ELECTRIC POWER RESEARCH INSTITUTE

Materials Reliability Program Overview

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MRP Integration Committee
Southern Nuclear Company

NRC/Industry Technical Meeting
Rockville, MD
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Contents

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MRP Organization

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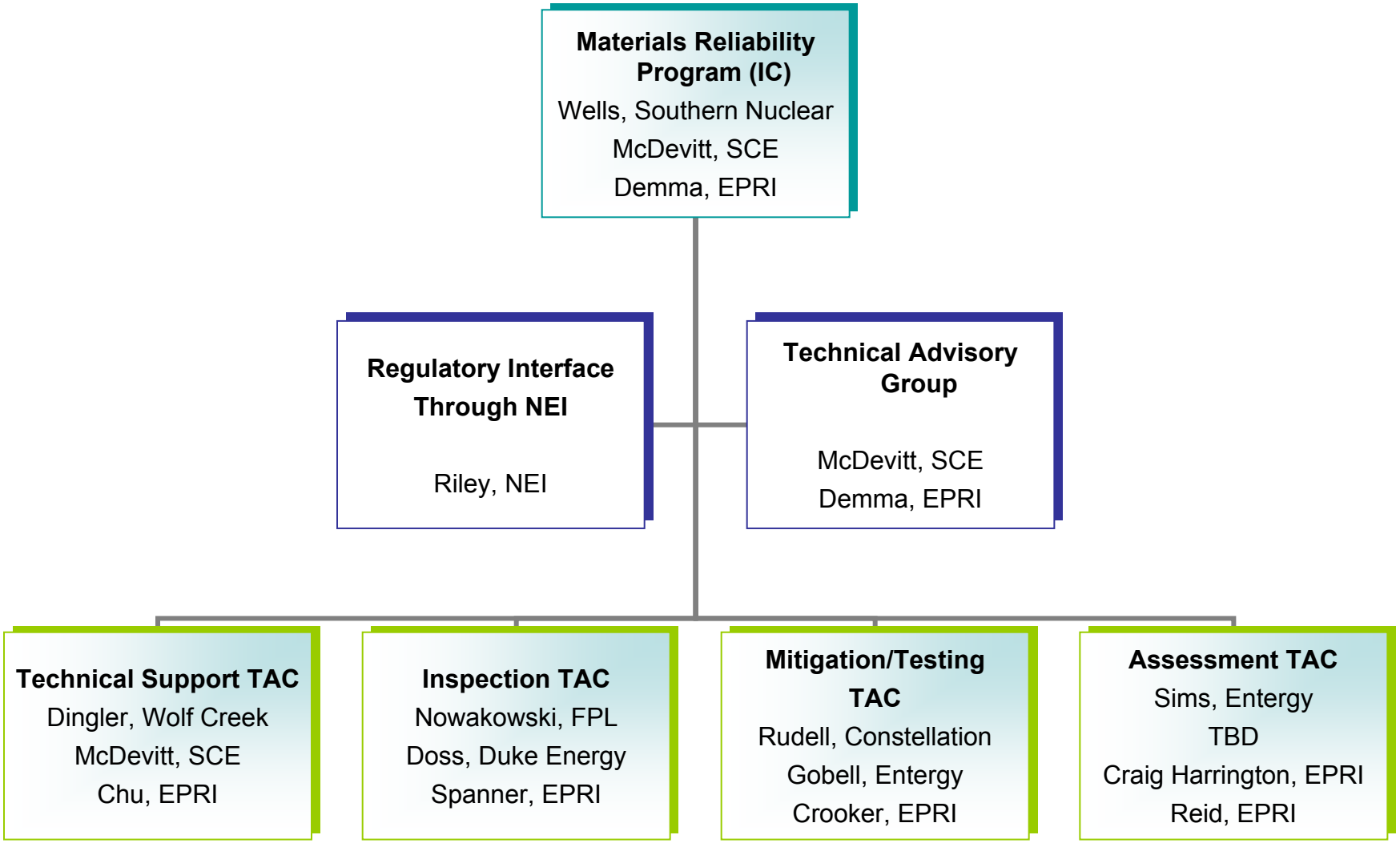
MRP Organization



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EPRI ELECTRIC POWER RESEARCH INSTITUTE

MRP Technical Advisory Group (TAG)

- Chaired by MRP Integration Committee (IC) Vice Chair with one core member from each utility
- Provide utility recommendations to the IC
- Distribute MRP information to appropriate personnel within the person's parent company
- Provide comments on MRP products as necessary
- Communicate MRP guidance per NEI 03-08 under review to utility executive
- Present utility experience reports at meetings

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MRP Technical Advisory Committees (TAC)

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
Mitigation/Testing --	what causes material degradation, what can be done for its mitigation
Tech. Support --	what causes thermal and environmental fatigue degradation, how to address them, maintain databases and guidelines

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Current MRP Members

- All US PWR Utilities
- Shikoku
- EdF
- Hokkaido
- KHNP
- UNESA
- TaiPower
- JAPC
- Kansai
- Rolls Royce

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MRP Strategic Plan

- Develop fundamental understanding of degradation mechanisms and identify materials (and locations) of high susceptibility
- Conduct generic operability and safety assessments for susceptible locations
- Develop Inspection and Evaluation (I&E) guidelines for identified locations
- Evaluate available mitigation options and, if necessary develop additional options.
- Evaluate repair/replace options, where necessary
- Monitor, evaluate and feedback plant Operating Experience
- Develop technical bases for regulatory review and support licensees on plant-specific applications

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Issue Management

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Materials Degradation and Issue Management

MDM

- Develop a fundamental understanding of the degradation phenomena/mechanisms

IMTs

- Perform functionality and safety assessments
- Develop Inspection and evaluation guidelines
- Evaluate available mitigation options
- Develop repair & replace options
- Monitor and assess plant operation experience
- Obtain regulatory acceptance

Materials Degradation Matrix (MDM) and Issue Management Tables (IMT) are effective materials aging management tools in support of industry's Materials Degradation and Issue Management Initiative

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PWR Issue Management Table

- Developed Based on Industry Input on Materials Degradation Issues
  - Updated every two years to add newly identified issues and close completed issues
  - Issues assigned to appropriate group for action (MRP, SGMP)
  - Current list has 76 gaps identified; 30 considered High Priority; 52 gaps assigned to MRP
- Issues are Prioritized by Industry Members
  - Prioritization evaluated annually

Table is Used for Determination and Prioritization of Research Projects and Funding Level

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Current High Priority Issues (1/2)

Gap ID	Gap Title	Rank
P-AS-12	PWSCC Factors of Improvement (FOIs): “Resistant” Ni-Alloys (A690, A52, A152)	1
P-AS-14	Fluence Impact on SCC of Stainless Steels (IASCC)	2
P-AS-02	Environmental Effects on Fatigue Life of Pressure-Retaining Components	3
P-AS-09	SCC of Stainless Steels Exposed to Primary Water	4
P-I&E-21	Reactor Internals Generic Acceptance Criteria	5
P-I&E-02	NDE Qualification Program for RPV Upper Head Ni-Alloy Penetrations	6
P-I&E-12	NDE Technology for Examination of CASS	7
P-AS-26	Steam Generator Tube Damage Due to Loose Parts or Foreign Objects	8
P-AS-30	ODSCC of Thermally Treated Alloy 600 Steam Generator Tubing	9
P-I&E-11	NDE Accessibility Evaluation for Reactor Internals	10
P-RG-09	Pipe Rupture Probability Reassessment (xLPR)	11
P-I&E-03	NDE Technology for J-Groove Weld Locations	12
P-RG-06	NDE Qualification for Reactor Internals Inspection (VT Evaluation)	13
P-MT-01	PWSCC Mitigation via Water Chemistry Controls (Zn / H_2)	14
P-AS-13	Thermal & Irradiation Embrittlement Synergistic Effects on CASS & SS Welds	15

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Current High Priority Issues (2/2)

Gap ID	Gap Title	Rank
P-AS-27	Alternative ASME Section XI Appendix G Methodology	16
P-MT-04	Steam Generator Tubing ODSCC Mitigation via Water Chemistry Controls	17
P-AS-01	Boric Acid Corrosion of Carbon & Low Alloy Steels	19
P-I&E-07	NDE Qualification for Reactor Internals Bolting	20
P-I&E-15	Steam Generator Eddy Current Technology	21
P-I&E-22	ASME Section XI Appendix VIII Compliance	22
P-AS-34	Steam Generator Improved Tubing Leak Rate Modeling	23
P-I&E-16	NDE Tools for Steam Generator Tubing Integrity Assessments	24
P-I&E-13	NDE Capability for Sizing Steam Generator Tubing ODSCC Indications	25
P-AS-35	Steam Generator Sludge Deposits and Scale Buildup	26
P-AS-11	PWSCC Crack Growth Rates for Alloys 600, 82, 182	27
P-AS-19	PWSCC Management for Ni-Alloy Reactor Internals	28
P-AS-31	Safety Significance of Cracks in Steam Generator Divider Plate	29
P-AS-17	Flow-Induced Vibration and Wear of Reactor Internals	30

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MRP High Priority Gaps and R&D Projects

Gap ID	Title	2010 Rank	Current R&D Projects
P-AS-12	PWSCC FOI for Alloys 690, 52, and 152	1	Task 15: Replacement Materials
P-AS-14	Fluence Impact on SCC of Stainless Steels	2	Task 4: RI Irradiated Materials Testing
P-AS-02	Environmental Effects on Fatigue Life: PBC	3	Task 14.1: ASME Fatigue Env Effects
P-AS-09	SCC of SS Exposed to Primary Water	4	Task 12: Degradation Mechanism Studies
P-I&E-21	Reactor Internals Generic Accept. Criteria	5	Task 1.1: RI I&E Guidelines Support
P-I&E-02	NDE Qual. for Upper Head Ni Penetrations	6	Task 7: RPV head inspection
P-I&E-12	NDE Technology for Examination of CASS	7	NDE Projects
P-I&E-11	NDE Accessibility Evaluation for RI	11	Task 3: Reactor Internals Inspection
P-RG-09	Pipe Rupture Probability (xLPR)	12	Task 9: Leak Before Break Evaluation
P-I&E-03	NDE Technology for J-Groove Locations	13	Task 7: RPV head inspection
P-RG-06	NDE Qualification for RI Inspection	14	Task 3: Reactor Internals Inspection
P-MT-01	PWSCC Mitigation via Chemistry Controls	15	Task 11: Chemical Mitigation
P-AS-13	Therm & Irrad Embrit on CASS & SS Welds	16	Task 4.5: Testing Synergetic Effects
P-AS-27	Alternative ASME XI Appendix G Methodology	17	Task 14.1: Support for 60+ Yrs Operation
P-AS-01	Boric Acid Corrosion of Carbon and LAS	19	Task 10: Boric Acid Corrosion
P-I&E-07	NDE Qualification for RI Bolting	20	Task 3.1 Internals Bolting
P-I&E-22	Appendix VIII Compliance	22	Task 7.6: UT Demo for New Mit Technique
P-AS-11	PWSCC CGR for Alloys 600, 82, and 182	27	Task 15.3: Low K Testing for A600/82/182
P-AS-19	PWSCC Management for Ni-Alloy RI	28	Task 1.3: Assess Deg Effects of Ni-Alloys
P-AS-17	Flow-Induced Vibration and Wear of RI	30	PWROG and EDF Projects

MRP: Current Issues/Activities

- Stress Corrosion Cracking (SCC) of nickel-based alloys
  - Mitigation of alloys 600/82/182
  - Quantify SCC superiority of alloys 690/52/152
  - Weld residual stresses
- Reactor Internals Degradation Management
- Testing for Irradiation Assisted Degradation of Reactor Internals
- I&E guidelines (e.g. Thermal Fatigue, Reactor Internals)
- SCC of stainless steel including CASS
- Low Alloy Steel corrosion (upper and bottom RPV Heads)
- Non-Destructive Examination (NDE) qualifications (e.g. CRDM, RI standards)
- Fatigue degradation management including Environmental Fatigue
- Reactor Pressure Vessel Integrity
- Extremely Low Probability of Rupture (xLPR)

More than 50 tasks defined and funded for 2011

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MRP Leveraging and Collaborations

- All Reactor Internals testing projects (Zorita, Halden, Gondole)
- Stainless steel SCC research with MAI/EDF & PWROG
- Alloy A690 international collaboration for long-term leveraging on A690/52/152 research
- xLPR (with NRC RES)
- Weld residual stresses (NRC RES)
- Chemical Mitigation (PWROG, FRP, Chemistry)
- Surface stress mitigation methods with Hitachi, Toshiba and MHI
- Low K testing with Studsvik and AREVA
- Environmental Fatigue (BWRVIP, ANT, NRC RES and others)
- Inspection issues with EPRI NDE Center
- Information exchange agreement with Naval Reactors contractors

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2012 Technical Areas of Growth

- Environment Assisted Fatigue
- xLPR
- Reactor Internals Irradiated Materials Testing

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MRP Guidelines

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MRP Guidelines Status

Guideline Title	ITG/ TSC	NEI 03-08[i]	MRP Rpt #	Current Rev #	G/L Report #	Last Pub. Date	Next G/L Review Date	Next G/L Rev Pub Date[ii]
Mitigation of Thermal Fatigue in Unisolable Piping Connected to PWR Reactor Coolant Systems	TSC	GP [iii]	29	0	1001017	Dec. 2000	2012	2012
Thermal Fatigue Monitoring Guidelines	TSC	GP[iv]	32	0	1001016	April 2001	-	June 2011
Computer-Based NDE Training for Thermal Fatigue Cracking	TSC	GP	36	1	1016935	Nov. 2008	-	2012
Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application	TSC	GP	47	1	1012017	Sept. 2005	-	2012
Generic Guidance for Alloy 600 Management	AST	Man.	126	0	1009561	Nov 2004	-	[v]
Primary System Piping Butt Welds Inspection and Evaluation Guidelines	AST	Man.	139	1	1015009	Dec. 2008	-	[vi]
Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines	TSC	Need	146	0	1011955[vii]	June 2005	-	June 2011
Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines – Supplemental Guidance	TSC	Need	146S	0	1018330	January 2009	2012	2013
Integrated Fatigue Management Guideline	TSC	GP	148	0	1012018	April 2005	-	2012
Thermal Fatigue Monitoring Guideline	TSC	GP	149	0	1011957	April 2005	2012	2013
Assessment of RHR Mixing Tee Thermal Fatigue in PWR Plants	TSC	GP	192	1[viii]	1018395	Dec. 2008	-	2012
Materials Reliability Program: PWR Internals Inspection and Evaluation Guidelines	AST	Man.	227	0	1016596	Dec. 2008	-	2011
Materials Reliability Program: Inspection Standard for PWR Internals	Insp	Need	228	0	1016609	July 2009	-	2012

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MRP Training

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2011 MRP Workshops

- **Thermal Fatigue in RCS Branch Lines – MRP-146 Revision 1**
  - Update training via webcast in June, August, and November

- **Fatigue Management Handbook Training**
  - February 14-18
  - June 6-10
  - Additional Session TBD

- **RV Integrity Primer/Workshop**
  - Two sessions planned (August and November)

- **Reactor internals Related Workshops**
  - European Workshop: Fall, in Madrid, Spain
  - PWR In Vessel Internals Inspections (MRP-228) Course (Q4)

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2012 International BWR/PWR Conference

International Boiling Water Reactor and Pressurized Water Reactor Materials Reliability Conference & Exhibition 2012

July 16-19, 2012

Gaylord Resort and Convention Center, 201 Waterfront Street, National Harbor, MD 20745

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