United States Nuclear Regulatory Commission Official Hearing Exhibit
In the Matter of: Entergy Nuclear Operations, Inc.
(Indian Point Nuclear Generating Units 2 and 3)
ASLBP #: 07-858-03-LR-BD01
Docket #: 05000247 | 05000286
Exhibit #: NYS000390-00-BD01
Identified: 10/15/2012
Admitted: 10/15/2012
Withdrawn:
Rejected:
Stricken:
Other:

NYS000390
Submitted: June 19, 2012

NEI Steam Generator Task Force

NRC/Industry Update

February 18, 2011

NEI
NUCLEAR ENERGY INSTITUTE

Agenda

8:30 am Introductions - NRC

Opening Remarks - NRC and Industry

NEI Steam Generator Task Force Update - Industry

1. NEI 97-06 Revision Status
2. TSTF-510 Update
3. EDF Divider Plate Cracking Update
4. License Renewal Issues
5. Pre-Service Inspection Code Change
6. Auto-Analysis Workshop Summary
7. U-Bend Axial Outside Diameter Stress Corrosion Cracking Inspection Technique Peer Review
8. Upcoming Changes to Industry Documents

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Agenda (Continued)

9. Steam Generator Operating Experience
10. Implementation of Noise Monitoring Techniques

11:00 am Address Public Questions/Comments

11:30 pm Lunch

1:00 pm NEI Steam Generator Task Force Update (continued) – Industry

11. Follow-up on Previous Meetings
12. Future Topics

3:30 pm NRC feedback on various issues - NRC and Industry

3:45 pm Address Public Questions/Comments - NRC and Industry

4:00 pm Adjourn

NEI 97-06 Revision Status

Jim Riley, NEI

NEI 97-06 Revision Status

- Revision 2 issued in 2005
- Need to capture changes in guidance and knowledge
- SGTF subgroup established
- Revision 3 distributed to TAG and NRC for review in November
- Final version of revision 3 completed in January 2011

NEI 97-06 Revision Status

- Industry comments addressed
- NRC comments
  - Consistency of “shall” and should statements
    - Changed “shoulds” to statements of fact
  - Sending Interim Guidance letters and Review Board Interpretations to the NRC
    - OK
  - Comments to establish consistency with technical specifications
    - Definition of condition monitoring
    - Change “Expected” to “Potential” tube degradation

NEI 97-06 Revision Status

- Main changes
  - Reduces “needed” (shall) statements in recognition of EPRI guideline contents
    - Uses “statements of fact”
  - Changes “Mandatory” statements
    - SG program consistent with 97-06 and EPRI guidelines
    - Lists required program elements
    - Removes requirement to adopt performance criteria since they are in tech specs
  - Updates definitions (consistent with guidelines)
  - Corrects inconsistencies with tech specs and EPRI guidelines

NEI 97-06 Revision Status

- SGTF and SGMP IC endorsed the revision
  - Suggested implementation
    - September 1, 2011 or
    - December 31, 2011 if plant has a spring 2011 outage
- PMMP approval requested
  - Expected PMMP approval in March, 2011

TSTF-510 Update

Jay Smith, Exelon

TSTF-510 Update

- Major Milestones Completed
  - Rev. 0 of the Traveler & Fee Waiver Request transmitted to NRC on 3/26/09
  - Fee Waiver Request Approved on 7/20/09 (ML092010534)
  - 8 RAIs received via email M. Honcharik (NRC) to B. Mann (TSTF), "TSTF-510 RAIs," February 4, 2010.
    - RAI Response and Rev. 1 submittal to NRC June 2010
  - 3 comments received at SGTF Mtg August 12, 2010
    - Response and Rev. 2 submittal to NRC October 11, 2010

TSTF-510 Update
Remaining Milestones

TSTF-510 Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection				
Milestone Action	**Original Target Date**	**Current Target Date**	**Responsible Group**	**Comments/Status**
Submit Rev. 0 TSTF Traveler to NRC	1/1/2009	3/26/2009	TSTF/NEI SGTF	Complete
Receive NRC Acceptance & Schedule Letter	3/1/2009	12/31/2009	TSTF /NEI SGTF	Not Sent
Receive Rev. 0 RAI's (email used)	6/1/2009	2/4/2010	TSTF /NEI SGTF	Complete
Respond to Rev. 0 RAI's	9/1/2009	6/15/2010	TSTF /NEI SGTF	Complete
Submit Rev. 1 TSTF Traveler to NRC	1/1/2010	6/17/2010	TSTF /NEI SGTF	Complete
Receive Rev. 1 RAI's (SGTF Mtg)	N/A	8/12/2010	TSTF /NEI SGTF	Complete
Respond to Rev. 1 RAI's	N/A	9/15/2010	TSTF /NEI SGTF	Complete
Submit Rev. 2 TSTF Traveler to NRC	N/A	9/22/2010	TSTF /NEI SGTF	Complete
Receive Notice for Comment	12/1/2009	4/15/2011*	TSTF /NEI SGTF	Current Estimate
Respond to Notice for Comment	1/1/2010	5/15/2011*	TSTF /NEI SGTF	Current Estimate
NRC Publish Notice of Availability	4/1/2010	8/31/2011*	NRC	Current Estimate
* Change since previous SGTF meeting				

NRC Feedback on TSTF-510

EdF Divider Plate Cracking Update

Helen Cothron, EPRI

EdF Divider Plate Cracking Update

- Only 900 MW plants have experienced divider plate cracking
  - All have 34mm (1.33”) divider plates
- All 900 MW units have been inspected at least one time
  - 4 have had consecutive inspections
  - First three divider plate inspections were conducted using PT for detection and non-qualified UT for sizing
    - No change in number of cracks, few variations in depth (~1mm of growth), but this could be NDE uncertainty
  - 2010 was the first use of qualified UT by Westinghouse
    - With qualified techniques, cracks that were sized as 7 to 8mm in depth were sized as <2mm deep
  - All indications are in or close to the heat affected zone (HAZ) of the tubesheet to stub runner weld and in or close to the HAZ of the stub runner to divider plate weld
  - No cracking in the welds
  - Only small (depth - 2 microns) cracks in stub runner itself.

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EdF Divider Plate Cracking Update

- EdF removed 2 divider plate samples from retired SG's at Chinon B1 in 2008
  - NDE prior to and following removal have same results
    - UT detection by Westinghouse was the same but the indicated depth was smaller at <2mm (1.8 mm after destructive measurement)
  - Stub runner discovered to be bowed in center
  - HAZ had carbide dissolution in about 2mm thick layer
  - EdF believes the deformation could have been caused by the first hydrostatic pressure test performed at 1.33 times design pressure (22.8 MPa or 3300 psi).
    - U.S. ASME Section III hydros performed at 1.25 times design Pressure (~3100 psi)

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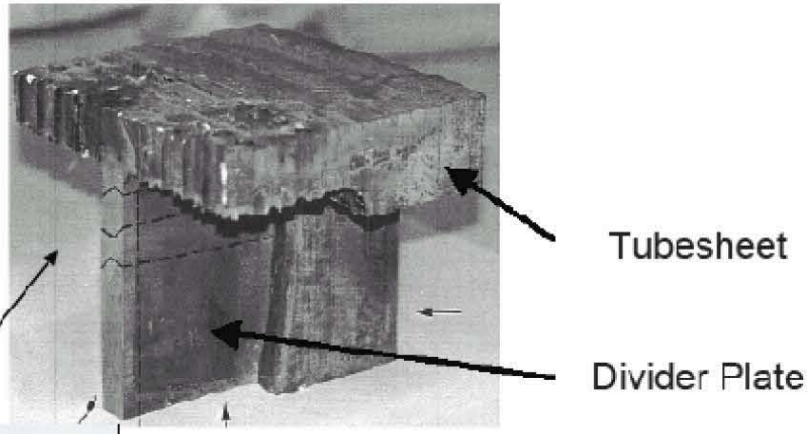
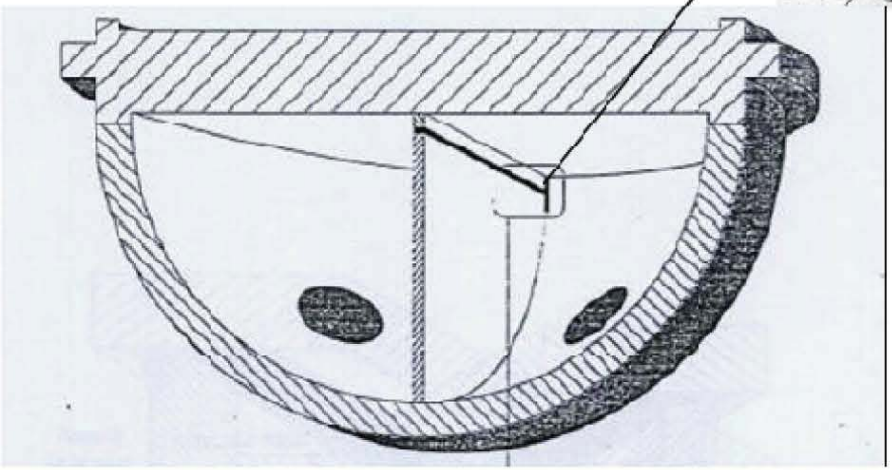
EdF Divider Plate Cracking Update

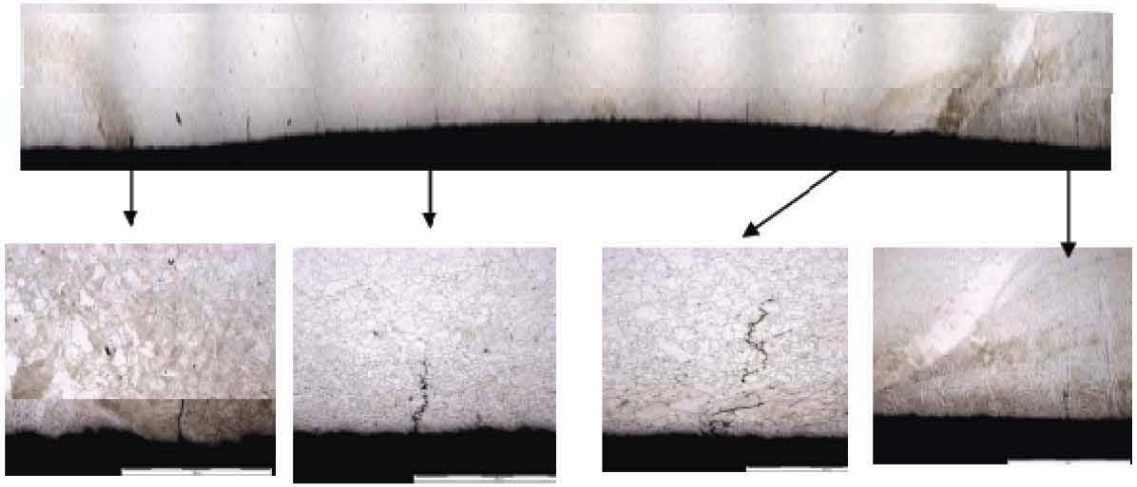
Triple Point

- DE on 3 SG divider plates
- Fabrication defects
- No SCC





EdF Divider Plate Cracking Update



- Deeper cracks are on the top and bottom of the stub runner
- Cracks are intergranular
- Propagation is parallel to the weld
- No cracks on the divider plate and no cracks on the weld
- No cracks at the triple point or near the tubesheet

EdF Divider Plate Cracking Update

- Root Cause
  - SCC observed in hot leg on SGs with operating time >120,000 hrs (13.7 yrs)
  - SCC observed in SG Divider Plate components where material was supplied by one vendor
    - Material had high carbide level (>0.5%) and high temperature final heat treatment promoting intra carbides
  - SCC observed in SGs with 34mm (1.33”) thick divider plates from 3 loop plants, containing stub runners with low mechanical properties and divider plates with high mechanical properties.
    - Important difference in yield strength in stub runner and divider plate. When stub runner has low mechanical properties than divider plate, then it deforms and becomes susceptible to cracking.

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EdF Divider Plate Cracking Update

- Mechanical tests performed on materials with representative mechanical properties shows:
  - Crack depth propagation in the center of the stub runner is from 0.07 mm/cycle (8,000 hrs) to 0.2 mm/cycle.
  - Crack depth propagation in the HAZ is 0.17 mm to 0.21 mm/cycle.

EdF Divider Plate Cracking Update

Comparison of EdF Affected Plants to US Plants

Apparent Causal Factor of DP Component SCC	EdF Plants with Divider Plate SCC	U. S. Plants
Divider Plate Thickness (Nominal)	1.33”	Model 51: 1.31” Model 44F: 1.50” Models 51F/51M/ 54F/D3*/D5/F: 2.0”
Primary Hydro Test Pressure	1.33 x P_{design} 3300 psi	1.25 x P_{design} Typically ~3100 psi
Stub Runner Low Strength Divider Plate High Strength	Yes	U.S. DP and stub runners mechanical properties are within A600 material spec limits
Plant Load Follow	Yes	No

* D3 – Ringhals-3 detected shallow cracking in stub runner in 2005 by PT exam. Not confirmed by UT.

EdF Divider Plate Cracking Update

- 900 MW SG Inspection Frequency as proposed for approval by the French Regulator
  - If SCC defects are detected that are <2mm deep, inspect every 10 years
  - If SCC defects are detected that are >2mm and <4mm deep, inspect every 4 years
  - If SCC defects are detected that are >=4mm deep, inspect every 2 years

EdF Divider Plate Cracking Update

- 1300 MW SG Inspection Frequency as proposed for approval by the French Regulator
  - Thicker divider plate, 60mm (2.36”)
  - All but 5 units have been inspected at least one time
    - 5 units have still to be inspected in order to inspect all heats at least one time
  - No SCC identified or expected
  - If no SCC, no additional inspections
- All Alloy 600 divider plates will be inspected at the triple point every 10 years

NEI

EdF Divider Plate Cracking Update

- Summary
  - NDE and DE have provided a good understanding of the local strain history on components affected by SCC
  - Divider Plate Components with SCC share the following characteristics:
    - SCC only found in 900 MW 3-loop plants with 34 mm (1.33”) thick divider plates
    - Divider plates supplied by one material vendor and were heat treated at high temperatures that promoted intra carbides and high carbide levels.
    - Stub runners had low mechanical properties while divider plate had high mechanical properties promoting plate deformation that was not anticipated
    - High hydrostatic pressure tests may have promoted divider plate deformation
    - SCC always located in most significantly strained areas. SCC not found with components with no significant plastic deformation.
  - SCC has not been found in the triple point.

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Divider Plate/Cladding Cracking EPRI SGMP Draft Work Scope for 2011 and 2012

Helen Cothron, EPRI

Chris Cassino, Westinghouse

Project Objectives

- Objective 1: Determine the chromium content in the as-constructed Alloy 82/182 clad tubesheet and Alloy 690 tubing
- Objective 2: Determine if cracks can propagate from the divider plate to other components and affect the integrity of the primary pressure boundary
- Two year SGMP project
  - Funding approved for 2011.

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Objective 1: Cracking in Alloy 600 Cladding

- Task 1: A literature review of crack growth rate studies
  - Review of the data supporting conclusions
  - Review of outliers and any data pertaining to the directionality of crack propagation

- Task 2: Obtain small boat samples for chemical analysis of cladding and final as-built tube end welds in typical SGs with Alloy 82 cladding and Alloy 690 tubing
  - Potential sources of these specimens are replacement SG manufacturers.

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Objective 2: Divider Plate Cracking

- Task 1: Finite element analysis to determine what conditions are necessary for cracks in the divider plate to propagate in any one of the following three paths

  (1) Initiating in the stub runner to tubesheet connection and propagating to an adjacent tube end weld

  (2) Initiating in the divider plate or stub runner material and propagating to the base metal of the channel head

  (3) Initiating in the divider plate or stub runner material and propagating to the base metal of the tubesheet.

- The goal of the study will be to evaluate what is necessary to turn the crack path from the divider plate into the components of the primary pressure boundary.

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Objective 2: Divider Plate Cracking

- Task 2: If Task 1 concludes that cracks can propagate as proposed, perform a feasibility study for designing and assembling mock-ups for testing of the possible crack propagation modes
  - Results could be used to estimate crack growth rates and guide potential inspection methodology
  - The feasibility study will determine if appropriate testing materials are available and if it would be practical to perform such tests

License Renewal Issues

Helen Cothron, EPRI

Jay Smith, Exelon

License Renewal Issues
Divider Plate Cracking

- Due to NRC License Renewal staff RAI, plants are committing to divider plate inspections once they have entered the extended period of operation.
- Utilities will use SGMP project results to validate or change their commitments.

License Renewal Issues
Tube Sheet Cladding Cracking

- Recent RAI on tubesheet cladding cracking postulates that cracking may initiate in the Alloy 600 cladding material and then propagate to the 600/690 weld at the tube end
- Utilities are committing to inspection of this area after entering the extended period of operation
- Utilities will use SGMP project results to validate or change their commitments.

License Renewal Issues
Primary Side Fouling Update

- During the August 12, 2010 SGTF meeting, it was discussed that a number of units have identified primary side fouling as a SG aging effect in their license renewal applications.
- Given the lack of information on the occurrence of primary side fouling in domestic SGs, the NRC Staff asked the Industry to provide additional information on primary side fouling.
- The industry agreed to discuss this issue with licensees that included primary side fouling in their license renewal application to determine the reason for its inclusion.
  - The NRC presented to the SGTF a list of 9 plants that included primary side fouling in their license renewal requests.

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License Renewal Issues
Primary Side Fouling Update

- SG primary side fouling was discussed at recent License Renewal Task Force (LRTF) and Implementation Working Group meetings.
  - After discussions, it was concluded that SG primary side fouling was not an aging mechanism and should not be included in future applications.
  - Possible reasons for inclusion included using generic heat exchanger GALL template for SGs and/or mis-understanding of the GALL requirement.
- Conclusion: SGTF does not consider SG primary side fouling an aging mechanism.
  - The identified plants that included primary side fouling were contacted and they understand that primary side fouling is not considered an aging mechanism.
    - Changes to LRA is a plant specific decision.
- Recommended Actions
  - SGTF to communicate conclusion to LRTF
  - NRR to communicate conclusion to NRC License Renewal Branch

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Pre-Service Inspection Code Guidance

Viki Armentrout, Dominion

Jay Smith, Exelon

Pre-Service Inspection Code Guidance

- NRC Comment regarding Pre-service Examination of SG tubing:
  - IWB-2200(c) of Section XI of the ASME Code indicates that steam generator tube examination shall be governed by the plant Technical Specification. The technical specifications do not address pre-service inspections. Discuss with the industry a path forward to address this issue (e.g., incorporating pre-service inspections into TSTF-510, modifying the ASME Code).

Pre-Service Inspection Code Guidance

- Action sent out for review and was presented to WGISC in February 2010
  - NRC Working Group attendee indicated that the revised wording would not be endorsed by NRC.
    - Per NRC, reference to steam generator preservice inspections should be removed from IWB-2200(c) and Table IWB-2500-1 should be modified.
  - ASME item BC 10-129 already in place to modify the steam generator inspection requirements.
  - Item was not moved for vote based on need to resolve this NRC comment.
  - The best likely date to achieve NRC approval in 10CFR50 will be 2015.
    - Next ASME Code Revision 2013
- Recommend to close action to ASME tracking item BC 10-129

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Auto-Analysis Workshop Summary

Steve Swilley, EPRI

Auto-Analysis Workshop Summary

- **Charlotte, NC, February 9th and 10th, 2011**
  - The EPRI Steam Generator Management Program invites you to attend a workshop in Charlotte, NC at EPRI on February 9th and 10th, 2011. The work shop will focus on the use of automated analysis tools for inspection of steam generator tubing. Although automated analysis tools have been used in the industry since the 1980's, there have been many significant advances in the software technology. This workshop will include utility, vendor, and regulatory updates on existing technology, current practice, field experience, and future directions.

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Auto-Analysis Workshop Summary

EPRI Steam Generator Automated Analysis Workshop
Charlotte, NC

EPRI Building 1 Room 402		
Wednesday February 9, 2011		
8:00 AM	Registration and Continental Breakfast	
Session 1 – Industry Perspectives		
8:30 AM	Welcome and Introduction	Steve Swilley *EPRI*
8:45 AM	Historical Perspective on Steam Generator Examination Guidance for Automated Analysis	Jim Benson *EPRI*
9:10 AM	Update on Industry Interim Guidance to the EPRI PWR SG Examination Guidelines	Scott Redner *Xcel Energy*
9:30 AM	Break	
Session 2 – Technology		
9:45 AM	Minimizing Human Variability in the Entire Analysis Process	Tom O'Dell *Zetec Inc.*
10:45 AM	Technical Description of Enhanced Auto Data Screening & Real Time Auto Analysis Programs	Qui Le *Westinghouse Electric Co.*
11:25 AM	Advantages and Difficulties of Automated Analysis when Compared with Manual Analysis	Ratko Vojvodic *AREVA NP Inc.*
11:55 AM	Lunch in Cafeteria	
Session 3 – Operating Experiences		
1:00 PM	Westinghouse Application of Auto Analysis	Rick Maurer *Westinghouse Electric Co.*
1:25 PM	Update on RevospECT Field Experience	Tom Bipes *Zetec Inc.*
1:55 PM	Ontario Power Generation Automated Analysis Field Trial Results Using Zetec's RevospECT Software	Terry Harasym & Gordon Bruce, *Ontario Power Generation – Inspection & Maintenance Services*
2:20 PM	Application of Computerized Data Screening to Automated Analysis of Bobbin Probe Inspection Data from SG Mock-up	S. Bakhtiari, T. W. Elmer, & W. J. Shack *Nuclear Engineering Division, Argonne National Laboratory*
2:50 PM	Break	
Session 4 – Operating Experiences		
3:05 PM	Recent Field Experience with EADS & RTAA	Steve Beehner *Westinghouse Electric Co.*; Doug Hansen *APS*
3:45 PM	Experiences with the "Detection Mode" Automated ECT Data Analysis Process	N. Kawase, M. Takatugu & K. Unate *Mitsubishi Heavy Industries, Ltd Kobe Shipyard and Machinery Works*; J. Siegel, *Solinex, Inc*
4:15 PM	AREVA Experience with Single and Dual Auto Analysis	Ratko Vojvodic, *AREVA NP Inc.*
4:45 PM	Advances in Automated Analysis of SG Tube Inspection Data	Lalita Udpa, Michigan State University
5:15 PM	End of Today's Sessions	
Wednesday Evening: *Reception and Dinner immediately following the last session.*		

Auto-Analysis Workshop Summary

EPRI Steam Generator Automated Analysis Workshop
Charlotte, NC

Thursday February 10, 2011		
8:00 AM	Continental Breakfast	
Session 5 – Panel Discussion		
8:30 AM	Opening Remarks and Follow-up from previous day	Steve Swilley, *EPRI*
8:45 AM	Panel Discussion • AREVA • Westinghouse • Zetec • Industry • NRC • MHI	Various representatives
10:00 AM	Break	
10:30 AM	Panel Discussion Continued	
11:00 AM	Compile discussion points for industry action	
11:45 AM	Lunch	
Session 6 – Technology Demonstrations		
1:00 PM	Functional demonstrations of vendor software applications for automated analysis	Zetec, AREVA, MHI, Michigan State, and Westinghouse
5:00 PM	End of Workshop	

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Auto-Analysis Workshop Summary

- **64 Attendees**
  - 25 Vendor
  - 16 Utility
  - 15 NRC
  - 2 Research
  - 6 EPRI

  - *11 were non US (Canada, Spain, Japan, France, Germany, and Croatia)*

Auto-Analysis Workshop Summary

- Industry Perspective
- NRC Perspective

U-Bend Axial Outer Diameter Stress Corrosion Cracking Inspection Technique Peer Review

Steve Swilley, EPRI

U-Bend Axial Outer Diameter Stress Corrosion Cracking Inspection Technique Peer Review

- ETSS's Peer Reviewed August 2010
  - "Detection of Axial ODSCC in Low Row U-Bends"
  - ETSS 10411, Plus Point Coil
    - Includes Phase and Amplitude Sizing
  - ETSS 10413, X-Probe
    - Detection Only
  - ETSS 10414, I-Probe
    - MIDAS analysis software
  - ETSS 10415, I-Probe
    - EddynetSuite analysis software

Techniques Available for Industry Use

Upcoming Changes to Industry Documents

Jim Benson, EPRI

SGMP Industry Document Status and Revision Schedule

Guideline Title	Current Rev #	Report #	Last Pub Date	Implementation Date(s)	Interim Guidance	Review Date	Comments
SG Integrity Assessment Guidelines	3	1019038	Nov-09	9/1/2010	SGMP-IG-10-01	2012	
SG In-Situ Pressure Test Guidelines	3	1014983	Aug-07	3/14/2008 6/14/2008	none		Rev 4 in progress
PWR SG Examination Guidelines	7	1013706	Oct-07	9/1/2008	SGMP-IG-08-04		Rev 8 in progress
PWR SG Primary-to-Secondary Leakage Guidelines	3	1008219	Dec-04	7/17/2006 10/17/2006	none		Rev 4 in progress. Expected to be issued by Dec 2011

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SGMP Industry Document Status and Revision Schedule

Guideline Title	Current Rev #	Report #	Last Pub Date	Implementation Date(s)	Interim Guidance	Review Date	Comments
PWR Primary Water Chemistry Guidelines	6	1014986	Dec-07	6/17/2008 9/17/2008	SGMP-IG-09-01	2011	
PWR Secondary Water Chemistry Guidelines	7	1016555	Feb-09	8/20/2009 11/20/2009	none	2011	
SG Management Program Administrative Procedures	3	1022343	Dec-10	TBD			Impl. Letter to be drafted by IC for PMMP EOC Chair signature
SG Degradation Specific Flaw Handbook	1	1019037	Dec-09	n/a	none	n/a	

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SGMP Administrative Procedures, Revision 3

- Revision 3 has been endorsed by the PMMP EC
- Published in December 2010
- The SGMP IC will be drafting an Implementation Letter
- Draft Implementation Letter was intentionally delayed to allow issuance at about the same time as NEI 97-06, Rev 3
- On Jan 12th, the IC:
  - Endorsed draft NEI 97-06, Rev 3
  - Recommended a "utility" implementation date of Sept 1, 2011
    - Dec 31, 2011 for utilities with a spring 2011 outage
    - EPRI implementation will be "immediate"
- The Implementation Letter will be signed by the PMMP EOC Chair prior to issuance
  - Letter expected to be issued in Feb 2011

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SG Operating Experience

Russ Lieder, Nextera Energy Seabrook, LLC

SG Operating Experience

- Objective of OE presentation and approach for future meetings
- OE is extensively discussed amongst utilities in non-public meeting

Implementation of Noise Monitoring Techniques

Helen Cothron, EPRI

Implementation of Noise Monitoring Techniques

- Vendors have the capability to monitor noise
- SGMP has worked with the vendors to ensure the output can be easily transferred to available software to recalculate probability of detection if necessary
- Lessons learned have been recorded during three pilot projects
  - Alloy 690TT replacement SGs
  - Alloy 600TT original SG
- One additional pilot is planned for 2011
  - Alloy 600MA SG with multiple degradation mechanisms
  - This experience is necessary prior to developing recommendations
- Revision 8 of the PWR Examination Guidelines is underway during 2011/2012 and will consider recommendation/requirements for noise monitoring
- Some plants are experimenting with the noise monitoring capabilities and are providing feedback to SGMP

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Follow-up on Previous Meetings

Future Topics

NRC feedback on various issues

- TSTF-510
- AVB Position Verification

Address Public Questions/Comments

Adjourn