Industry Significant Mechanical Comments on DRAFT SLR GALL/SRP

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XI.20 Open-Cycle Cooling Water System

- XI.M20-3, Line 23 Element 7 Corrective Actions – Suggest deleting following sentence: “Fouling deposits are removed to determine if loss of material has occurred and to prevent further degradation in the system.”

- The first two sentences of the 2nd paragraph of element 7 provide corrective actions for minimum wall thickness and evaluation of fouling for reduction of heat transfer and flow blockage.

XI.M3 Reactor Head Closure Stud Bolting

Recommend removing the 150ksi yield strength preventative measure recommendation

- The recommendation is based on Regulatory Guide 1.65, Rev. 1 (issued in 2010). Many plants were built to RG 1.65, Rev. 0 (issued in 1973) which included a position that stud bolting should not exceed 170ksi for ultimate tensile strength.
- GALL should not specify different plant design from previously approved. The intent should be to do aging management of the approved design.
- Many LRAs have taken AMP exceptions due to in-service studs fabricated with greater than 150ksi yield strength material per the CMTRs. The exception is based on a justification that these studs are periodically UT examined for cracks due to SCC per ASME Section XI. The NRC has accepted this exception justification in the past.
- No recent industry cracking for Reactor Studs with greater than 150ksi yield strength.

XI.M7 BWR Stress Corrosion Cracking

Element 1 (Program Scope) revised the RCS temperatures and no longer consistent with the G.L. 88-01 which may cause scope expansion

- AMP scope for piping and welds containing RCS temperature was lowered to temperatures from above 200F to above 140F. This is also in conflict with the SLR UFSAR Supplement.
- No justification provided.

Recommendation: Revise the 140F value back up to 200F to be consistent with the GL and the SLR UFSAR supplement.

Element 1 (Program Scope) lists the CRD Return line nozzle caps and associated welds

- Not necessary to call out specific components within the AMP scope. There may be CRDRL nozzle caps less than 4" or not stainless steel and therefore not in scope. This would require an AMP exception.

Recommendation: Remove reference to the CRDRL or if must remain due to XI.M6 AMP deletion clarify that the nozzle-to-cap weld may be in scope.

XI.M7 BWR Stress Corrosion Cracking (cont.)

Elements 3 and 4 indicate examination and inspection methods delineated per BWRVIP-75A

- BWRVIP-75A does not include guidance relative to examination, inspection methods, or test techniques. BWRVIP-75A only provides alternative guidance for extent and schedule (i.e., number of welds to inspect and frequency).

Recommendation: Remove reference to BWRVIP-75A relative to examination methods or test techniques. Retain the NUREG-0313, Rev.2, and NRC GL 88-01.

XI.M11B Cracking & LOM of Nickel Alloy Components

- A new recommendation for branch line connections has been added as a 2nd paragraph to element 4: "The program also performs a baseline volumetric or inner-diameter surface inspection of all susceptible nickel alloy branch line connections and associated welds as identified in Table 4-1 of MRP-126 if such components or welds…"
  - This recommendation mandates the use of qualified method in accordance with ASME Code Section XI. Such methods have not been developed for many of these locations. To do so would take years of development and significant resources.
  - If the existing Code inspections are inadequate to assure safety, the staff should work through the ASME process to have such recommendations codified.

XI.M11B Cracking & LOM of Nickel Alloy Components (cont.)

- A new recommendation for bottom mounted instrument nozzles (BMN) has been added as a 3rd paragraph to element 4: "In addition, this program performs a baseline inspection of bottom-mounted instrumentation (BMI) nozzles of reactor pressure vessels (RPVs) using a qualified volumetric examination method. …"
  - The MRP's BMN safety assessment, shared with NRC in public meetings, concluded that the existing 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 is not necessary to assure safety.

XI.M35: ASME Code Class 1 Small-Bore Piping

Element 4 Table XI.M35-1Examinations – Category B

- Category B could result in new mitigated welds (potentially with years of good OE) being destructively examined.
- Revise Note 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 and repaired, demonstrate no additional failures in the period following repair, then these welds may be placed into Category A.**

Recommendation: Delete Category B or revise Note 3.

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

- XI.M40-1, Line 39, element 4, Detection of Aging Effects: A new recommendation has been added: "The maximum interval between inspections for polymer based materials (e.g., Carborundum, Tetrabor), regardless of operating experience, should not exceed 5 years." Please provide the basis for 5 years. The industry is not aware of basis or issue that warrants the frequency change regardless of OE.

XI.M27 Fire Water System

- Table XI.M27-1, The column for NFPA-25 sections includes sections that address the calibration of gauges used during flow testing. A footnote should be added to explain that gauges and their calibration are not part of this AMP.
- Inspections described in NFPA-25 as “annual” should be described in this AMP as “every refueling cycle” based on LRAs that have taken exception to this.
- Element 4b, delete last sentence “When fouling is identified deposits are removed…”
- Element 6, Acceptance Criteria, Section c) states “no fouling exists”. This is overly stringent. Our view is that the acceptance criteria provided in 6.a) “the water-based fire protection system is able to maintain required pressure and flow rates” should be adequate and 6.c) should be deleted.
- Delete the last paragraph of Element 7, Corrective Actions which 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 covered by the first paragraph in Element 7.

XI.M32 One-Time Inspection

- Recommend deleting long term loss of material aging effect. It would be difficult to satisfy the XI.M32 element 1 (M32-1 line 24) recommendation for representative samples conducted every 5 years up to at least the 50th year of operation. In addition, aging effects for raw water and waste water environments are more effectively managed by other AMPs.
- Recommend combining all units on a 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 inspection. Ref. p. XI.M32-5, lines 26,27

XI.M33 Selective Leaching

- Recommend that the two mandatory destructive examinations noted in element 4 (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 single period.
- Recommend a similar reduction for mandatory destructive examinations in two unit sites for each population at each less than 50 components such that there is a total of 100 components between the two units. (M33-3 line 22).
- Clarify element 4 (M33-3 line 42) to read: "Dependent on plant-specific operating experience and implementation of preventive actions, the exclusions for external surface coatings of buried components may no longer apply and the inspection population is adjusted as follows:"

XI.M36 External Surfaces Monitoring and XI.M38 Inspection of Internal Surfaces

- XIM36-3 Line 31 and XI.M38-4 Line 13 – Remove recommendation for periodic surface examinations from these paragraphs. Surface exams are impractical for system engineer walk downs and opportunistic surface inspections. OE with code inspections and research in progress has demonstrated adequacy of visual inspections to detect cracking.

XI.M36 External Surface Monitoring and XI.M38 Inspection of Internal Surfaces In Miscellaneous Piping And Ducting Components

- Acceptance criteria should be associated with the parameters monitored or inspected and with the methods identified in detection of aging effects. For example, M36 inspects surface condition with visual inspection. Acceptance criteria should be related to the surface condition such as 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.

- Provisions proposed in GALL-SLR M36 and M38 acceptance criteria are evaluation considerations that should be applied during the evaluations conducted under the corrective actions program element. Those type consideration are generically applicable to most AMPs and are implicit in corrective action program evaluations.

XI.M42 Internal Coatings/Linings

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

Provide Reactor Vessel Internal AMR Lines

- MRP-227 is the industry program for managing aging of PWR reactor vessel internals
- GALL-SLR AMR lines should be provided consistent with MRP-227 Rev 1 primary, expansion and existing inspection categories.
- GALL-SLR AMR could be updated consistent with the Staff safety evaluation for MRP-227 Rev 2 for SLR when it is available.
- Further Evaluations for Reactor Vessel Internals capture SLR period aging evaluations and would apply.

Delete AMR Lines for Long Term Loss of Material Due to General Corrosion

- GALL-SLR indicates this aging effect is associated with reactor coolant, treated water, raw water, and waste water environments.
- Reactor coolant and treated water environments are managed by Chemistry Programs and XI.M32 One-Time Inspection programs using existing AMR lines
- Raw water and waste water environments are aggressive environments and are more appropriately managed by periodic inspections such as XI.M20 Open Cycle Cooling Water Programs and XI.M38 Internal Surfaces Monitoring using existing AMR lines.
- It would be difficult to satisfy the XI.M32 element 1 recommendation for periodic wall thickness measurements on a representative sample conducted every 5 years up to at least the 50th year of operation.

Further Evaluation for Cracking of Aluminum Due to SSC

- Delete “The susceptibility of the material is to be established prior to evaluating the environment”. Either a non-susceptible material or a non-aggressive environment will not require additional evaluation for aging management recommendations.
- This is a good example for a further evaluation with several SRP Table 1 items that used multiple AMR lines with different AMPs rather than specify “plant specific” for the AMP that will result in review inefficiencies.
- Provide None/None AMR lines for non-susceptible aluminum in environments other than gas that do not require aging management for cracking or loss of material.
- Use of coatings as a barrier to aggressive environments: Recommend deleting this because you always have the option to use XI.M42 as a plant specific program.

Further Evaluation for Loss of Material for Aluminum in Air Environments

- This is a good example where a review of operating experience and a one-time inspection can be used to inform the aging evaluation and the aging management required.
- Rather than specify this as “plant specific” aging management required in the AMR lines, provide multiple AMR lines with different AMPs based on the acceptable AMPs identified in the further evaluation. SLR-SRP Tables would identify multiple AMPs based on specifics discussed in the further evaluation.
- Visual examinations are assumed to be conducted.
- Provide None/None AMR lines for non-susceptible aluminum lines in air environments other than gas that do not require aging management for cracking or loss of material.

Further Evaluation for Cracking and Loss of Material for Stainless Steel in Air Environments

- Recommend use of an OE review and one-time inspection approach consistent with further evaluation to manage loss of material for aluminum components in air environments
- Use of coatings as a barrier to aggressive environments: Recommend deleting this because you always have the option to use XI.M42 as a plant specific program.

Further Evaluation of Stainless Steel and Nickel Alloys in a Treated Water Environment

- Simplify the further evaluation. Aging of stainless steel and nickel alloys in a treated water or treated borated water environment is expected to progress very slowly such that unacceptable degradation will not occur and can be managed with XI.M2 Water Chemistry and XI.M32 One-Time Inspection. Note that LR-ISG-2011-01 recommended only water chemistry if O2<100ppb.
- Unless a plant-specific program was identified in the 40-60 year period, OTI should be sufficient.
- Rather than specify this as “plant specific” aging management required in the AMR lines, provide multiple AMR lines with different AMPs based on the acceptable AMPs identified in the further evaluation. A SLR-SRP Table item or items (if necessary) would identify AMPs based on specifics discussed in the further evaluation.

Other AMR Line Considerations

- Delete AMR lines for loss of material for causes other than selective leaching for gray cast iron in various environments. The lines are redundant to steel AMR lines in the same environments that are managed by the same AMPs
- Recommend revising the sunlight environment to “air-outdoor”.
- Recommend deleting cracking from the various A-414 lines for internally coated component aging effects columns. Cracking due to SCC is not expected in most environments listed and required temperatures above 140F. Internal coatings are not expected in those environments.
- Recommend revising SRP line 3.3.1-28 to delete further evaluation 3.3.2.2.12 and recommend water chemistry consistent with LR-ISG-2011-01 for cracking in treated borated water >140F with low oxygen content.

XI.M9 BWR Vessel Internals

Element 1 (Program Scope) no longer aligns with BWRVIP-183.

- The draft SE endorses BWRVIP-183 which requires that 10% of the Top Guide grid beams cells be inspected every 12 years and 5% must be within first 6 years. Therefore, BWRVIP-183 allows the flexibility to do all 10% during the same inspection outage within the first six years and the GALL does not.
- This no longer allows the efficiency of doing all 10% (e.g., 19 cells) in one outage vs two 5% each in outages every 12 years.
- No justification provided.

Recommendation: Allow the BWRVIP-183 flexibility in the new GALL.

Element 1 (Program Scope) describes Control rod drive (CRD) housing and lower plenum components as part of the AMP scope

- The CRD housing and lower plenum are managed per BWRVIP-47A as described in GALL AMP XI.M8, BWR Penetrations.
- The CRD housing and lower plenum is not needed to be listed in the M9 – Element 1

Recommendation: Remove reference to the CRD housing and lower plenum from the M9 Program scope.

XI.M9 BWR Vessel Internals (cont.)

Element 4 (Detection of Aging Effects) does not define expectations for plant-specific supplemental inspections.

- Recommends determining if inspections are required in addition to existing BWRVIP guidelines for vessel internal components and welds to manage IASCC, and loss of fracture toughness due to thermal aging and neutron embrittlement.
- No technical bases are provided for the further evaluations in SRP-SLR sections 3.1.2.2.12, 3.1.2.2.13, 3.1.3.2.12, and 3.1.3.2.13. Existing XI.M9 program and its use of the BWRVIP documents are adequate to manage the effects of aging.

Recommendation: Delete the further evaluations referenced above.

XI.M16A PWR Vessel Internals

- MRP-227 is the industry program for managing aging of PWR reactor vessel internals and is mandated by NEI 03-08.
- Recommend revising the SLR GALL to use MRP-227 Rev 1 as a starting point for the GALL-SLR XI.M16A PWR Vessel Internals.
- Primary, expansion and existing inspection categories for the MRP-227 for the SLR period will be updated consistent with the process used to develop MRP-227-A. Known aging effects will be projected into the 60 to 80 year period. Some changes are expected, none are expected to be major.
- GALL-SLR AMP XI.M16A would be updated by revision or LR-ISG to be consistent with the Staff safety evaluation for MRP-227 Rev 2 for SLR when it is available.
- The MRP-227 program will continue to be informed through the applicants OE program and updated as appropriate.

XI.M12 Thermal Aging Embrittlement of CASS

Pump casings should be treated the same as valve bodies and not require screening, or guidance addressing pump casings should be added

- The NRC May 19, 2000 letter indicated screening for susceptibility to TAE is not required for valve bodies and pump casings.
- Valves and pumps are adequately managed by ASME code inspection recommendations.
- Pumps and valves are included in ASME XI Table IWB-2500-1 and require a visual, VT-3 inspection and acceptance standard is per IWB-3519.
- No technical justification or OE provided to justify including supplemental inspections of pump casings beyond ASME Section XI recommendations.

Recommendation: Continue to exempt pump casings from the AMP similar to valve bodies.

X.M2 Neutron Fluence Monitoring

- Fluence data in non-traditional beltline regions is not generally available at this time.
- In addition, regulatory standards to define an acceptable degree of agreement between fluence data and the calculated fluence do not exist for non-traditional beltline fluence calculations.
- An industry program is proposed to collect fluence measurements in the extended beltline with development of reference cases and benchmarks/justification of the neutron fluence calculations.
- Recommend deletion of reactor vessel internals (RVI) components from the fluence monitoring program. RVI component materials and functions are not consistent with RPV embrittlement analysis. MRP-227 has analyzed fluence thresholds for selected degradation mechanism that will be re-evaluated for the SLR Period and incorporated into SLR revision of the MRP-227 program.

XI.M31: Reactor Vessel Material Surveillance

Existing regulations in 10 CFR 50 Appendix H are adequate for reactor vessel material surveillance in the SLR period, with the only exception being that additional surveillance data may be needed if data obtained during the 60-year operating period does not envelope end of SLR period fluence values.

- Opening sentence of this draft guidance seems to imply all beltline materials with projected fluence greater than 10^{17} n/cm^2 need to be monitored per 10CFR50 Appendix H - XI.M31-1 lines 3-7
  - However, 10CFR50 Appendix H says all RVs with fluence exceeding 10^{17} n/cm^2 need to have a surveillance program; not all materials
- States that program must comply with ASTM E185-82- XI.M31-1 line 16
  - However, many programs were built to an earlier version of E185 and cannot practically comply with the E185-82 version
- Cites ASTM E185-82- XI.M31-2 line 7
  - Recommend citing 10CFR50 Appendix H (being updated to the latest version of E185 and E2215) rather than an older version of E185

XI.M31: Reactor Vessel Material Surveillance (cont.)

- This draft guidance includes removal and testing of at least one capsule during SLR operating period. - XI.M31-1 line 25
  - However, some plants have already removed (and tested) a capsule with a fluence applicable to 80 years of operation
  - Many plants have tested or will have tested all capsules by the end of 60 years

XI.M31: Reactor Vessel Material Surveillance (cont.)

- This draft guidance recommends the capsule fluence be between 1 and 1.25 of the SLR peak RV fluence. - XI.M31-1 line 26
  - However, some plants have already tested a capsule that has a fluence higher than 1.25x the RV and no other capsules remain.
  - The embrittlement curve flattens out at high fluence, therefore meaningful metallurgical data can be obtained with higher fluence than 1.25x.
  - The latest 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.
  - 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. Many plants have a capsule that provides fluence data that is representative of SLR conditions but was withdrawn prior to the SLR period. This data should not be discredited strictly because it did not have the same time exposure as a capsule pulled within the SLR period.

XI.M31: Reactor Vessel Material Surveillance (cont.)

- Page XI.M31-5, lines 32-37: "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**. 10CFR50.61 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: Reactor Vessel Material Surveillance (cont.)

- Peak wall fluence is not relevant for BWRs since the PTS Rule applies only to PWRs. 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 fluence.
- This draft guidance would recommend 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 recommendation provides 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 recommendation for a contingency capsule.

X.M1 Cyclic Load Monitoring

All fatigue monitoring methods are not clearly addressed

Fatigue monitoring using cycle counting, where numbers of transient cycles are counted and compared to cycle limits for each transient type, is clearly addressed. Two other methods where cycles are converted to CUF are not as clearly addressed.

- Cycle-based fatigue monitoring (CBFM) computes the fatigue CUF to-date that has resulted from the number of cycles counted to-date based on design transient severity. The CUF to-date is periodically compared to the design limit of 1.0.

- Stress-based fatigue monitoring (SBFM) computes the fatigue CUF to-date that has resulted from the number of cycles counted to-date, but the transient severity is computed based upon monitored fluid temperatures, pressures, and flow rates that have affected the component during plant operations. The CUF to-date is periodically compared to the design limit of 1.0. This provides a more accurate computation of the fatigue CUF to-date, which may be necessary in order to maintain qualification of limiting components through the SLR period and beyond.

- Both CBFM and SBFM have been accepted for use by the NRC staff in the past and are presently used at many plants for monitoring. Both can be used to confirm the CUF and CUF_{en} values to-date are less than the 1.0 limit.

Recommendation: In the program description and associated program elements, clarify that CBFM and SBFM monitoring methods are acceptable for managing fatigue.

X.M1 Cyclic Load Monitoring (cont.)

Regulatory Guide 1.207, Rev. 1, does not endorse NUREG/CR-5704(SS) or 6583 (CS/LAS) for evaluating environmental fatigue

- Both NUREG/CR-5704 and NUREG/CR-6583 were deemed acceptable methods for evaluating the effects of environmental fatigue per GALL, Rev. 2, and therefore have been used by many applicants to prepare their EAF analyses.
- Without these methods, applicants that previously used these would need to replace the original environmental fatigue analyses with new analyses for SLR, which is costly and should be unnecessary if CUFen values to-date remain below 1.0.
- No justification has been provided that indicates these standards are no longer acceptable.

Recommendation: Add these NUREGs back into the list of acceptable methods for evaluating environmental fatigue.

XI.M5 BWR Feedwater Nozzle

- 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
- Adequate aging management is accomplished through implementation of ASME Section XI

Recommendation: NUREG-0619 should be sunset and this AMP eliminated

F/E 4.2.2.15 and 4.2.2.16 BWR RPV Circumferential Weld Exemption/Axial Weld Inspection Relief

- The SRP-SLR addresses BWR RPV circumferential weld exemption and axial weld ISI relief based on probabilistic fracture mechanics as follows:
  - *Approved technical alternatives for SLR have yet to be developed. They will be evaluated on a case-by-case basis to ensure that the aging effects will be managed in accordance with 10 CFR 54.21(c).*
- Some BWRs can demonstrate that the criteria established for 60-year evaluations remain valid through an SLR period. It is logical that if the existing criteria can continue to be met thru 80 years, such an approach should be acceptable. Therefore, clarification should be added that plants demonstrating continued compliance with the existing criteria can use that approach as an acceptable method for demonstrating the TLAA.