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BWRVIP Program Overview

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BWRVIP Integration Chairman

EPRI-NRC Technical Exchange Meeting

May 25-26, 2010

Overview Outline

- Background
- Structure and Organization
- BWRVIP Guidelines and Implementation
- Strategic Plan and Current Research Gaps
- BWRVIP Major Tasks
- NRC Submittals
- Contact Information

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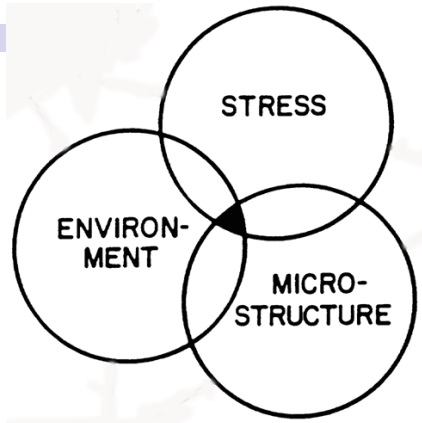
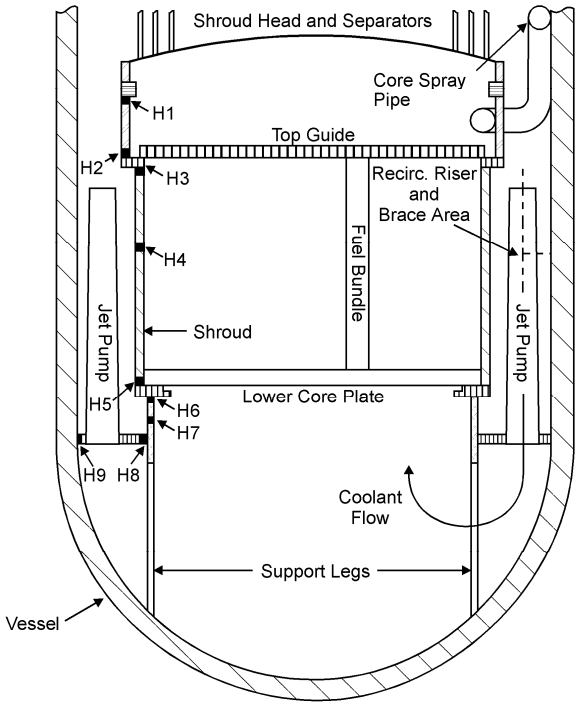
Background

Background

- Intergranular Stress Corrosion Cracking (IGSCC) in austenitic piping was a major issue for Boiling Water Reactors (BWRs) in the 1980s – susceptibility of reactor internals to IGSCC was also recognized





- Shroud cracking in 1993-1994 confirmed that IGSCC of internals is a significant issue for BWRs
- BWR utility executives formed the BWRVIP in mid-1994 to proactively address BWR reactor vessel and internals material condition issues
- The goal was to lead industry toward proactive generic resolution of vessel and internals material condition issues with generic, cost-effective strategies

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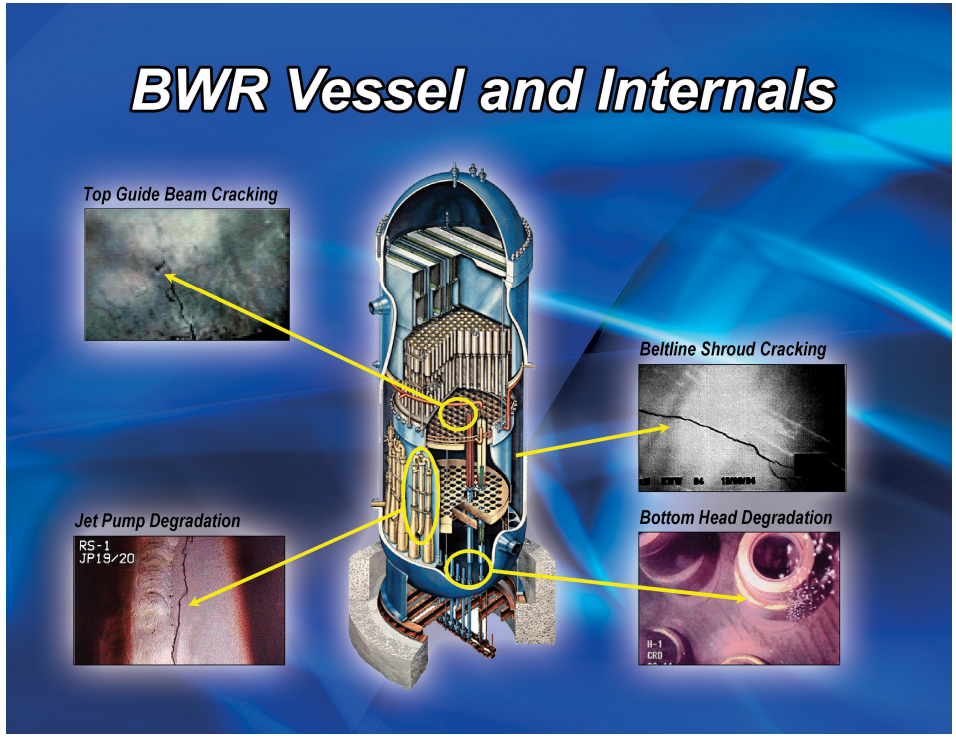
BWRVIP Objectives

- Lead industry toward proactive generic resolution of vessel and internals material condition issues
- Identify or develop generic, cost-effective strategies from which each operating plant will select the alternative most appropriate to their needs
- Serve as a focal point for the regulatory interface with the industry in BWR vessel and internals material condition issues (including license renewal)
- Share information among members to obtain useful data from many sources



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Structure and Organization

BWRVIP Member Utilities

U. S. (14 utilities, 35 units)

- **Constellation Nuclear, Nine Mile Point LLC**
- **DTE Energy**
- **Energy Northwest**
- **Entergy**
- **Exelon**
- **FirstEnergy**
- **FPL Energy Duane Arnold**
- **Nuclear Management Co.**
- **PPL Susquehanna, LLC**
- **Progress Energy**
- **PSEG Nuclear**
- **Southern Nuclear Company**
- **Tennessee Valley Authority**
- **Xcel Energy**

International (13 utilities, 43 units)

- **BKW FMB Energie AG – Switzerland**
- **Chubu Electric Power Company – Japan**
- **Chugoku Electric Power Company – Japan**
- **Comision Federal de Electricidad – Mexico**
- **Forsmarks Kraftgrupp AB – Sweden**
- **Iberdrola Generation – Spain**
- **Japan Atomic Power Company – Japan**
- **Kernkraftwerk Leibstadt – Switzerland**
- **Nuclenor – Spain**
- **OKG Aktiebolag – Sweden**
- **Ringhals AB – Sweden**
- **Taiwan Power Company – Taiwan**
- **Tokyo Electric Power Company – Japan**

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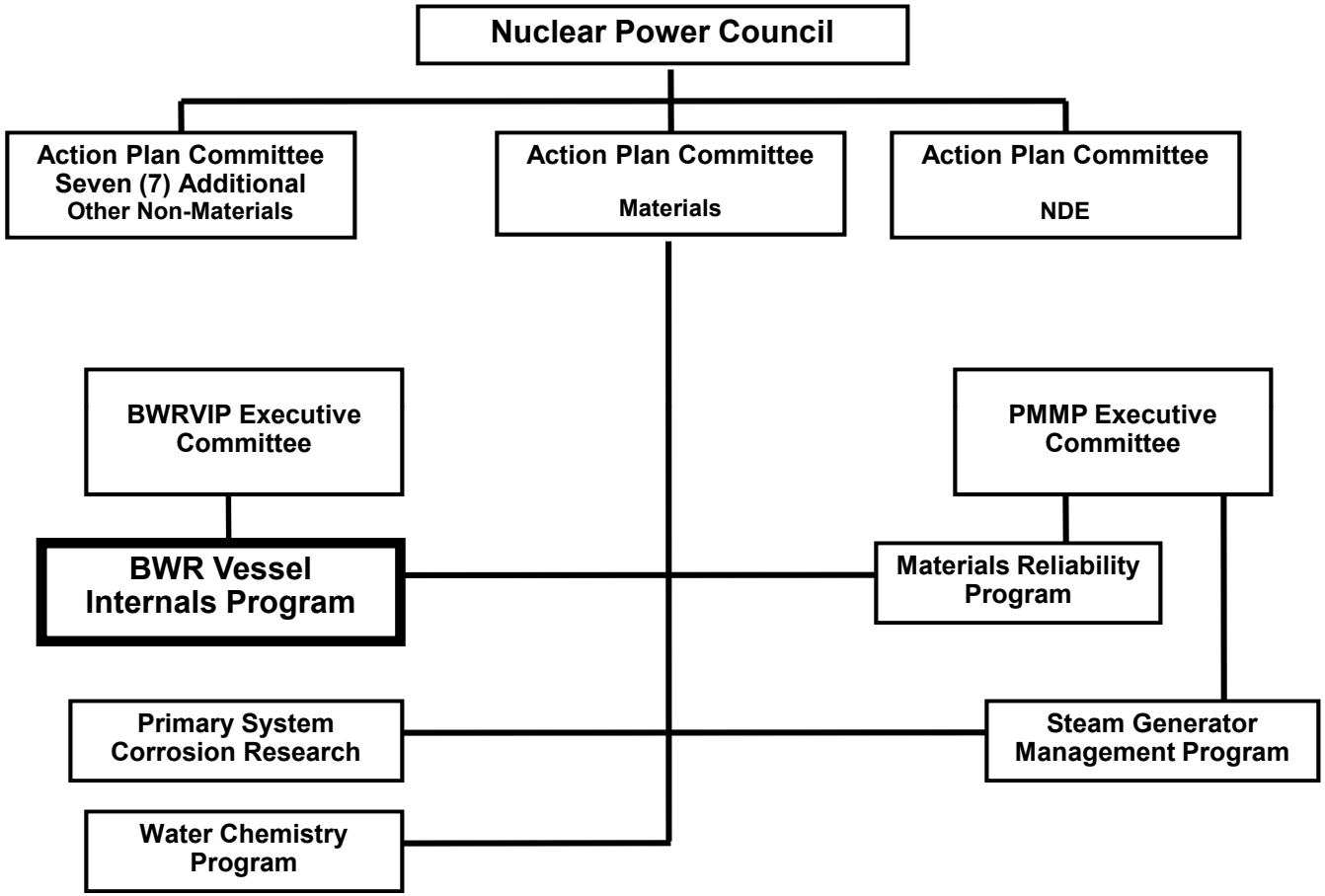
EPRI Structure



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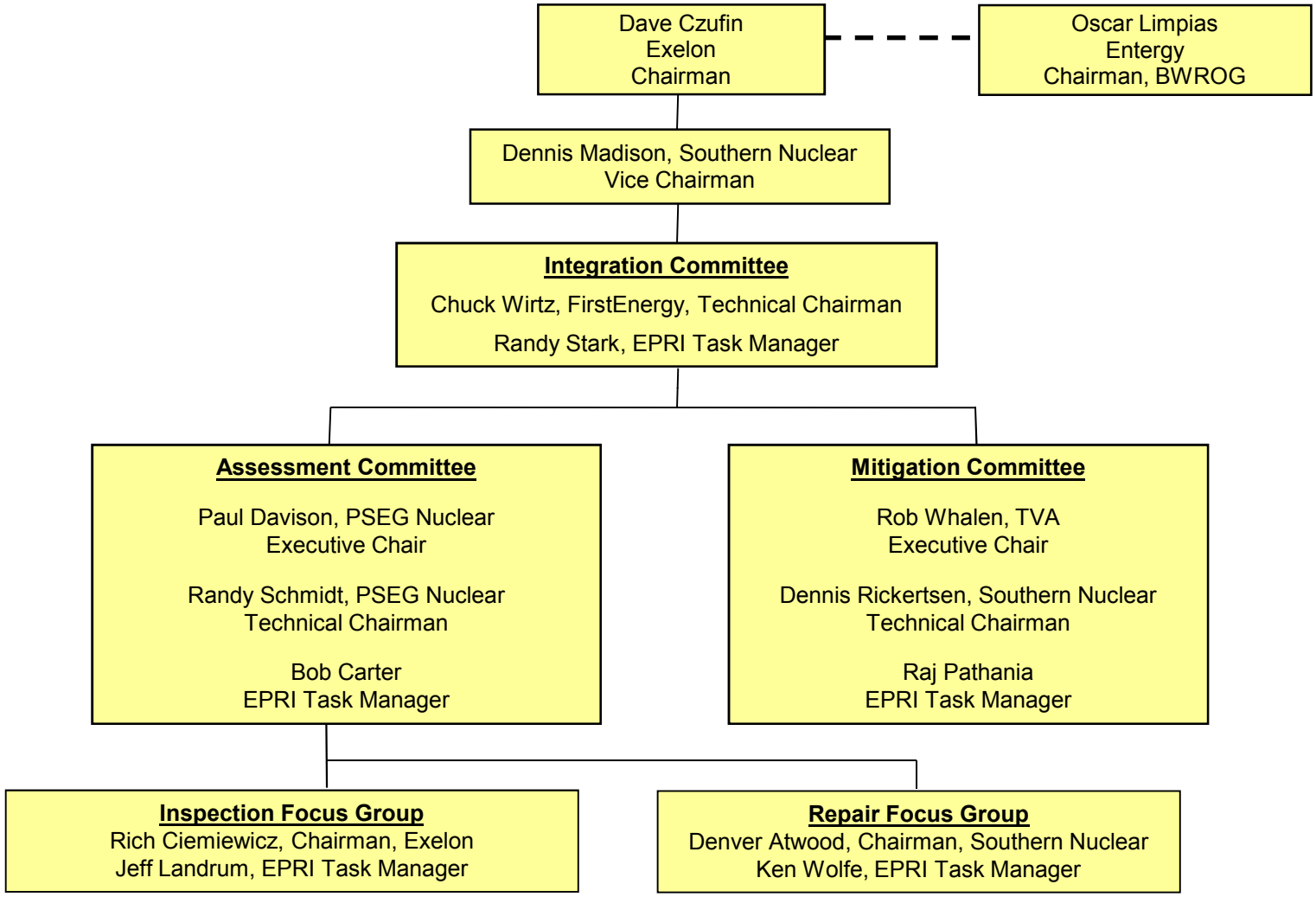
BWRVIP Organization



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Technical Committee Responsibilities

Assessment --	What needs to be inspected, when it needs to be inspected, inspection options, how to disposition observed degradation
Inspection --	How to inspect, what equipment and techniques are available, what are the associated uncertainties
Repair/replace --	What repair/replacement techniques are available and what are the associated requirements that must be met
Mitigation --	How can SCC degradation be prevented or reduced

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BWRVIP Guidelines and Implementation

BWRVIP Guidelines to Manage Degradation

Component	Assessment (I&E) Guidelines	Inspection Guidelines	Repair/Replace Design Criteria	Mitigation Recommendations
Core shroud	BWRVIP-76-A	BWRVIP-03	BWRVIP-02-A/-04-A	BWRVIP-62/-190
Core spray	BWRVIP-18-A	BWRVIP-03	BWRVIP-16-A/-19-A/-34	N/A
Shroud support	BWRVIP-38	BWRVIP-03	BWRVIP-52-A	BWRVIP-62/-190
Top Guide	BWRVIP-26-A	BWRVIP-03	BWRVIP-50-A	N/A
Core Plate	BWRVIP-25	BWRVIP-03	BWRVIP-50-A	BWRVIP-62/-190
SLC	BWRVIP-27-A	BWRVIP-03	BWRVIP-53-A	BWRVIP-62/-190
Jet pump assembly	BWRVIP-41	BWRVIP-03	BWRVIP-51-A	BWRVIP-62/-190
CRD guide/stub tube	BWRVIP-47-A	BWRVIP-03	BWRVIP-17/-55-A/-58-A	BWRVIP-62/-190
In-core housing/dry tube	BWRVIP-47-A	BWRVIP-03	BWRVIP-17/-55-A	BWRVIP-62/-190
Instrument penetrations	BWRVIP-49-A	BWRVIP-03	BWRVIP-57-A	BWRVIP-62/-190
LPCI coupling	BWRVIP-42-A	BWRVIP-03	BWRVIP-56-A	N/A
Vessel ID brackets	BWRVIP-48-A	BWRVIP-03	BWRVIP-52-A	BWRVIP-62/-190
Reactor pressure vessel	BWRVIP-74-A	N/A	N/A	N/A
Primary system piping	BWVIP-75-A	N/A	N/A	BWRVIP-62/-190
Steam dryer	BWRVIP-139-A	BWRVIP-03	BWRVIP-181	N/A
Access hole cover	BWRVIP-180	BWRVIP-03	TBD	BWRVIP-62/-190
Top guide grid beam	BWRVIP-183	BWRVIP-03	BWRVIP-50-A	N/A
Bottom head drain line	BWRVIP-205	N/A	BWRVIP-208	N/A

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Utility Implementation of BWRVIP Guidelines

- Utilities have committed to implement BWRVIP guidelines:
  - BWRVIP letters to NRC
  - Consistent with Nuclear Energy Institute (NEI) 03-08 Guideline for Management of Materials Issues
- BWRVIP-94 establishes framework for implementing BWRVIP guidance:
  - Develop/strengthen inspection program consistent with BWRVIP guidelines
  - Implement BWRVIP guidelines (as approved by Executive Committee) within two refueling outages
  - Notify NRC within 45 days of plans not to implement NRC-approved guidelines
  - Deviations from BWRVIP guidelines require a deviation disposition

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Assessing Implementation

- INPO assesses utility implementation of BWRVIP products through the Review Visit process
- INPO provides the results of the Review Visits to the BWRVIP twice yearly
- BWRVIP transmits the results to the all BWRVIP committee members
- Results of INPO Review Visits are also used to improve the BWRVIP program, processes and identify needs (report revisions, clarifications, etc.)
- In accordance with Section 5.11 of NEI 03-08, Rev 2, Self Assessments of the Program performed every 2 years

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Strategic Plan and Current Research Gaps

NEI 03-08 Integrated Materials Issues Strategic Plan

- Provides Systematic Approach to Managing Materials Issues
  - Identify vulnerabilities
  - Assess condition (inspect & evaluate)
  - Mitigate degradation initiation and propagation mechanism
  - Repair or replace as required
- Approach Used:
  - Degradation Matrix and Issue Management Tables
    - Degradation Matrix and Issues Management Tables to be maintained as living documents with annual updates

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Issue Management Table(s)

- BWRVIP Prepared the BWR IMTs
  - Utilized BWRVIP-06, Safety Assessment
  - Information reflects current state of the BWRVIP Program
  - Identified and prioritized “gaps”
  - Published as BWRVIP-167, Revision 1 in 2008
  - New gaps, gap revisions, gap closures, and gap prioritizations (High, Medium & Low) have already been drafted for the BWRVIP-167, Revision 2, which will be published in 2010

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IMTs High Priority Gaps – April 2010

Gap	2010 BWRVIP Tasks	2011 BWRVIP Tasks	Changes
B-AS-18 Jet Pump Degradation Management	2.17	2.17	
B-I&E-07 NDE Capability: RPV Drain Line	2.16, 2.27	2.16, 2.27	
B-AS-10 Assess Impact of High Fluence SCC Crack Growth Rates	2.5, 2.6, 2.13	2.5, 2.6, 2.13	
B-AS-17 Evaluate Hidden Weld Locations (Thermal Sleeves)	2.14 (2008)	2.14 (2008)	
B-MT-02 Demonstrate Improved ECP Model	3.2	3.2	
B-MT-05 Startup & Shutdown Chemistry	3.1, 3.6	3.1, 3.7, 3.10, 3.11	
B-RR-06 Develop Repair Solutions for Bottom Head Drain Line	2.16	2.16	
B-AS-26 Assess Alloy X-750 SCC Susceptibility	2.15	2.15	
B-I&E-03 NDE Capability: Shroud & Shroud Support Locations	2.27	2.27	
B-AS-29 Steam Dryer Evaluation Methodology	2.8	2.8	
B-DM-06 Environmental Effects on Fracture Resistance	PSCR	PSCR	
B-RR-02 Develop Welding Processes for Repair of Irradiated Material	2.21	2.21	
B-RG-08 Management of License Renewal Issues	Many	Many	New Gap
B-AS-32 Assessment of Core Plate Rim Hold Down Bolts	2.18	2.18	New Gap
B-RG-05 Evaluation of EVT-1	2.27, 2.28	2.27, 2.28	Medium to High
B-MT-04 NMCA Technology Improvement	3.1, 3.5, 3.8	3.1, 3.5, 3.8, 3.9, 3.12, 3.13	Medium to High
B-AS-07 Environmental Fatigue Issues: Pressure Boundary	2.11 (not funded)	2.11, 2.30, 2.31	Medium to High
B-AS-09 Assess Impact of High Fluence on Fracture Toughness	2.5, 2.7, 2.xx	2.5, 2.7, 2.xx	

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IMTs Medium Priority Gaps – April 2010

Gap	2010 BWRVIP Tasks	2011 BWRVIP Tasks	Changes
B-AS-27 Alloy 182/Creviced Alloy 600 SCC Susceptibility	2.13 (2007)	2.13 (2007)	
B-AS-28 Impact of BWR Nozzle Penetrations on Pressure-Temperature Limit Curves	BWROG	BWROG	
B-MT-01 Development of Alternative Mitigation Technologies		2.24	
B-I&E-02 NDE Capability: Hidden Locations (Thermal Sleeves & Piping)	2.27	2.27	
B-AS-05 Fluence Spectra Effects: C&LAS			
B-I&E-01 NDE Capability: Core Plate Rim Hold Down Bolts	2.18 Eval. vs. Inspect	2.18 Eval. vs. Inspect	
B-AS-15 High Cycle Fatigue: Reactor Internals	2.8	2.8, 2.31	
B-RR-05 Develop Alternate High-Strength Materials	2.22 (2009 -- not funded)	2.22 (2009 -- not funded)	
B-RR-08 Availability of Laser Welding for Repairs to Highliy Irradiated Components	2.21	2.21	
B-DM-07 Chloride Transient Effects on Low Alloy Steel Crack Growth Rates			New Gap
B-AS-30 Material Surveillance Program Implementation for 80 Year Service Lives	2.1	2.1	New Gap
B-RG-07 Reactor Pressure Vessel Material Surveillance Program Implementation for 80 Yesar Service Lives	2.1, 2.27	2.1, 2.27	New Gap
B-AS-31 BWRVIP-47-A (CRGT) Re-Inspection Requirements	2.13	2.13	New Gap

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IMTs Low Priority Gaps – April 2010

Gap	2010 BWRVIP Tasks	2011 BWRVIP Tasks	Changes
B-I&E-05 NDE Capability: Appendix VIII Compliance	2.27	2.27	
B-AS-14 Environmental Fatigue Effects: Reactor Internals	2.11 (not funded)	2.11, 2.31	
B-AS-11 Assess Fast Reactor Data Applicability to BWR Environment	2.5	2.5	
B-AS-19 In-Vessel Fastener Loosening			
B-AS-22 High Cycle Thermal Fatigue - Piping Locations	2.12 (not funded)	2.12	
B-I&E-08 Develop Inspection and Evaluation Guidance for Repairs			
B-I&E-06 NDE Capability: CASS Weldments			
B-AS-12 Thermal & Irradiation Embrittlement: Synergistic Effects (on CASS BWR Reactor Internals)	2.13 (2007)		
B-DM-03 Low Temperature Crack Propagation	PSCR	PSCR	
B-I&E-09 Examination Technologies for Detection of Stress Relaxation in Reactor Internals Components			
B-DM-10 Long Term Stress Stability (LTO Based Gap)			New Gap
B-DM-08 Long Term Neutron Fluence Effect on Low Alloy Steel Cracking Susceptibility			New Gap
B-DM-09 Long Term SCC Susceptibility (Late Life Initiation)			New Gap
B-AS-20 Assess Non-Safety Locations	2.9 (not funded)	2.9	Medium to Low

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Major BWRVIP Tasks

BWRVIP Major Tasks

- Crack Growth and Fracture Toughness in High Fluence BWR Materials
- Steam Dryer Loads Methodology Report
- Jet Pump Degradation Management
- Optimization of Inspection Frequencies
- Testing of X-750 Materials
- Evaluation of Core Plate Bolts
- Online NMCA Demonstration Project
- Generic Safety Evaluation and Demonstration of Alternate Reductant Injection to Mitigate IGSCC at Low Temperatures

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Submittals to the NRC

Recent Submittals to NRC

- BWRVIP-06, Revision 1-A (safety assessment of BWR reactor internals)
- BWRVIP-97-A (guidelines for performing weld repairs to irradiated components)
- BWRVIP-114-A (RAMA fluence methodology theory manual)
- BWRVIP-115-A (RAMA fluence methodology benchmark manual)
- BWRVIP-117-A (RAMA fluence methodology plant application)
- BWRVIP-121-A (RAMA fluence methodology procedures manual)
- BWRVIP-139-A (steam dryer I&E guidelines)
- BWRVIP-145-A (evaluation of Susquehanna 2 top guide and shroud using RAMA)
- BWRVIP-174, Revision 1 (review of core shroud UT re-inspection results)
- BWRVIP-214NP (technical basis for ASME Code Case n-769, roll expansion of in-core housing bottom head penetration)
- BWRVIP-215NP (risk-informed method to determine ASME Section XI Appendix G limits)
- BWRVIP-216NP (BWR RPV embrittlement studies)
- BWRVIP-222 (accelerated program for BWRVIP-75-A Category C DM welds)

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Final Safety Evaluations from the NRC in the Near Term

- Received:
  - BWRVIP-76 license renewal SE (shroud I&E)
  - BWRVIP-158 (flaw proximity rules)
  - BWRVIP-181 (steam dryer repair design criteria)
  - BWRVIP-182 (guidance for demonstration of steam dryer integrity for power uprate)
  - BWRVIP-62 (inspection relief for HWC)
- Expected:
  - Non-Destructive Examination uncertainty

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Expected Near Term Submittals

- BWRVIP-76-A (core shroud I&E guidelines)
- BWRVIP-158-A (flaw proximity rules)
- BWRVIP-181-A (steam dryer repair design criteria)
- BWRVIP-182-A (guidance for demonstration of steam dryer integrity for power uprate)
- BWRVIP-217 (access hole cover repair design criteria)
- BWRVIP-234 (thermal aging and neutron embrittlement evaluation of cast austenitic stainless steels)

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Need More Info?

- Contact the Utility Technical Chairman, Chuck Wirtz, FirstEnergy 440-280-7665 (w), 440-346-7124 (c), cjwirtz@firstenergycorp.com

Or …

- Talk with EPRI BWRVIP Task Managers
  - Inspection: Jeff Landrum 704 595 2553 jlandrum@epri.com
  - Assessment: Bob Carter 704 595 2519 bcarter@epri.com
  - Repair: Ken Wolfe 650 855 2141 kwolfe@epri.com
  - Mitigation: Raj Pathania 650 855 8762 rpathani@epri.com
  - Integration: Randy Stark 650 855 2122 rstark@epri.com
  - Also:
    - Larry Steinert 650 855 2140 (general BWRVIP support)
    - Robin Dyle 205 426 5371 rdyle@epri.com

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