS.	SLR program is implemented prior to the subsequent period of extended operation	GALL III / SRP 3.5

GALL Table XI-01. FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management of Applicable Systems for SLR				
AMP	**GALL-SLR Program**	**Description of Program**	**Implementation Schedule***	**Applicable GALL-SLR Report and SRP- SLR Chapter**
X.S1 (from page X01-3)	Concrete Containmen t Tendon Prestress	The prestressing tendons are used to impart compressive forces in the prestressed concrete containments to resist the internal pressure inside the containment that would be generated in the event of a LOCA. The prestressing forces generated by the tendons diminish over time due to losses in prestressing forces in the tendons and in the surrounding concrete. The prestressing force analysis and evaluation has been completed and determined to remain within allowable limits to the end of the subsequent period of extended operation, ~~and~~ or corrective actions implemented to ensure that the trend lines of the measured prestressing forces will stay above the minimum required prestressing forces for each group of tendons to the end of this period.	Existing program	GALL II / SRP 4.5

Attachment 7

NUREG-2191 and NUREG-2192 Electrical Comments

AMP Comments Included:

X.E1	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
X.E2	Electrical Insulation for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits
XI.E3A	Electrical Insulation for Inaccessible Medium Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
XI.E3B	Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
XI.M3C	Electrical Insulation for Inaccessible Low Voltage Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
XI.M4	Metal Enclosed Bus
XI.M5	Fuse Holders
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
XI.E7	High Voltage Insulators
X.E1	Environmental Qualification of Electrical Components

Attachment 7
NUREG-2191 and NUREG-2192 Electrical Comments

XI.E1 - ELECTRICAL INSULATION FOR ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Description of Change and Justification	
XI.E1 - 1	Program Description:
	Comment: Condition monitoring using non-visual testing methods on a sample population of cables that were found in adverse local environments (ALE) during the 1st and 2nd PEO. Recommend specifying an acceptable sample size as modeled in the Electrical Connections AMP (E6) – 20% up to 25 cables. Same for the Table 3.0-1 and Table XI-01 discussions in the SRP.
XI.E1 - 2	Element 3: Parameters Monitored or Inspected
	Comment: There is no mention of the AMP's "testing portion" parameters is made in this element. Consider taking credit for existing surveillance / tests on those cables (as modeled in the E2 and E6 AMPs).
XI.E1 - 3	Element 6: Acceptance Criteria
	Comment: The use of the word "free" is an unachievable acceptance criteria There will always be some level of indication of aging effects on the cable or connection insulation surface. Recommend: Visual inspection results show that accessible cable and connection insulation material are free from **<u>unacceptable</u>** visual indications of surface abnormalities that indicate cable or connection insulation aging effects exist. On a positive note, the SLR GALL XI.E1 Report Element 6 definition is very well written: *"An unacceptable indication is defined as a noted condition or situation, if left unmanaged, could potentially lead to a loss of the intended function."* Consider its use in the other electrical AMPs.

XI.E1 - 4	SRP Section 3.6
	Comment: Table 3.0-1 and Table XI-01 implementation Schedule states “First inspection for license renewal....” Does the definition of “inspection” now include the testing portion? Visual inspection + Cable Tests = Inspection

XI.E1 Markup

Page XI.E1-3 Markup
Program Description (cables, connection electrical insulation) might be induced during accident conditions.” Since the cable and connection electrical insulation is not subject to the **EQ** ~~EA~~ requirements of 10 CFR 50.49, an AMP is needed to manage the aging mechanisms and effects for the

XI.E2 - ELECTRICAL INSULATION FOR ELECTRICAL CABLES AND CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS USED IN INSTRUMENTATION CIRCUITS

<table>
<tr><td colspan="2"><u>Description of Change and Justification</u></td></tr>
<tr><td>XI.E2 - 1</td><td>Program Description:</td></tr>
<tr><td></td><td>Comment:

Having the same ALE discussion in two places results in confusion in later revisions; the definition of an ALE for E2 cables should be the same as E1 cables.

Example:
E1 – Line 16, 17 - An adverse localized environment is an environment that exceeds the most limiting environment (e.g., temperature, radiation, or moisture) for the electrical insulation of cable and connectors.

E2 – Line 19, 20, 21 - An adverse localized environment is an environment that exceeds based on the most limiting environment (e.g., temperature, radiation, or moisture) for the insulation of cable and connections or insulation material.

Recommend referring the ALE discussion to the E1 program discussion.

XI. E2-1 line 19, "...and environment that exceeds..." exceeds what?</td></tr>
</table>

XI.E3A - ELECTRICAL INSULATION FOR INACCESSIBLE MEDIUM VOLTAGE POWER CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Description of Change and Justification	
XI.E3A - 1	Program Description:
	Comment: The focus of these AMPs is to manage cable insulation deterioration due to significant moisture. The discussion of the general definition of an ALE in AMPs E3A, E3B and E3C is out of place and confusing. Recommend removing the ALE discussion from E3 and just point the E1 program discussion if necessary.
XI.E3A - 2	Element 2: Preventive Actions
	Event driven inspections - Clarify "...thawing of ice and snow..." to "...**rapid** thawing of ice and snow..." (page XI.E3A-3, XI.E3B-4, XI.E3C-4)

XI.E3B - ELECTRICAL INSULATION FOR INACCESSIBLE INSTRUMENT AND CONTROL CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Description of Change and Justification	
XI.E3B - 1	Program Description:
	Comment: Little known significant operating experience that warrants performing preventive actions or condition monitoring activities on submerged I&C cables. Recommend a plant specific AMP for susceptible insulation materials or local operating experience. Recommend using: • One-time assessment prior to SPEO • Specify an acceptable sample size modeled on the Electrical Connections AMP (E6) – 20% up to 25 cables (aids in the staff's review efficiency) • Credit existing surveillance activities for cable conditioning (modeled on the E6 AMP) Based on the information gathered, further activities can be determined.

XI.E3C - ELECTRICAL INSULATION FOR INACCESSIBLE LOW VOLTAGE POWER CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Description of Change and Justification	
XI.E3C - 1	Program Description:
	Comment: Little known significant operating experience that warrants performing preventive actions or condition monitoring activities on submerged low voltage power cables. Recommend a plant specific AMP for susceptible insulation materials or local operating experience. Table 3.0-1 and Table XI-01 mentions sample method; the GALL AMP report does not discuss using sample method when large numbers of low voltage power cables are in the scope of the program. Recommend using: • One-time assessment prior to SPEO • Specify an acceptable sample size modeled on the Electrical Connections AMP (E6) – 20% up to 25 cables (aids in the staff's review efficiency) • Credit existing surveillance activities for cable conditioning (modeled on the E6 AMP) Based on the information gathered, further activities can be determined.

XI.E4 – METAL ENCLOSED BUS

Description of Change and Justification	
XI.E4 - 1	Program Description:
	Comment: Bolted Connection Inspections should remain on a sample basis – the MEB AMPs have been effective using a sample method. The cable bus duct discussion seems out of place since the AMR line items point to a plant-specific program. Recommend relocating the cable bus discussion to the SRP Section 3.6.2.2.2. The SLR GALL E4 Program Description can point to the SRP.
XI.E4 - 2	Element 4: Detection of Aging Effects (Page XI.E4-3)
	Comment: Thermography should be considered a condition monitoring test, not a visual inspection method. Recommend the following change (Page XI.E4-3): 26 The first inspection for measuring connection resistance **<u>or thermography</u>** is completed prior to the 27 subsequent period of extended operation and every 10 years thereafter. This is an 30 *As an alternative to* **<u>thermography or</u>** *measuring connection resistance of bolted connections, for* 31 accessible bolted connections covered with heat shrink tape, sleeving, insulating boots,
XI.E4 - 3	Element 7: Corrective Actions
	Comment: Corrective actions are prescriptive as written. Recommend the following change (Page XI.E4-4): 22 Corrective actions are taken and an engineering evaluation is performed when the 23 *acceptance criteria are not met. Corrective actions* **<u>may</u>** *include, but are not limited, to*

XI.E5 - FUSE HOLDERS

Description of Change and Justification	
XI.E5 - 1	Program Description:
	Comment: Strengthen the alignment with the XI.E1 AMP Report. Recommend an explicit statement: Insulation portion of fuse blocks in the E5 AMP scope is evaluated in E5 AMP. Insulation portion of fuse blocks not in E5 AMP scope is evaluated in the E1 AMP.
XI.E5 - 2	Element 7: Corrective Actions
	Comment: The discussion should be edited to tailor it to the scope of this program; the generic discussion does not apply (i.e. recalibration and circuit troubleshooting). Recommend using the element 7 discussion in XI.E7 has a more suitable model for the E5 AMP.

XI.E6 - ELECTRICAL CABLE CONNECTIONS NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Description of Change and Justification	
XI.E6 - 1	Program Description:
	Comment: Little known significant operating experience that warrants performing periodic condition monitoring activities on electrical cable connections. Recommend a plant specific AMP for local operating experience. Recommend using: • One-time assessment prior to SPEO Based on the information gathered, further periodic activities can be determined.

XI.E7 - HIGH VOLTAGE INSULATORS

Description of Change and Justification	
XI.E7 - 1	General Comment
	Comment: Two aging effects of concern should be so delineated throughout GALL program discussion. This new program is to manage contamination of HVI from environmental conditions and loss of material of the external surfaces of metallic components of HVI due to mechanical wear or corrosion. The program description and elements 1 through 6, at a minimum need to address both of these potential aging effects or state that it is not applicable. For example, element 2 should state that there are no program preventative actions for loss of material of metallic components. As another example, in element 3 the frequency of inspection is 5 years instead of twice per year for insulators that are coated. Not aware of information that supports coating of insulator surfaces would prevent loss of material of metallic components.
XI.E7 - 2	Program description
	Comment: "Adverse localized environment" discussion is not appropriate here in context of how it is defined in the other AMPs. Some switchyards include intermediate medium voltage distribution systems that utilize post insulators – recommend refining the HVI commodity definition.
XI.E7 - 3	Element 1
	Comment: High voltage insulators (HVI) could be in scope for SLR for many reasons, not just those credited for recovery of offsite power. Recommend clarifying the phrase – "within the scope of the subsequent period of extended operation."

XI.E7 - 4	Element 2
	Comment: Inspections do not prevent the build of HVI contamination. Use of a corona camera is more appropriate, rather than thermography for this AMPs.
XI.E7 - 5	Element 3
	Comment: Twice per year inspection is too prescriptive. Recommend the inspection frequency should be based on plant operating experience (use the E3 cable vault inspection frequency model).
XI.E7 - 6	Element 6
	Comment: Use of the word “free” is an unachievable acceptance criteria. There will always be some level of contamination on the high-voltage insulator surface. There will be some small amount of acceptable material loss on the metallic parts of the HVI. Consider the following change: 17 6. Acceptance Criteria: High voltage insulator surfaces are free of **<u>unacceptable</u>** contamination such as 18 significant salt or dust buildup or other contaminants. Metallic parts must be free of **<u>unacceptable</u>** loss 19 of materials due to pitting, crevice, and general corrosion. Acceptance criteria will be

X.E1 ENVIRONMENTAL QUALIFICATION OF ELECTRIC COMPONENTS

Description of Change and Justification	
X.E1 - 1	**Underlying Assumptions** (Page X.E1-4). Statement is made that the first periodic inspection is to be performed prior to the subsequent period of license renewal. This, if implemented, creates additional requirements for the EQ Program and EQ equipment prior to SLR.
	Comment: Clarify that the SLR AMP X.E1 Report is limited to passive components only. The intent of X.E1 is to manage cable and connection insulation material. Recommend defining EQ electrical equipment in the GALL Report to mean cable and connection insulation material (See SLR SRP Section 2.5.3). Avoids conflicts with Regulatory Guide 1.89 and 10CFR50.49 attributes for active equipment.
X.E1 - 2	**References** (Page X.E1-8): Delete "2015" after 10 CFR references.
	Comment: Providing the year date of 2015 is irrelevant related to the Code of Federal Regulations.
X.E1 - 3	**References** (Pages X.E1-8 and X.E1-9): Delete international cable related references.
	International Cable-related references are not applicable to the US-related SLR activities (Vienna, IAEA, Japan, France).
X.E1-4	SRP Section 4.4.1.1.1
	Statement was added on Line 35 & Line 36 (Section 4.4.1.1.2) regarding 10 CFR 50.49 (L) required to be addressed. This is the Legacy upgrade requirement of 10 CFR 50.49 unless "Sound Reasons To The Contrary" exists and is documented. This applies to NUREG-0588 CAT II equipment in this section, but this same statement was not added to SRP Section 4.4.1.1.1 for DOR equipment, which also applies.

X.E1 – ENVIRONMENTAL QUALIFICATION OF ELECTRIC COMPONENTS - Markups

Program Description

Page X.E1-1

24 Operating plants requesting subsequent license renewal shall meet the qualification
25 requirements of 10 CFR 50.49 and license renewal aging management provisions of 10 CFR
26 Part 54 for certain **passive** electrical equipment important to safety. 10 CFR 50.49 defines the scope of
27 equipment to be included in an EQ program, requires the preparation and maintenance of a list

Page X.E1-2

25 Reanalysis of an aging evaluation to extend the qualification of **passive** equipment qualified under the
26 program requirements of 10 CFR 50.49(e) is performed as part of an EQ program. Important

Page X.E1-3
1 evaluate the TLAA of EQ of **passive** electrical equipment and the reanalysis shows that a 80-year
2 qualification is established prior to the plant entering the subsequent period of
3 extended operation.

Page X.E1-4

21 In areas within a NPP, the actual ambient environments (e.g., temperature, radiation, or
22 ~~moisture~~) may be less severe than the anticipated plant design environment. However, in a
23 limited number of localized areas, the actual environments may be more severe than the plant

Page X.E1-5

3 • Visual inspection of equipment and environmental monitoring (e.g., periodic
4 environmental monitoring) of accessible EQ equipment including, as appropriate, EQ
5 equipment identified by (a, b, c, d, and e above).

6 Accessible **passive** electrical EQ equipment is visually inspected and the **passive** EQ equipment environment
7 evaluated every 10 years to identify in-scope electrical equipment subjected to an adverse
8 localized environment and evaluate the impact on EQ electrical equipment including

qualified life. The first periodic inspection is to be performed prior to the subsequent period of extended operation.

The periodic visual inspection is specifically intended to address **passive** EQ electrical equipment where most if not all equipment subjected to an adverse localized environment is accessible. **Passive** EQ equipment from accessible areas is inspected and the applicant shows that it represents, with reasonable assurance, all in-scope **passive** EQ equipment in the adverse localized environment.

Scope of Program

Scope of Program: EQ programs apply to certain electrical equipment that are important to safety and could be exposed to harsh environment accident conditions, as defined in 10 CFR 50.49 and RG 1.89, Rev.1. **This report applies to passive EQ equipment.**

Detection of Aging Effects:

4. ***Detection of Aging Effects***: 10 CFR 50.49 does not require the detection of aging effects for in-service equipment. EQ program actions that could be viewed as detection of aging effects including, (a) inspecting or testing equipment periodically with particular emphasis on condition assessment of equipment EQ including a 10 year periodic inspection of accessible in-scope **passive** EQ components to identify EQ components subject to an adverse localized environment and, (b) monitoring of plant environmental conditions or component parameters that are be used to ensure that the equipment is within the bounds of its environmental qualification basis including attributes, assumptions, and conservatisms for equipment/environmental conditions and other factors. Monitoring or inspection of certain environmental conditions or component parameters may also provide a means to assess equipment qualified life.

   The first periodic visual inspection is to be performed prior to the subsequent period of extended operation. Visual inspection (and the use of additional diagnostic tools such as thermography) of EQ components is performed as appropriate, ~~by opening junction boxes, pull boxes, or terminal boxes~~. Scaffolding may be used if available. The purpose of the visual inspection is to identify adverse localized environments that may impact an EQ components qualified life. Potential adverse localized environments are evaluated through the applicant's corrective action program.

References

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

10 CFR 50.49. "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants." Washington, DC: U.S. Nuclear Regulatory Commission. ~~2015~~.

10 CFR 54.21. "Contents of Application—Technical Information." Washington, DC: U.S. Nuclear Regulatory Commission. ~~2015~~.

EPRI. "Plant Support Engineering: License Renewal Electrical Handbook." EPRI Report 1003057. Revision 1. Palo Alto, California: Electric Power Research Institute February 2007.

~~IAEA. TECDOC1188, "Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: In-Containment Instrumentation and Control Cables." ML15013A087. Vienna: International Atomic Energy Agency. 2015.~~

~~_____. IAEA D-NP-T.3.6, "Guideline for Qualification and Ageing Management of I&C Cables in Current and Future NPGS." ML15013A087. Vienna: International Atomic Energy Agency. 2015.~~

~~_____. NS-G-2.12, "Ageing Management for Nuclear Power Plants." Vienna: International Atomic Energy Agency. 2009.~~

IEEE. IEEE Std. 1205-2014, "IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations." New York, New York: Institute of Electrical and Electronics Engineers. 2014.

~~JNSO. JNES-SS-0903, "The Final Report of the Project of "Assessment of Cable Aging for Nuclear Power Plants." Minato-ku, Tokyo: Japan Nuclear Safety Organization, Nuclear Energy Systems Safety Division. July 2009.~~

NRC. "Condition-Monitoring Techniques for Electric Cables Used in Nuclear Power Plants," Regulatory Guide 1.218. ML103510458. Washington DC: U.S. Nuclear Regulatory Commission. April 2012.

NUREG/CR-7000, "Essential Elements of an Electric Cable Condition Monitoring Program." ML100540050. Washington, DC: U.S. Nuclear Regulatory Commission. January 2010.

_____. "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants." Regulatory Guide 1.211. ML082530205. Washington, DC: U.S. Nuclear Regulatory Commission. April 2009.

_____. Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients." ML13098A126. Washington, DC: U.S. Nuclear Regulatory Commission. February 2007.

_____. "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants." Regulatory Guide 1.100, Rev. 3. ML091320468. Washington DC: U.S. Nuclear Regulatory Commission. September 2003.

_____. "Environmental Qualification of Low-Voltage Instrumentation and Control Cables." Regulatory Issue Summary 2003-09. May 2003.

_____. "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants." Regulatory Guide 1.89. Rev. 1. ML14070A119. Washington, DC: U.S. Nuclear Regulatory Commission. June 1984.

_____. NUREG–0588, "Interim Staff Position on Environmental Qualification of Safety-

Related Electrical Equipment." Revision 1. ML031480402. Washington, DC: U.S. Nuclear Regulatory Commission. July 1981.

_____. "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors." (DOR Guidelines) ML032541214. Washington, DC: U.S. Nuclear Regulatory Commission. November 1979.

~~OCED/NEA. "Technical Basis for Commendable Practices on Aging Management—SCC and Cable Aging Project (SCAP) Final Report." Final Report, NEA/CSNI/R (2010)15. France: April 2011.~~