

Information Meeting

GALL-SLR REPORT STRUCTURAL SLR-AMPS

Office of Nuclear Reactor Regulation (NRR)
Division of License Renewal

Office of Nuclear Regulatory Research (RES)
Division of Engineering
04-08-2015

Agenda for Meeting



Time	Topic
9:00a	Opening
9:20a	XI.S1 ASME Section XI, Subsection IWE (John Burke, RES)
9:30a	XI.S3 ASME Section XI, Subsection IWF (John Burke, RES)
9:40a	XI.S2 ASME Section XI, Subsection IWL (Mita Sircar, RES)
9:50a	X.S1 Concrete Containment Tendon Prestress (Andrew Prinaris, NRR) TLAA 4.5 Concrete Tendon Prestress (Andrew Prinaris, NRR)
10:10a	Break
10:25a	XI.S8 Protective Coating Monitoring and Maintenance (John Burke, RES)
10:30a	XI.S6 Structures Monitoring (John Burke, RES)
10:40a	XI.S5 Masonry Walls (Mita Sircar, RES)
10:50a	XI.S7 Inspection of Water-Control Structures Associated with Nuclear Power Plants (Mita Sircar, RES)
11:00a	Public Participation

Agenda for Meeting



Time	Topic
12:00p	Lunch
1:00p	XI.S4 10 CFR Part 50, Appendix J (Andrew Prinaris, NRR)
1:10p	TLAA 4.6 Metal Containment, Liner Plate, and Penetrations Fatigue Analysis (Andrew Prinaris, NRR)
1:25p	Plant Specific AMP - Aggregate Reactivity (John Burke, RES)
1:35p	New Plant Specific AMP - Irradiation of Concrete (Mita Sircar, RES)
1:50p	Public Participation
3:45p	Closing
4:00p	Adjourn

Purpose of Meeting



- **Inform external stakeholders of:**
 - Proposed revisions to the portions of the GALL and SRP related to structures and structural components
 - Aging Management Programs (AMPs) and Time-Limited Aging Analyses (TLAAs).
 - Basis for the proposed revisions
 - Other important changes to the GALL and SRP

GALL-SLR AMPS



■ **Basis for Changes**

- To reflect expected aging differences for increased operating time from 60 to 80 years
- New plant operating experience since GALL Rev 2
- Gaps identified in current guidance
- Improvements in efficiency and effectiveness of applications and NRC reviews
- Errors in GALL and SRP
- Incorporate Interim Staff Guidance since GALL Rev 2

Aging Management Program (AMP) Elements



- Program Description (PD)
- Scope of Program (Element 1)
- Preventive Actions (Element 2)
- Parameters Monitored or Inspected (Element 3)
- Detection of Aging Effects (Element 4)
- Monitoring and Trending (Element 5)
- Acceptance Criteria (Element 6)
- Corrective Actions (Element 7)
- Confirmation Process (Element 8)
- Administrative Controls (Element 9)
- Operating Experience, OpE (Element 10)

Format Changes for GALL-SLR and SRP-SLR



- Standard Elements 7, 8, and 9 for each AMP
- Renamed GALL Chapter X to:
 - Aging Management Programs That May Be Used to Demonstrate Acceptability of Time-Limited Aging Analysis In Accordance with 10 CFR 54.21(c)(1)(iii)
- New Chapter 5 for the SRP:
 - Technical Specifications Changes
- More detailed FSAR Supplement summary description examples

Structural SLR AMP – XI.S1



■ Proposed Changes: AMP XI.S1 (ASME, Subsection IWE)

- PD: Clarify by including surface examination of SS welds, surface or augmented examinations for two-ply penetration bellows, and surface examination for dissimilar welds for penetration sleeves or bellows
- Element 1: Clarify by incorporating content of LR-ISG-2006-01 regarding inaccessible areas of BWR Mark I steel containment drywell shell; and for successive inspections of inaccessible areas to align ASME Code, Section XI, IWE-2420 requirements with 10 CFR 50.55a(b)(2)(ix)
- Element 3: Clarify that bulges in shells and liners could be areas of potential distress and *corrosion* (Element 4). Include “periodically” monitoring sand pocket areas of BWR Mark I steel containments
- Element 4: Clarify by deleting discussion for inservice examinations in accordance with inspection programs A or B delineated in IWE-2400. Clarify additional examinations:
 - Supplemental surface examinations be performed for two-ply bellows, vent line bellows, and steel bellows for cracking due to cyclic loads (if there are no CLB fatigue analyses). For components, where supplemental surface examinations are not feasible, 10 CFR Part 50 Appendix J local leak rate testing be performed “as a minimum”
 - Supplemental volumetric examinations, with a frequency to be determined on a plant-specific basis, in areas of metal shell or liner that are inaccessible from one side and susceptible to corrosion

Structural SLR AMP – XI.S1



■ **Proposed Changes: AMP XI.S1 (ASME, Subsection IWE - Continued)**

- Element 5: Align element with ASME Code Section XI, Subsection IWE-3120 inservice inspection acceptance requirements (e.g., corrective actions, repair, replacement, engineering evaluations)
- Element 6: Clarify guidance for acceptance criteria, where applicable, to be quantitative
- Element 10: Add relevant references (e.g., IN 2010-12 on containment liner corrosion, IN 2011-15 on corrosion of BWR Mark I steel containments, IN 2014-07 on degradation of floor weld leak chase channels; NUREG-1611 on augmented examinations of two-ply bellows and the NRC Technical Letter Report on containment liner corrosion OpE summary, ADAMS Accession Number ML112070867). For two-ply containment bellows cracking (for which leak rate testing was inadequate for detection) resulting in loss of leak tightness, recommend augmented surface examinations using qualified enhanced techniques (NUREG-1611). Consider through-wall corrosion from possible foreign objects embedded in concrete

Structural SLR AMP – XI.S3



- **Proposed Changes: AMP XI.S3 (ASME, Subsection IWF)**
 - PD: Include additional supports outside of the existing IWF sample population (sample size increase). Delete NUREG-1339 on high-strength bolting degradation
 - Element 1: Clarify by including acceptability of inaccessible support areas to be based on conditions existing in accessible areas
 - Element 3: Clarify monitoring to include cracking of welds and of concrete around anchor bolts; and that all bolting within the scope of program to be monitored for corrosion, loss of bolting integrity
 - Element 4: Increase IWF sample beyond that required by ASME Code, Section XI, for Class 1, 2, and 3 for piping supports, by 5% with supports outside of the existing IWF sample to provide reasonable assurance that no age-related degradation would go undetected
 - Element 5: If supports are repaired to as-new condition (but do not exceed IWF-3400 structural integrity acceptance requirements for increase in scope), modify or increase sample as necessary to ensure sample is representative of remaining population
 - Update FSAR supplement to reflect additions

Structural SLR AMP – XI.S2



■ **Proposed Changes: AMP XI.S2 (ASME, Subsection IWL)**

- PD: Clarify by adding expectation for plant-specific AMP for plants with grouted tendon based on RG 1.90 (Inservice Inspection of Prestressed Concrete Structures Containment with Grouted Tendons)
- Element 5: Clarify by emphasizing importance of documenting and trending inspection results. Recommend photography to record and track aging effects. Quantitative measurements for all applicable parameters to be recorded and trended. Clarify by adding reference to ASME Code, Section XI, Subsection IWL-3220 (acceptance by examination) for trending tendon prestressing forces.
- Element 6: Clarify by adding language to include quantitative acceptance criteria to be consistent with Chapter 5 of ACI 349.3R (“Evaluation of Existing Nuclear Safety-Related Concrete Structures”) in addition to the acceptance standard in ASME Code, Section XI, Subsection IWL-3000
- Element 10: Add relevant references (e.g., IN 2010-14 concerning the containment surface condition examination frequency and acceptance criteria). Also add recent prestressed concrete containment delamination as lessons learned - NRC Inspection Report 05000302/2009007, ADAMS Accession Number ML 102861026)

Structural SLR AMP – X.S1



- **Proposed Changes: AMP X.S1 (Concrete Containment Tendon Prestress)**
 - Title: change to “**Concrete Containment *Unbonded* Tendon Prestress**”
 - PD: Clarify the focus of the TLAA AMP is to assess adequacy of measured tendon prestress forces for each sampled group (i.e., hoop, vertical, dome, inverted-U, helical) of unbonded tendons
 - Element 1: Clarify assessment of “unbonded” tendons prestress forces are measured in accordance with the requirements of ASME Code, Section XI, Subsection IWL
 - Element 2: Clarify, the program is a condition monitoring program. Corrective actions are taken before tendon forces fall below design values
 - Element 3: Clarify that sampled tendons, excluding the control tendon, are randomly selected
 - Element 4: Clarify the specifics on how to evaluate loss of tendon prestress (i.e., measure, analyze, trend sampled tendons) for each group of tendons. Data to be obtained as part of ASME Code, Section XI, Subsection IWL examinations

Structural SLR AMP – X.S1



- **Proposed Changes: AMP X.S1 (Concrete Containment Tendon Prestress - Continued)**
 - Element 5: Clarify that predicted lower limit (PLL), the minimum required value (MRV), and lift off force trend lines are projected to the end of the period for SLR
 - Element 6: Clarify the importance of PLL line for each trended group of tendons. If the trend line crosses the PLL line, its cause is determined, documented, evaluated, and corrected
 - Element 10: Include relevant references (e.g., NUREG/CR-7111 references plants with low lift-off forces). Add review of upward trending tendon force measurements
 - Include a FSAR supplement

Structural SLR TLAA – 4.5

- **Proposed Changes: TLAA 4.5 (Concrete Containment Tendon Prestress Analysis)**
 - Title: change to “**Concrete Containment *Unbonded* Tendon Prestress Analysis**”
 - Review of Responsibilities: Clarify that the primary discipline responsible for the review is Structural Engineering
 - Areas of Review: Clarify by adding additional aging effects (other than sustained elevated temperatures) can also contribute to loss of tendon prestress (e.g., breakage of tendon wires, improper anchorages, effects of SCC, tendon relaxation when replacing existing inservice tendons with new). Clarify TLAA reviews for PLL and bonded tendons. Reviews for these are performed under TLAA 4.7, “Other Plant-Specific Time Limited Aging Analyses”
 - For 10 CFR 54.21(c)(1)(ii): Clarify, this section of the regulations require a reevaluation of the TLAA. Demonstrate through analysis that unbonded tendon prestressed concrete containment design adequacy remains valid. Delete tendon management program to be an acceptable substitute for the required reevaluation
 - Update TLAA FSAR supplement to include write-up for 10 CFR 54.21(c)(1)(ii)

Structural SLR AMP – XI.S8



- **Proposed Changes: AMP XI.S8 (Protective Coating Monitoring and Maintenance Program)**
 - Element 5: Clarify that assessment from periodic inspections and analysis of total amount of degraded coatings in the containment be compared with the total amount of permitted degraded coatings to ensure post-accident operability of the Emergency Core Cooling System (ECCS)

Structural SLR AMP – XI.S6



■ **Proposed Changes: AMP XI.S6 (Structures Monitoring)**

- Element 1: Clarify by adding to scope of program seismic joint fillers, elastomeric materials; and steel edge supports and steel bracings associated with masonry walls. Also add groundwater and protective coatings as areas of review for the condition of below grade concrete or substrate/under coating
- Element 3: Add monitoring of through-wall leakage of groundwater for its volume and chemistry for signs of concrete and steel reinforcement degradation. Clarify by including monitoring of:
 - steel bracing and edge supports of masonry walls for deflection/distortion
 - paint/coating degradation for signs of substrate distress (e.g., flaking, blistering, cracking, peeling, delamination, discoloration)
 - sliding surfaces for accumulation of debris
- Element 4: Clarify by adding:
 - Seasonal evaluation (quarterly or semi-annually) and inleakage of groundwater chemistry to be in areas of contact with structures. If there is infiltration/leakage through concrete, corrective actions to be taken. Recommend supplemental (other than visual) inspections/evaluations (e.g., NDE, destructive testing, analytical methods)

Structural SLR AMP – XI.S6



- **Proposed Changes: AMP XI.S6 (Structures Monitoring - Continued)**
 - Element 4 (continued): Clarify by adding:
 - Focused inspections of inaccessible concrete areas exposed to aggressive groundwater in frequency not to exceed 5 years.
 - Tactile evaluation of elastomers
 - Element 5: Clarify, quantitative results (measurements) and qualitative data from periodic inspections to be trended with photographs and surveys for the type, severity, extent, and progression of degradation. Quantitative baseline inspections be established and performed with acceptance criteria of (*Element 6*) prior to the period of SLR
 - Element 6: Clarify that quantitative criteria is to be used wherever applicable; and those listed in ACI 349.3R are acceptable
 - Element 10: Include relevant references (e.g., IN 2011-20 on groundwater infiltration leading to alkali-silica reaction degradation (see slide 23 on plant specific AMP), IN 2004-05 and IN 2006-13 on through-wall water leakage from spent fuel pools)

Structural SLR AMP – XI.S5

■ **Proposed Changes: AMP XI.S5 (Masonry Walls)**

- Element 1: Clarify scope by identifying the types and components of the masonry wall (solid or hollow concrete block, mortar, grout, steel bracing, reinforcing and supports). Referred to XI.S6 for steel components
- Element 3: Clarify by including monitoring of cracking and loss of material at the mortar joints
- Element 4: Clarify by adding inspection frequency every 3 years for unreinforced and unbraced walls. Add more frequent inspection where signs of degradation are observed for all walls. Add inspection of steel elements be performed by XI.S6
- Element 5: Delete current statement “Trending is not required.” Change to include documenting quantitative and qualitative inspection results, comparing the results, and trending the condition of the masonry walls. The attributes for monitoring and trending are crack length and width, and gaps between supports and masonry walls. Add photographic records to record and trend type, severity, extent, and progression of degradation
- Element 6: Clarify by including other degradation (i.e., cracking or loss of material at the mortar joints, and gaps between the supports and masonry walls). Also clarify the expectation of technical justification/engineering evaluation to accept degraded condition without repair or corrective actions.

Structural SLR AMP – XI.S7



- **Proposed Changes: AMP XI.S7 (RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants)**
 - Title: Change to delete “**RG 1.127**” (Similar change to FSAR supplement)
 - PD: Clarify that AMP is independent of RG 1.127. Reference to the RG is still included in AMP write-up for additional guidance.
 - Element 1: Clarify scope by including additional items (flood protection walls, gates, protective coatings)
 - Element 2: Clarify expectations for high strength bolts
 - Element 3: Clarify the parameters (flaking, blistering, cracking, peeling, delamination, discoloration etc.) to be monitored or inspected for protective coatings and substrate
 - Element 4: Clarify by adding language on:
 - Qualification of inspection and evaluation personnel – ACI 349.3R acceptable
 - Need for increased frequency or special inspection based on observed degradation
 - Frequency of raw water and groundwater chemistry evaluation to identify seasonal variation

Structural SLR AMP – XI.S7



- **Proposed Changes: AMP XI.S7 (Inspection of Water-Control Structures Associated with Nuclear Power Plants - Continued)**
 - Element 4 (continued): Clarify by adding wordings on:
 - High-strength structural bolting > 1 inch (25mm) in diameter inspection supplemented by surface or volumetric examination
 - Aging effects due to groundwater infiltration or through-concrete leakage. Assess by engineering evaluation, more frequent inspection, concrete properties, pH level. Leakage volume assessment includes pH, mineral, chloride, sulfate, iron content
 - Submerged concrete inspection interval and acceptance to be within a 5 year interval unless otherwise justified in the LRA
 - Areas for inspection that are covered by vegetation, silt, etc. are considered accessible
 - Plant-specific inspection and frequency of below-grade inaccessible structural elements exposed to aggressive environment (not to exceed 5 years)
 - Element 5: Clarify staff expectations for documenting and comparing periodic inspection results to identify changes over time (similar to XI.S6)
 - Add new GALL-SLR item III.A6.T-34 regarding cracking of concrete (accessible areas) due to expansion of aggregates and align it with AMP

Structural SLR AMP – XI.S4



■ Proposed Changes: AMP XI.S4 (10 CFR Part 50, Appendix J)

- PD: Clarify:
 - The role of the AMP. The AMP credits the existing program required by 10 CFR Part 50, Appendix J and augments it to ensure all containment pressure retaining components are managed for age-related degradation.
 - Leakage rate tests may be performed under a “mixed” Option A (prescriptive) and Option B (performance based).
 - Integrated leakage rate test (ILRT) pressure is a calculated pressure for LOCA
 - ASME Code Section XI, Subsections IWE and IWL mandated examinations can be substituted for the recommended general visual examination requirements
- Element 1: Clarify that all pressure retaining boundary components are under review for aging effects. Those components that are excluded from 10 CFR Part 50 Appendix J testing still need to be managed for aging effects. Other AMPs may be credited for aging management of excluded components. The components and the proposed SLR AMPs should be clearly identified
- Element 4: Clarify that for valves and penetrations, administrative leakage rate limits may be set lower than the regulatory acceptance criteria for early detection of age-related degradation

Structural SLR TLAA - TLAA 4.6

- **Proposed Changes: TLAA 4.6 (Containment, Liner Plate, and Penetration Fatigue)**
 - Review of Responsibilities: Clarify that the primary discipline responsible for the review is Structural Engineering and the secondary discipline is Mechanical Engineering
 - Areas of Review: Clarify the focus of the review to be evaluations of fatigue parameters (fatigue analyses, fatigue waivers) for metal containments, metal liners (concrete containments) and penetrations (mechanical, electrical); and it includes personnel airlock, equipment hatch, and control rod drive (CRD) hatch. Clarify also for the areas of review the cyclic loads assumed in the fatigue parameter evaluations, be identified (i.e., number of occurrences). Include EPRI reference (TR-1003456) on aging management of mechanical and electrical penetrations
 - For liners, add ASME Code Section III fatigue waiver evaluations to 10 CFR 54.21(c)(1)(i) or (ii). Recognize acceptable programs to 10 CFR 54.21(c)(1)(iii) for monitoring and tracking the number of cycles and occurrences and severity of relevant transients
 - Align SRP-SLR “3.5.2.2.1.5 Cumulative Fatigue Damage,” Further Evaluation, Table 3.5-1, item 3.5.1-9, and also GALL-SLR items II.A3.C-13 and II.B4.C-13 to include metal liner/metal plates, personnel airlock, equipment hatch, (CRD) hatch as areas of review

Plant Specific AMP Aggregate Reactivity

- Propose to:
 - Clarify current Further Evaluation entry in SRP-SLR for Aggregate Reactivity for a plant-specific AMP:
 - A plant-specific AMP is necessary if reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates, or visual inspections of accessible concrete have identified indications of aggregate reactions, such as “map” or “patterned” cracking or the presence of reaction byproducts (e.g., alkali-silica gel).
 - The reviewer confirms that the applicant has not identified one of the above conditions
 - Delete relevant SRP-SLR references to ASTM and ACI standards
 - Align SRP-SLR Table 3.5-1 entries and GALL-SLR items II.A1.CP-67, III.A1.TP-204, III.A6.TP-220 with the newly added language (above) for cracking due to expansion from reaction with aggregates

New Plant Specific AMP (Irradiation of Concrete)

- Propose to:
 - Further Evaluation entry to SRP-SLR to determine the effects of estimated irradiation dose (fluence) received by the concrete from neutron and/or gamma radiation for the period of SLR. If the estimate exceeds threshold limits, or OpE indicates concrete irradiation degradation may impact intended functions, a plant-specific AMP to be used
 - Add a SRP-SLR Table 3.5-1 entry for BWR/PWR Group 4 concrete structures and components and GALL-SLR item regarding inspection concrete in reactor cavity area proximate to the reactor vessel (reactor primary/biological shield wall, sacrificial shield wall, reactor vessel support/pedestal structure). Align item to the proposed plant specific AMP for managing aging effects for reduction of strength, loss of mechanical properties due to irradiation of concrete

GALL-SLR AMPs and TLAAs - Structural



Additional Comments
or
Questions?