

Information Meeting

GALL-SLR REPORT

Mechanical – AMPS AND TLAAS

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

Office of Nuclear Regulatory Research (RES)
Division of Engineering

May 7, 2015
9:00 AM- 4:00 PM
3WFN 1C03 & 1C05

Agenda for Meeting



| Time | Topic | |
|-------------|-------------------------|---|
| 9:00am | Opening | |
| 9:20am | GALL XI.M6 | BWR Control Rod Drive Return Line Nozzle (Bart Fu) |
| 9:35am | GALL XI.M16A | PWR Vessel Internals, replaced with a further evaluation (Jim Medoff) |
| 9:50am | GALL X.M1 | Cyclic Load Monitoring (formerly Fatigue Monitoring) (Jim Medoff) |
| 10:05am | GALL XI.M31 | Reactor Vessel Material Surveillance (Carolyn Fairbanks) |
| 10:20am | Break | |
| 10:35am | GALL X.M2 | Neutron Fluence Monitoring (Matt Hardgrove) |
| 10:50am | SRP 4.1 (Jim Medoff) | Identification of Time-Limited Aging Analyses and Exemptions |
| 11:05am | SRP 4.2 | Reactor Vessel Neutron Embrittlement Analysis (Jim Medoff) |
| 11:20am | SRP 4.3 | Metal Fatigue (Jim Medoff) |
| 11:35am | GALL XI.M32 | One-Time Inspection (Bill Holston) |
| 12:00pm | Lunch | |

Agenda for Meeting



Time

Topic

| | |
|---------|--|
| 1:00pm | GALL XI.M33 Selective Leaching (Bill Holston) |
| 1:15pm | Further evaluation: Polyvinyl chloride exposed to outdoor air (Bill Holston) |
| 1:30pm | Further evaluation: Underground stainless steel components exposed to raw water (Bill Holston) |
| 1:45pm | Further Evaluation: Cracking due to stress corrosion cracking in aluminum alloys (Christopher Hovanec) |
| 2:00pm | XI.M27 Fire Water System (Amy Hull) |
| 2:15pm | GALL XI.M9 BWR Vessel Internals (Seung Min) |
| 2:30:pm | GALL XI.M11B Cracking of Nickel Alloys (Seung Min) |
| 2:45pm | GALL XI.41 Buried and Underground Piping and Tanks (Bill Holston) |
| 3:00pm | Further Q& A |
| 3:30pm | Public Participation |
| 4:00pm | Adjourn |

Purpose of Meeting



- **Inform external stakeholders of:**
 - Proposed revisions to the portions of the GALL and SRP related to mechanical components
 - Aging Management Programs (AMPs), Time-Limited Aging Analyses (TLAAs), Further Evaluation/Plant-Specific Programs.
 - Informal comments from external stakeholders

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

Format Changes for GALL-SLR and SRP-SLR



- Standard Elements: Corrective Actions, Confirmation Process, and Administrative Controls 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
- FSAR Supplement summary description examples
 - More detailed, specific summary descriptions
 - Tables of summary descriptions in both GALL-SLR and SRP-SLR

Schedule



| Milestone | Date |
|---|-----------------------|
| Second Public Meeting on SLR Mechanical AMPs | TBD |
| ACRS Technical Meeting | October 2015 |
| Draft GALL-SLR and SRP-SLR Publication | December 2015 |
| Public Meetings | January-February 2016 |
| ACRS Sub-Committee Meeting | February 2016 |
| Public Comment Period Ends | February 2016 |
| ACRS Full-Committee | February 2017 |
| Final GALL-SLR, SRP-SLR and Technical Basis/Response to Public Comments Publication | May 2017 |
| First SLR applications | 2018-2019 |

AMP XI.M6 – Control Rod Drive Return Line Nozzle

Basis for No AMP in GALL-SLR



- AMP in GALL 2 used to manage cracking in BWR control rod drive (CRD) return lines
- Previously renewed BWRs, Nine Mile Pt., Unit 2 (NMP-2) and Oyster Creek (OC) established procedures to perform UT examinations of the CRD return lines
- Aging in all other BWRs managed by other AMPs
- AMP XI.M6 is no longer needed to manage cracking in the CRD return lines
- Appropriate AMR line items and SRP-SLR further evaluation sections have been added or modified to account for the revised basis

AMP XI.M16A – PWR Vessel Internals

Basis for No AMP in GALL-SLR



- AMP in GALL 2 used to manage PWR reactor vessel internals (RVIs)
- AMP based on methodology in EPRI Technical Report MRP-227-A
- Scope of MRP-227-A does not cover 80-year operating basis
- New AMR further evaluation (FE) section addresses aging management
- New FE section will request plant-specific AMP for PWR RVIs
- AMP XI.M16A will not be included in the GALL-SLR report

AMP X.M1 – Cyclic Load Monitoring

(Previously Named “Fatigue Monitoring Program”)

- Program Description (PD), Scope of Program, Detection of Aging Effects, and Monitoring and Trending: Elements renamed and amended to clarify that AMP X.M1 is a “condition monitoring” program
 - May be used to accept cycle-based TLAAAs accordance with §54.21(c)(1)(iii)
 - Includes all types of cycle-related TLAAAs in SRP-SLR 4.2
 - Monitoring to cover number of cycles and severity of design transient occurrences
 - States that technical specification requirements may apply
- Acceptance Criteria: Appropriate thresholds to be established for each type of fatigue analysis monitored by the AMP

AMP XI.M31, Reactor Vessel Material Surveillance



- Program Description:
 - Based on requirements in 10 CFR Part 50, Appendix H
 - Adjusted to provide adequate reactor vessel (RV) surveillance program criteria to cover plant operations through a 80-year period of licensed operation
 - Updated to differentiate between plant-specific RV material surveillance programs and RV material integrated surveillance programs (ISPs)
- Scope of Program, Detection of Aging Effects, and Monitoring and Trending Elements: Improved element criteria defined for implementation of both plant-specific RV material surveillance programs and RV material ISPs
- Parameters Monitored: Updated capsule removal schedule and RG 1.190 conformance criteria

AMP XI.M31, Reactor Vessel Material Surveillance (cont.)



- Detection of Aging Effects and Monitoring and Trending Elements:
Withdrawal and testing of additional capsule during the subsequent period of extended operation that achieves a capsule fluence that is between 1 and 2 times the maximum ID fluence that is projected for the RV through 80 years of licensed operation
 - Program element criteria includes alternative management activities if no surveillance capsules are available for withdrawal and testing during a subsequent license renewal period

New AMP X.M2, Neutron Fluence Monitoring



- Program Description (PD) and Scope of Program: Added to provide a method for accepting reactor pressure vessel (RV) neutron embrittlement TLAAAs in accordance with §54.21(c)(1)(iii).
 - May be used for other non-TLAA assessments
 - AMP to be used in conjunction with GALL-SLR AMP XI.M31
 - Use of X.M2 is analogous to use of AMP X.M1 for fatigue TLAAAs
- Detection of Aging Effects and Monitoring and Trending Element Clarifications:
 - Monitoring methods for components in the RV beltline to be consistent with RG 1.190.
 - Methodology for monitoring RVI components or RV components away from the beltline may need additional justification, on a plant-specific basis
 - Monitoring to be performed in comparison to the neutron fluence methods, assumptions, and results used in the TLAAAs or aging management assessments
- Acceptance Criteria and Corrective Action Elements: When monitoring is applied to NRC mandated analyses, regulatory requirements for updating the analyses and for submitting the analyses to the NRC must be adhered to, as defined in the applicable regulations or Technical Specification requirements

SRP-SLR Section 4.1, Identification of Time-Limited Aging Analyses (TLAAs) and Exemptions



- Added that TLAAs may be applicable to the assessment of in-scope, active components
- Clarified that some analyses not qualifying as TLAAs before could qualify as TLAAs for a proposed subsequent period of extended operation
- Added examples of regulatory exemptions in past LRAs that were granted in accordance with 10 CFR 50.12 and are based on a TLAA

SRP-SLR Section 4.2, Reactor Vessel Neutron Embrittlement Analysis and SRP-SLR Section 3.1.2.2.3 Subsection 1

- Added “acceptance criteria” and “review procedure” criteria for neutron fluence methodology TLAAs
- PTS TLAAs for SLR may be based on either §50.61 or §50.61a (depending on CLB)
- AMP, when used in conjunction with XI.M31, provides one way to accept under §54.21(c)(1)(iii)
- BWR RV girth and axial weld probability of failure analyses for SLR to be reviewed on a case-by-case basis

SRP-SLR Section 4.3, Metal Fatigue

- Section expanded to include all cycle-based TLAAAs in previous LRAs
- Prior environmentally-assisted fatigue analyses will be TLAAAs for SLR
- Subsections regrouped by those for: (a) environmentally-assisted fatigue analyses, and (b) other types of cycle-based analyses
- Additional clarifications for accepting TLAAAs per §54.21(c)(1)(iii):
 - AMP X.M1, Cyclic Load Monitoring, a way to accept under (iii)
 - Other bases for (iii) to be reviewed on a case-by-case basis
 - If an inspection-based AMP is used for (iii), AMP must inspect the specific components during the subsequent PEO

XI.M32 One-Time Inspection

- Scope of Program
 - Results of prior one-time inspections when acceptance criteria not met, industry OE, or environment not equivalent excludes use
 - Steel components exposed to environments without corrosion inhibitors
- Parameters Monitored or Inspected
 - One-time inspections for SLR
 - Inspection quantity is unit-based
- Acceptance Criteria
 - Acceptance criteria for individual and compiled results
- Corrective Actions
 - Expanded scope of inspections

XI.M33 Selective Leaching

- Detection of Aging Effects
 - Periodic inspections dependent on environment
 - One-time inspections dependent on environment
 - Destructive examinations are conducted
 - Internal and external coatings, cathodic protection
 - Visual inspections for copper based
 - Mechanical inspections for gray cast iron
 - Inspection quantity is unit-based
- Acceptance Criteria
 - Components meet design criteria until end of subsequent PEO
- Corrective Actions
 - Expanded scope of inspections

Further Evaluation: PVC Exposed to Outdoor Air

- Long-term (2 years or longer) exposure of PVC to sunlight can result in a reduction in impact strength
- JM Eagle™ Technical Bulletin, “The Effects of Sunlight Exposure on PVC Pipe and Conduit,” JM Manufacturing Company Inc., January 2009
- Opaque wrap or paint can eliminate aging effect
- Manage loss of coating integrity or reduction in impact strength

Further Evaluation: Underground Stainless Steel Components Exposed to Raw Water

- SRP-LR further evaluation addresses stainless steel components exposed to outdoor air
- Cracking due to stress corrosion cracking is the current aging effect
- Underground stainless steel components can be exposed to raw water due to vault in-leakage

Further Evaluation: Cracking due to Stress Corrosion Cracking in Aluminum Alloys



- Added a Further Evaluation (FE) to the SRP-SLR for determining if cracking of aluminum alloys is adequately managed during SLR
 - Added GALL Report AMR line items to recommend further evaluation for aluminum piping, piping components, & tanks exposed to potentially aggressive environments
 - AMPs have been revised to allow for surface examinations and inspections to manage cracking of aluminum when applicable
- Contents of FE:
 - Material Susceptibility
 - Potentially Aggressive Environment
 - Sustained Tensile Stress

XI.M27 Fire Water System

- Preventive Actions
 - Acknowledged flushing as a means to mitigate or prevent flow blockage
- Parameters Monitored or Inspected
 - Corrected misstatement associated with detecting changes in nominal wall thickness
- Detection of Aging Effects
 - Clarified the potential of corrosion in sprinkler systems
 - Added deluge testing every 3 years unless design flow not met due to nozzle blockage
 - Addressed portions of fire water systems with only an (a)(2) intended function
- Monitoring and Trending
 - Added trend rates of degradation

XI.M9 BWR Vessel Internals

- Scope of Program:
 - Added: Loss of preload due to thermal or irradiation-enhanced stress relaxation (for core plate rim holddown bolts and jet pump assembly holddown beam bolts)
 - Clarified: Cracking due to cyclic loading includes cracking due to flow-induced vibration (for steam dryers)

XI.M9 BWR Vessel Internals (cont'd)

- Detection of Aging Effects: Added evaluations to determine need for supplemental inspections
 - The SLR term increases neutron fluence levels and operational periods, which can promote (a) loss of fracture toughness due to neutron irradiation or thermal aging embrittlement and (b) cracking due to IASCC in nickel alloy and stainless steel internal components
 - Applicants should evaluate the need for supplemental inspections in addition to the existing BWRVIP examination guidelines
 - Evaluations should consider neutron fluence, cracking susceptibility (i.e., applied stress, operating temperature, and environmental conditions), thermal aging susceptibility, and fracture toughness
 - Supplemental inspections based on evaluations
 - Accordingly, further evaluation sections added to SRP-SLR

XI.M11B Cracking of Nickel-Alloy Components and Loss of Material Due To Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components

- Scope of Program (clarified)
 - Nickel alloy components and welds identified in ASME Code Cases N-770, N-729, and N-722, as incorporated by reference in 10 CFR 50.55a
 - All nickel alloy components and welds which are identified at the plant in accordance with the guidelines of EPRI MRP-126
 - Components that are susceptible to boric-acid corrosion and may be impacted by leakage of boric acid from adjacent nickel alloy components described above

XI.M11B Cracking of Nickel-Alloy Components and Loss of Material Due To Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (cont'd)

- Detection of Aging Effects:
 - Inspections are conducted in accordance with 10 CFR 50.55a
 - Other nickel alloy components and welds not addressed by 10 CFR 50.55a are inspected in accordance with the guidance in MRP-126
 - Added: A baseline inspection of all susceptible nickel alloy bottom-mounted instrumentation nozzles is performed using a volumetric method prior to the subsequent period of extended operation. Alternatively, applicant-proposed and staff-approved mitigation methods may be used to manage PWSCC
 - Added: Baseline inspection provisions are added for branch line connections, control rod drive mechanism housings, and associated welds that are fabricated with nickel alloys susceptible to PWSCC

GALL XI.M41 Buried and Under-ground Piping and Tanks

- Preventive Actions
 - Limiting critical potential (-1200mV) moved to Preventive Actions
- Parameters Monitored or Inspected
 - Loss of material due to wear for polymeric materials
 - Change in material properties for cementitious materials
- Detection of Aging Effects
 - Annual fire water system leakage testing
 - Table 4a extent of inspections for buried piping
 - Polymeric material – physical manipulation
 - Transitioning to a higher number of inspections late in interval
- Acceptance criteria
 - Cathodic protection acceptance criteria

GALL-SLR AMPs and TLAAs - Mechanical



Additional Comments
or
Questions?

Acronyms



- CLB – current licensing basis
- CRD – control rod drive
- FE –further evaluation
- FSAR – Final Safety Analysis report
- IASCC –irradiation-assisted stress corrosion cracking
- ISP - integrated surveillance program
- LRA – license renewal application
- NMP- 2 – Nine Mile Point Nuclear Station, Unit 2
- OC- Oyster Creek Generating Station
- PEO – period of extended operation
- PD – Program Description
- PTS – pressurized thermal shock
- PVC - Polyvinyl chloride
- PWSCC – primary water stress corrosion cracking
- RV – reactor vessel
- RVI – reactor vessel internals
- SLR – subsequent license renewal
- TLAA –time-limited aging analysis

