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Summary Report on EPRI Project to Assess R&D Efforts to Support Aging Management Program Application to Long-Term Operations

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Contents

- Review of EPRI Project on Aging Management Program (AMP) R&D Assessment for Long-Term Operation (LTO, >60 years operation)

R&D Gap Assessment

- A three step process:
  1. Reviewed on-going R&D for LTO and identified incremental needs
     - Materials Degradation Matrix report and related efforts used to populate potential R&D needs
  2. Assessed R&D needs relative to aging management program (AMP) plant actions
  3. Mapped R&D gaps to AMPs using GALL Rev 2 as a baseline set of plant actions
     - 3 categories were used to characterize the R&D efforts required to support AMP application to LTO

R&D Gap Assessment

- Note that the Material Degradation Matrix mapping processes for LTO were effective in identifying technical issues
  - No new issues for SLR
- Key needs were to extend data coverage to 80 years for irradiation, environmental and thermal effects
  - Discussion of technical work by Robin Dyle
- Linkage of technical research to AMPs provided by this project
  - Binned in 3 categories per R&D needs

AMP Categories Based on R&D Priorities

1. R&D to better characterize and manage 60 to 80 years materials performance
2. R&D to improve implementation, efficiency or cost effectiveness where aging degradation is already well-characterized
3. No new R&D role identified

Category 1 Background

- AMPs in this category were judged to have technical data needs relative to the projected operating conditions to 80 years
  - Expand current knowledge base
    - Degradation mechanistic understanding for LTO
      - Where to look
    - Degradation rate understanding for LTO
      - When and how often to look

Category 1 Summary

GALL AMP ID	AMP Name	Potential LTO Impact on AMP
XI.M9	BWR Vessel Internals	Irradiation and environmental effects on material performance
XI.M11B	Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components	Environmental effects on material performance
XI.M12	Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)	Thermal aging and possible irradiation effects on material performance
XI.M16A	PWR Vessel Internals	Irradiation and environmental effects on material performance
X.M31	Reactor Vessel Surveillance	Neutron fluence on reactor pressure vessel materials
XI.S6	Structures Monitoring	ASR susceptibility and irradiation effects on material properties
XI.E1	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Combined effects of thermal and radiation exposure
XI.E2	Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used In Instrumentation Circuits	Combined effects of thermal and radiation exposure

Category 2 Background

- R&D projects, on-going programs, and/or relevant operating experience will be used for continuous improvement of the aging management program implementation.
- The on-going research results and relevant OE may be used to improve inspection techniques, inspection coverage, and frequency.
- Some AMPs in this category are tied to mitigation processes that are monitored and expected to continue, i.e. the EPRI Chemistry Program Guidelines.

Category 2 Summary (1 of 3)

GALL AMP ID	AMP Name	Programmatic or Industry Guidance Source
X.M1	Fatigue Monitoring (TLAA)	Plant specific evaluation addressing additional fatigue cycles supported by EPRI Report: Materials Reliability Program: Thermal Fatigue Monitoring Guidelines (MRP-32, Revision 1)
XI.M2	Water Chemistry	EPRI Reports :PWR Primary Water Chemistry Guidelines PWR Secondary Water Chemistry Guidelines; BWRVIP-190: BWR Vessel and Internals Project, BWR Water Chemistry Guidelines - 2008 Revision The Guidelines have an established review and approval cycle and are periodically updated
XI.M3	Reactor Head Closure Stud Bolting	Inspection and assessment guidance in accordance with NRC Regulatory Guide 1.65 supported by on-going EPRI NDE R&D on improved inspection methods
XI.M4	BWR Vessel ID Attachment Welds	Inspection and assessment Guidelines (BWRVIP-48-A: BWR Vessel and Internals Project, Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines; ASME Code Section XI
XI.M5	BWR Feedwater Nozzle	Inspection and assessment Guidelines in accordance with NUREG-0619, BWRVIP-74-A: BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal, and ASME Code Section XI
XI.M6	BWR Control Rod Drive Return Line	Inspection and assessment Guidelines in accordance with NUREG-0619, BWRVIP-74-A: BWR Vessel and Internals Project, BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal, and ASME Code Section XI
XI.M7	BWR Stress Corrosion Cracking	Inspection and guidance in accordance with NRC Generic Letter 88-01 and BWRVIP-75-A: Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules.

Category 2 Summary (2 of 3)

GALL AMP ID	AMP Name	Programmatic or Industry Guidance Source
XI.M10	Boric Acid Corrosion	Inspection and assessment in accordance with NRC Generic Letter 88-05 and NUREG-1823 supported by MRP-199, Reactor Vessel Head Boric Acid Corrosion Testing, and MRP-268, Reactor Vessel Bottom Mounted Nozzle Boric Acid Corrosion Testing: Design and Analysis of Full-Scale BMN Mockups,
XI.M17	Flow-Accelerated Corrosion	FAC Program Implementation NSAC-202 "Recommendations for Effective Flow-Accelerated Corrosion Program"
XI.M18	Bolting Integrity	Inspection and assessment per EPRI Report: Nuclear Maintenance Applications Center: Bolted Joint Fundamentals. Periodically updated.
XI.M19	Steam Generators	EPRI Steam Generator Management Program Guidelines for inspections, assessments and repairs; periodically updated – see listing in Section 7 under SGMP
XI.M21A	Closed Treated Water Systems	Guidance per EPRI Report: Closed Cooling Water Chemistry Guideline, Revision 1
XI.M25	BWR Reactor Water Cleanup System	BWRVIP-190: BWR Vessel and Internals Project, BWR Water Chemistry Guidelines—2008 Revision
XI.M35	One-Time Inspection of ASME Code Class 1 Small Bore Piping	MRP -146 guidelines for location selection criteria for thermal fatigue in addition to ASME Section XI

Category 2 Summary (3 of 3)

GALL AMP ID	AMP Name	Programmatic or Industry Guidance Source
XI.M37	Flux Thimble Tube Inspection	Inspection and assessment per MRP- 227A: Pressurized Water Reactor Internals Inspection and Evaluation
XI.M38	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Inspection and repair/replace as needed; Guidance in EPRI Reports, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 4 and "Nuclear Maintenance Applications Center: Passive Component Maintenance Guide for Nuclear Power Plant Personnel"; reports periodically updated
XI.M40	Monitoring of Neutron-Absorbing Materials Other than Boraflex	Monitoring and assessment technology per EPRI Report, Strategy for Managing the Long Term Use of BORAL(R) in Spent Fuel Storage Pools
XI.M41	Buried and Underground Piping and Tanks	NEI Initiative 09-14 "Guideline for the Management of Underground Piping and Tank Integrity"
XI.S8	Protective Coating Monitoring and Maintenance Program	Inspection and assessment in accordance with EPRI Reports, "Plant Support Engineering: Guideline on Nuclear Safety-Related Coatings, Revision 2" and "Field Guide: Coatings Assessment"

Category 3 Background

- These AMPs are typically plant specific involving periodic inspections, repairs and replacements.
  - No R&D effort for application to LTO period.
- ASME Code compliance efforts are included in this category.

Category 3 Summary (1 of 3)

GALL AMP ID	AMP Name
XI.M1	ASME Section XI In-service Inspection
XI.M20	Open-Cycle Cooling Water System
XI.M22	Boraflex Monitoring
XI.M23	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (corrosion and loss of preload)
XI.M24	Compressed Air Monitoring
XI.M26	Fire Protection
XI.M27	Fire Water System
XI.M29	Aboveground Metallic Tanks

Category 3 Summary (2 of 3)

GALL AMP ID	AMP Name
XI.M30	Fuel Oil Chemistry
XI.M32	One-Time Inspection
XI.M33	Selective Leaching
XI.M36	External Surfaces Monitoring of Mechanical Components
XI.M39	Lube Oil Analysis
XI.S1	ASME Section XI, Subsection IWE
XI.S2	ASME Section XI, Subsection IWL
XI.S3	ASME Section XI, Subsection IWF

Category 3 Summary (3 of 3)

GALL AMP ID	AMP Name
XI.S4	10 CFR Part 50, Appendix J
XI.S5	Masonry Walls
XI.S7	RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants
XI.E3	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements
XI.E4	Metal Enclosed Bus
XI.E5	Fuse Holders
XI.E6	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Publication Content

- Reporting
  - Project results will be presented in a publicly accessible EPRI report
    - R&D assessment per 3 categories
    - R&D project summaries

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