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BWR Vessel and Internals Project Update

2020 EPRI-NRC Technical Exchange Meeting

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July 14, 2020

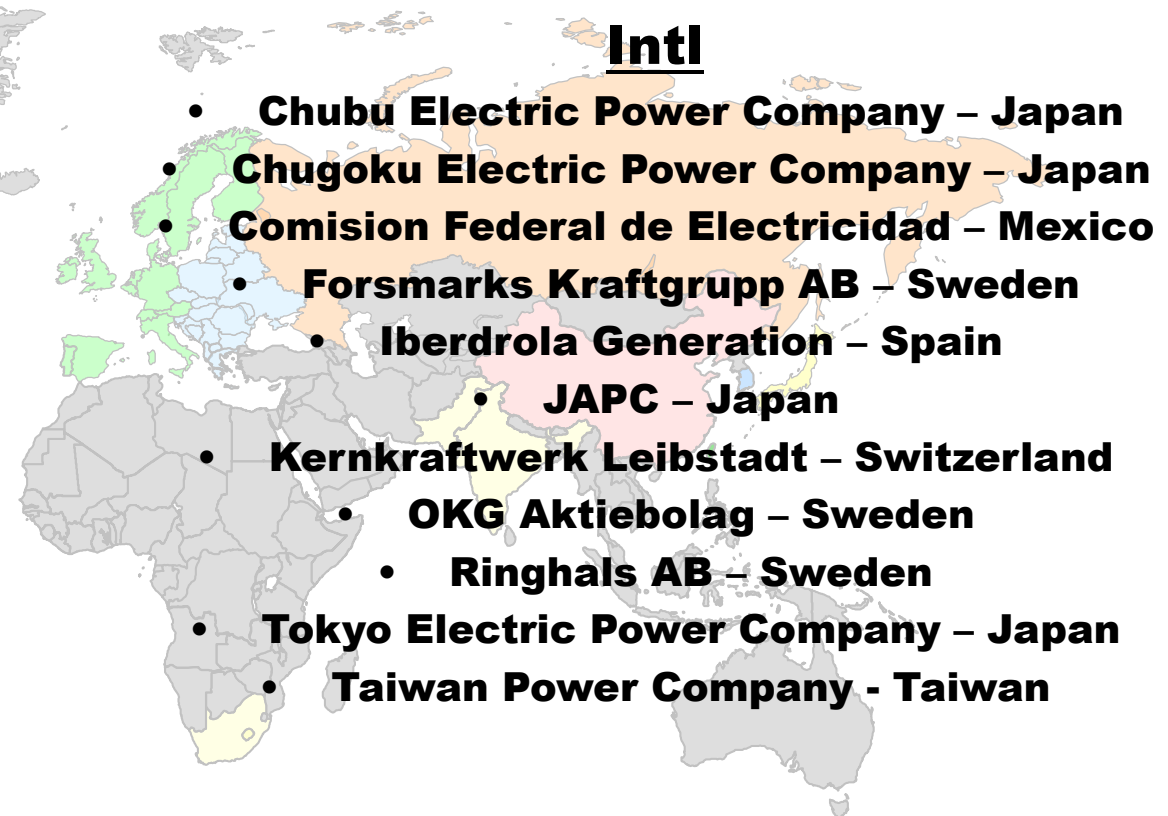
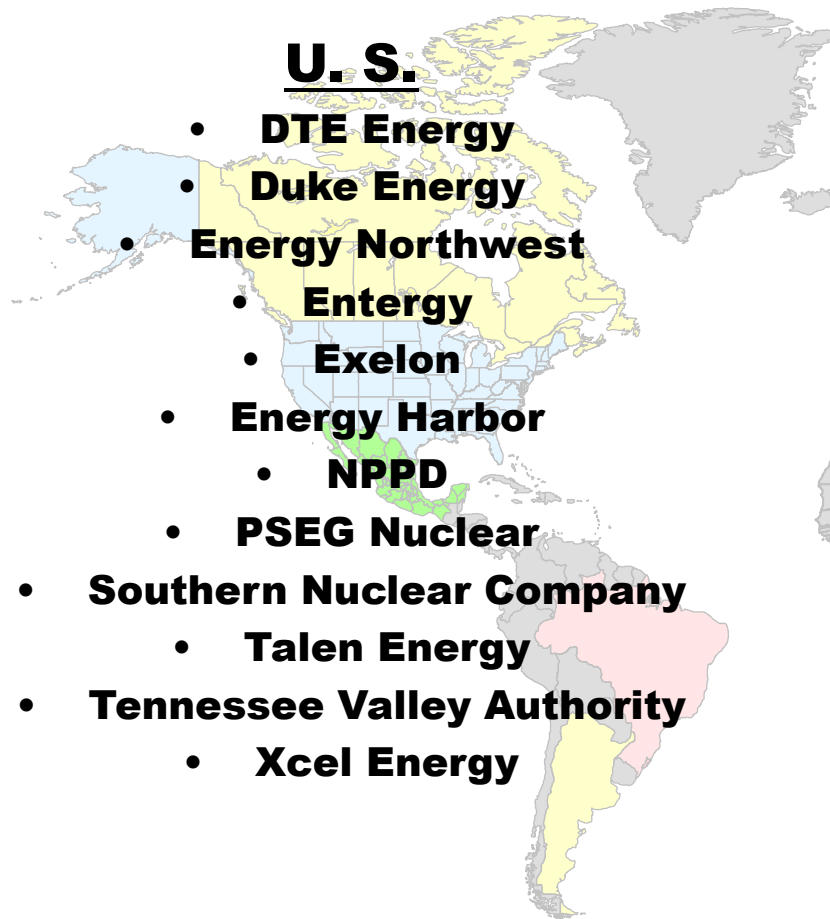


Agenda

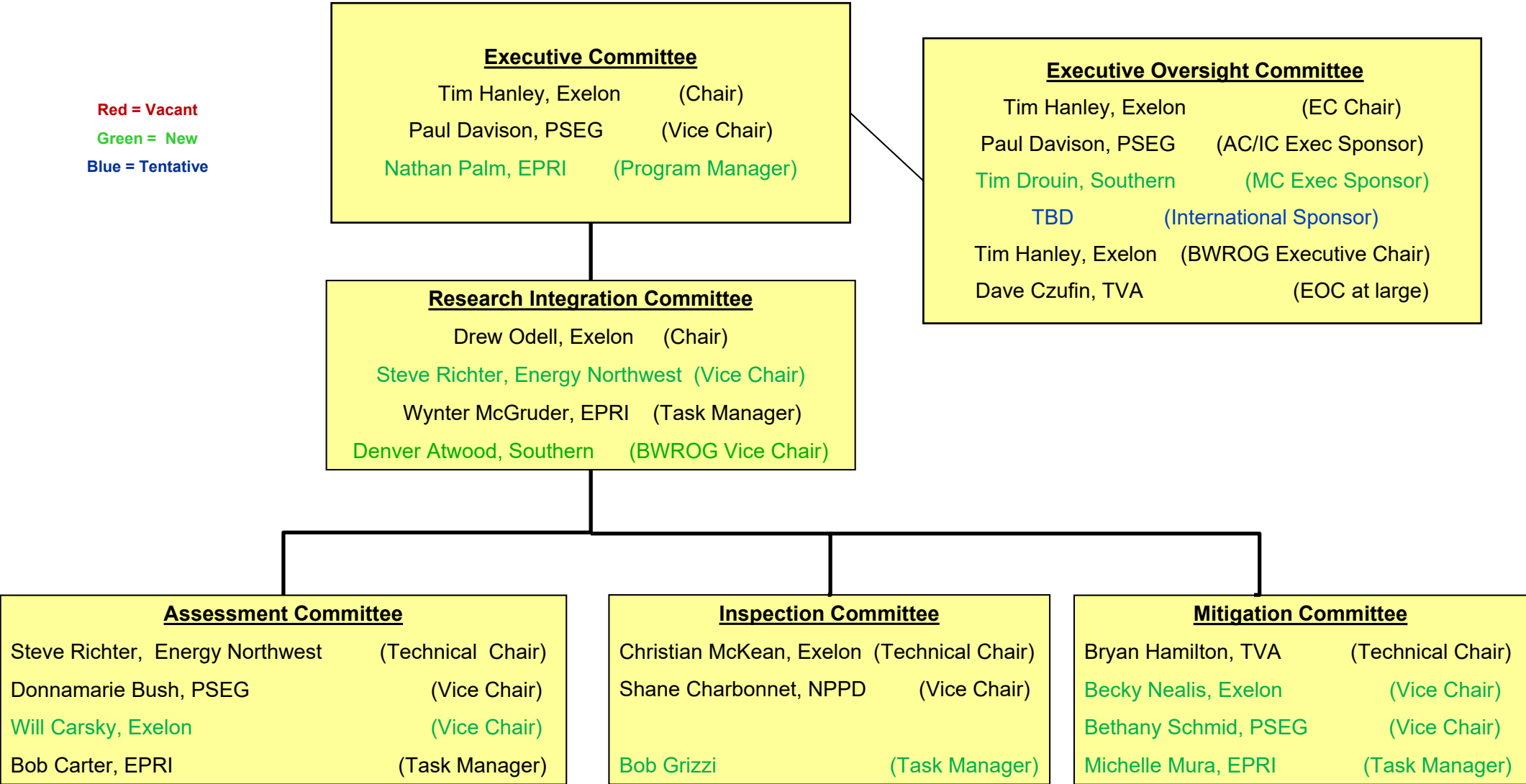
- Program Status
- BWRVIP IMT Update
- Recent BWR Materials Operating Experience
- NRC Interactions

Program Status

2020 BWRVIP Member Utilities



BWRVIP Organization



Technical Committee Responsibilities

Technical Committee	Technical Committee Responsibilities
Assessment	What needs to be inspected, when it needs to be inspected, inspection options, how to disposition observed degradation. Repair/replacement techniques are available including the associated requirements.
Inspection	How to inspect, what equipment and techniques are available, what are the associated uncertainties.
Mitigation	How can SCC degradation be prevented or reduced.
Research Integration	Coordinates overall BWRVIP issue management strategy for resolution of vessel and internals issues

2020 Technical Activities (Major Tasks)

- Crack growth testing, fracture toughness evaluations, and metallurgical examinations of highly irradiated materials (2020 Technical Reports)
- Further development of a fleet-wide inspection results database and analysis tool that will be used to inform continued maintenance and optimization of BWRVIP inspection and evaluation guidelines
- Development of a core shroud weld PFM evaluation (2021 Technical Report)
- Analysis of core shroud weld off-axis flaw inspection data (2020 Technical Report)
- Initiation of design and fabrication of supplemental surveillance capsules for extension of the ISP for SLR (per BWRVIP-321)

2020 Technical Activities (Major Tasks)

- Continued updating of the MDM and BWR Issue Management Tables to ensure the highest priorities are being addressed (Published in June 2020)
- Development of technical basis on BWRVIP RPV materials aging to inform decisions regarding second license renewal (2020 Technical Report)
- Investigations of top guide rim and grid beam connection cracking (2020 Technical Report)
- Updates to chemistry and mitigation guidance and implementation documents (2020 Technical Reports)
- Development of comprehensive leakage evaluation guidance for reactor vessel internals (2021 Technical Report)
- Development of virtual reality tools for BWR IVVI training

BWRVIP IMT Update

IMT Background

- The main use of the Issue Management Tables (IMTs) today is to maintain a set of R&D gaps that are used to establish R&D program focus and to prioritize work
- R&D gap definition:
 - *An R&D “Gap” is an area of research identified as important to achieving a reasonable standard of confidence that primary system component degradation can be managed such that components will remain serviceable and capable of performing their intended functions for the remainder of plant life.*
- The R&D gaps and associated priorities are an important element considered when prioritizing BWRVIP tasks for funding
- Periodic revision ensures that industry commitments under the NEI 03-08 Materials Initiative continue to be met

IMT Revision 4

- BWRVIP-167, Revision 4, EPRI TR# 3002018319, was published in June 2020 (available from www.epri.com as a no cost download)
- Revision 4 Objectives:
 - Identifying gaps that have been closed since Revision 3 was published in 2013
 - Incorporate results from the 2018 revision of the Materials Degradation Matrix
 - Updating gaps to accurately capture the current state of knowledge and industry priorities
 - Establishing separation between technical gaps and regulatory issues

Separating Technical Gaps and Regulatory Issues

- A CLEAR distinction between technical gaps and regulatory issues has not been established previously which causes difficulties in prioritizing issues that are largely driven by regulatory context
- Technical R&D gaps remain fundamentally unchanged - are not impacted by regulator climate / positions
 - Generally applicable to both US and international plants (so long as design / materials are similar)
 - Resolution is independent of regulatory needs and a common basis for prioritization exists
- Historically, regulatory gaps have represented issues associated with regulatory concerns
 - Issues vary significantly by country or evolve over time due to new regulations or changes within regulatory organizations
- Regulatory issues are treated as distinct from technical R&D gaps in IMT revision 4 and captured in a separate document

BWRVIP-167, Revision 4 – Key Findings

- Key R&D areas include assessment of stress corrosion cracking (SCC) crack growth, management of highly irradiated components, and effective implementation of water-chemistry-based SCC mitigation technologies
- By focusing R&D gaps on technical issues, a significant number of gaps were closed, with a majority of these gaps being assessment (AS) gaps
- Few new gaps were identified. This is consistent with the expectation that as IMT gap assessments are repeated over time, fewer issues not identified in initial assessments are captured.

Recent BWR Materials Operating Experience

BWRVIP Operating Experience (OE) - Protocol

- NEI 03-08, Guideline for the Management of Materials Issues
 - Provides the framework for identification, assessment and management of emergent industry issues.
- Utilities communicate new materials issues with potential generic significance to the BWRVIP within 24 hours of characterization when possible.
- Using the Emergent Issue Protocol in BWRVIP-94, the BWRVIP evaluates the material issue based on safety significance, demonstration of a new degradation type, impact on the technical basis of industry guidance, and effect on the existing knowledge base and determines the issue classification (i.e. emergent, significant, etc.)
- Based on the issue classification and the details of the issue, EPRI and the BWRVIP utility members work collaboratively to develop specific strategies to address the generic industry implications of the issue. Those strategies may include but are not limited to:
 - Industry survey and data collection
 - Interim inspection and/or evaluation guidance
 - Revision of current guidance documents
 - Technical evaluation
 - Failure analysis and investigation
 - Development of repair/replacement guidance and/or technology

Recent BWR Materials Operating Experience

- 2020 – Identification of a flaw in a LPCI coupling strut to elbow weld
- 2019 – No events
- 2018 – Identification of flaws in a top guide grid beam to rim connection location not specifically addressed by BWRVIP guidance

BWRVIP Operating Experience – LPCI Coupling Strut to Elbow Weld Indication

- Emergent Issue
 - A domestic BWR/6 identified an ~1/2” indication in their LPCI coupling strut to elbow weld (unique configuration for BWR/6 design). While the indication was identified in the course of performing BWRVIP exams, it was the first indication found for this location.
- BWRVIP Response
 - BWRVIP emergent issue protocol invoked due to the indication being a first for this inspection location
 - Findings reviewed by BWRVIP Research Integration Committee and determined to be consistent with IGSCC, not significant from a safety perspective, and in a location previously determined to be susceptible to IGSCC
 - Findings communicated to BWRVIP EC Chair, MAPC Chair, and BWRVIP Committees
 - No further actions determined to be needed

BWRVIP Operating Experience – Top Guide Indications

- Emergent Issue
 - A domestic BWR identified indications in their top guide grid beam to attachment welds. The location of the indication were not specifically addressed in the BWRVIP top guide inspection guidance.
- BWRVIP Response
 - BWRVIP focus group established to examine extent of condition based on plant configuration and identify top guide locations considered to be at risk of similar degradation.
 - BWRVIP project established and funded to develop additional BWRVIP guidance as necessary based on focus group findings
 - Evaluations performed to investigate the structural significance of the observed degradation and determine whether changes/additions to the existing BWRVIP I&E guidance are necessary
 - Final report to be issued in 2020

BWRVIP – NRC Interactions

Status of BWRVIP Report Submittals

- Recently Received Safety Evaluations
- Recent Approvals of “-A” Reports
- Submittals Still in the Review Process
- Expected 2020 Submittals
- BWRVIP Reports Screening with the NEI 03-08 Screening Process

Most Recent Safety Evaluations and Approvals of “-A” Reports

- BWRVIP-25, Revision 1: Core Plate Inspection and Flaw Evaluation, final NRC SE dated March 23, 2020
- BWRVIP-108-A, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Weld and Nozzle Blend Radii, Approved 01/15/2020
- BWRVIP-241-A, Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Weld and Nozzle Blend Radii, Approved 01/15/2020
- BWRVIP-41-Revision 4-A, BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines, Approved 01/15/2020

Submittals Still in the Review Process

- BWRVIP-321, Plan for Extension of the BWR Integrated Surveillance Program (ISP) through the Second License Renewal (Submitted 3/8/2019)
 - NRC approved the fee waiver request on 4/1/2019
 - NRC Acceptance of Report for Review on 4/25/2019
 - Initial RAs received on 10/23/2019
 - Response to RAs provided 06/08/2020
- BWRVIP-329, Updated Probabilistic Fracture Mechanics Analyses for BWR RPV Welds to Address Extended Operations (Submitted 8/22/2019)
 - NRC approved the fee waiver request on 09/23/2019
 - NRC Acceptance of Report for Review on 10/7/2019
 - Initial RAs received on 05/11/2020
 - Response to RAs due November 2020

Submittals Still in the Review Process

- BWRVIP-315, Reactor Internals Aging Management Evaluation for Extended Operations (Submitted 10/22/2019)
 - NRC approved the fee waiver request on 11/26/2019
 - NRC Acceptance of Report for Review received 02/24/2020
 - NRC originally indicated that their new Modified Review Process, but after review decided that the report would need to be reviewed using their standard process
 - Initial RAIs received on 06/04/2020
 - Response to RAIs due December 2020

2020 Report Submittals

- Submittal of Reports for Review and Approval:
 - BWRVIP-316, Reactor Pressure Vessel Aging Management Evaluation for Extended Operations
 - Pre-submittal meeting held on March 25, 2020
- Submittals for Information Only:
 - BWRVIP-94NP, Revision 4, Program Implementation Guide
 - BWRVIP 2019 Inspection Summary Report

2020 “-A” Report Submittals

- BWRVIP-25, Revision 1-A: Core Plate Inspection and Evaluation Guidance (September 2020)

Documents Within the NEI-03-08 Screening Process

- 2019 Screened BWRVIP Documents
 - BWRVIP-303 - Load Definitions and Combinations for Use in BWR Internals Repair/Replacement and Flaw Evaluations
 - NEI 03-08 Screening Conclusion: BWRVIP-303 may be generically released for implementation without NRC approval based on the determination that the guidance is equivalent or more conservative as the guidance specified in previously approved BWRVIP reports.
 - BWRVIP-48, Revision 1 – Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines
 - NEI 03-08 Screening Conclusion: BWRVIP-48, Revision 1 may be generically released for implementation without NRC approval based on completion of a qualitative risk assessment that concluded that the change to inspection guidance does not represent a significant change in risk.
 - BWRVIP member utilities may have to submit revised BWRVIP in lieu of ASME Code relief requests to implement BWRVIP-48, Revision 1.
- NEI 03-08 Appendix C Letter Submitted to the NRC on April 3, 2020 (BWRVIP Letter 2020-022)

BWRVIP Action Items from Master Materials Action Item List

- “2) The NRC and BWRVIP will establish communications related to the effects of leak test pressure on Appendix G limits.”
 - Joint MRP and BWRVIP report published in June 2020
 - *Assessment of the Effect of Small Inner Surface Flaws on ASME Section XI Appendix G Pressure-Temperature Limits (MRP-437 and BWRVIP-328)*, 3002015928 (publicly available)
 - Conclusions stated regarding a potential need for increased leak test temperatures
 - The PFM results indicate that when the BWR system leak test is performed at normal operating pressure and the ASME Appendix G methodology is used to define the leak test temperature and allowable P-T limit curves for heatup and cooldown:
 - The dominant contribution to risk occurs during cooldown subsequent to completing the leak test.
 - Because the contribution to the TWCF is essentially negligible at the leak test temperature defined by ASME Appendix G, an increase in leak test temperature above that currently required by the Code is not warranted.
 - Presentation and discussion expected to occur during August ASME BPV Committee Meetings

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