Steam Generator Technical Issues

NEI SGTF/NRC Meeting

May 2, 2007

Mike Melton – NEI Project Lead

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Agenda

- Introductions and Opening Remarks – NEI and NRC
- NRC Feedback on Industry Position - NRC
- TSTF–449 Tube Inspection Sampling Plans – Tom Bipes
- AILPC Bending Load Project Update – Jim Begley
- Tools for SG Integrity – Helen Cothron
- Technical Issue Tracking – Gary Boyers, Tom Bipes & Helen Cothron
- Summary

NRC Feedback

- Update on status with current wording of Paragraph d.2

TSTF–449 Tube Inspection Sampling Plans

Tom Bipes

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TSTF–449 Tube Inspection Sampling Plans

Insert 5.5.9.d.2

[2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.]

[2. Inspect 100% of the tubes at sequential periods of 120, 90, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected.]

[2. Inspect 100% of the tubes at sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. In addition, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. No SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected.]

TSTF–449 Tube Inspection Sampling Plans

Implementation issues

- Adding new sample plans to address degradation at another plant after an Inspection Period starts
- Completion of inspection requirements with respect to the start, midpoint, and end of Inspection Periods
  - 1/09/2007 Industry position provided to NRC
  - 2/14/2007 Meeting cancelled due to weather
  - 3/08/2007 NRC provided feedback to Industry
  - 3/23/2007 SGTF considers impact of NRC position and requests further dialogue (5/2/2007)

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TSTF–449 Tube Inspection Sampling Plans

Adding new sample plans to address degradation at another plant after an Inspection Period starts

- Possible implementation strategies
  - Pro-rated strategy based on current sampling population
  - DA based sampling
- NRC Feedback
  - Pro-rated strategy is an acceptable approach
  - DA based sampling is only acceptable when sampling for degradation not considered as existing or potential

TSTF–449 Tube Inspection Sampling Plans

Treatment of Inspection Period start point, midpoint, and end point & inspection requirements

- Industry Position on Inspection Period start point
  - The first period begins after the first ISI of the SGs
  - Each period thereafter begins when the SGs accumulate the specified EFPM of operation based on the tubing material regardless of when the last inspection was performed.
- NRC Feedback
  - The first period begins upon plant start up after the first ISI.
  - Each period thereafter begins upon plant start up after the last inspection that completed the periodicity requirements for that period.

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TSTF–449 Tube Inspection Sampling Plans

Treatment of Inspection Period start point, midpoint, and end point & inspection requirements (cont')

- Industry Position on Inspection Period midpoint
  - The midpoint inspection can be completed on either side of the actual EFPM midpoint provided that an outage selected after the midpoint must be closer than the outage preceding it
- NRC Feedback
  - The midpoint inspection can be completed on either side of the actual EFPM midpoint

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TSTF–449 Tube Inspection Sampling Plans

Treatment of Inspection Period start point, midpoint, and end point & inspection requirements (cont')

- Industry Position on Inspection Period end point
  - The end point inspection can be completed on either side of the actual EFPM end point provided that an outage selected after the end point must be closer than the outage preceding it
- NRC Feedback
  - The end point inspection must be before the actual EFPM end point. In addition, the next period begins upon plant start up following completion of the inspection requirements during the second half of the period.
  - Additionally, each plant with TSTF 449 Rev.4 approved Technical Specifications are to use the positions described above to determine which sequential period they are in, where they are in the period and develop future inspection sample plans in accordance with the requirements.

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TSTF–449 Tube Inspection Sampling Plans

Treatment of Inspection Period start point, midpoint, and end point & inspection requirements (cont')

- Primary differences
  - Completion of end point inspection requirements
  - Start point of next sequential period
- Impacts
  - Compression of Inspection Periods, particularly in the 60 EFPM sequential periods
  - Reduction or elimination of ability for SGs with 600-TT and 690-TT tubing to operate two or three cycles between inspections

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TSTF–449 Tube Inspection Sampling Plans

Example of Inspection Period Compression

600TT Example

Example 1 True EFPM accumulative periods

Cumulative EFPM	Cycle	Exams		Date	
		Bobbin	RC		
	Baseline	100%	100%		
0.00	1st ISI	100%		1984	
10.46	RFO2			1986	
21.45	RFO3	20%		1987	
33.23	RFO4			1988	
45.03	RFO5	30%	20%	1990	
56.98	RFO6			1991	Midpoint
69.87	RFO7	20%		1993	
82.78	RFO8			1994	
96.93	RFO9	30%	20%	1996	
113.08	RFO10			1997	120 EFPM
130.01	RFO11	20%	20%	1999	
147.04	RFO12			2000	
163.88	RFO13	30%	20%	2002	Midpoint
180.63	RFO14			2003	
197.38	RFO15	50%	50%	2005	90 EFPM
214.13	RFO16			2006	
230.88	RFO17	50%	50%	2008	Midpoint
247.63	RFO18			2009	
264.38	RFO19	50%	50%	2011	60 EFPM
280.60	RFO20			2013	
296.80	RFO21	50%	50%	2014	Midpoint
313.00	RFO22			2016	
329.20	RFO23	50%	50%	2017	60 EFPM
345.70	RFO24			2019	
362.20	RFO25	50%	50%	2020	Midpoint
378.70	RFO26			2022	
395.20	RFO27	50%	50%	2023	60 EFPM

Example 2 Reset after last inspection before end of period

Cumulative EFPM	Reset EFPM periods	Cycle	Exams		Date	
			Bobbin	RC		
		Baseline	100%	100%		
0.00	0.00	1st ISI	100%		1984	
10.46	10.46	RFO2			1986	
21.45	21.45	RFO3	20%		1987	
33.23	33.23	RFO4			1988	
45.03	45.03	RFO5	30%	20%	1990	
56.98	56.98	RFO6			1991	
69.87	69.87	RFO7	20%		1993	
82.78	82.78	RFO8			1994	
96.93	0.00	RFO9	30%	20%	1996	RESET
113.08	16.50	RFO10			1997	
130.01	33.00	RFO11	20%	20%	1999	
147.04	49.50	RFO12			2000	Midpoint
163.88	66.00	RFO13	30%		2002	
180.63	0.00	RFO14	50%	20%	2003	RESET
197.38	16.50	RFO15			2005	
214.13	33.00	RFO16	50%	50%	2006	Midpoint
230.88	0.00	RFO17	50%	50%	2008	RESET
247.63	16.50	RFO18			2009	
264.38	33.00	RFO19	50%	50%	2011	Midpoint
280.60	0.00	RFO20	50%	50%	2013	RESET
296.80	16.50	RFO21			2014	
313.00	33.00	RFO22	50%	50%	2016	Midpoint
329.20	0.00	RFO23	50%	50%	2017	RESET

Same number of inspections, 6 years earlier

Each successive Reset 60 EFPM period would reduce the period significantly, however.

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TSTF–449 Tube Inspection Sampling Plans

Straw man for revised Insert 5.5.9.d.2 (600MA & 600TT)

[2. Inspect 100% of the tubes at fixed sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. Inspection requirements may be completed at the refueling outage immediately after the end of a period provided the refueling outage immediately after end of the period is closer than the refueling outage immediately preceding it. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.]

[2. Inspect ~~100% of the~~ SG tubes at fixed sequential periods of 120, 90, and, thereafter, 60 effective full power months (EFPM). The first sequential period shall be considered to begin after the first inservice inspection of the SGs. ~~In addition~~ During the 120 and 90 EFPM periods, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. During the 60 EFPM periods, inspect 100% of the tubes by the refueling outage nearest the end of the period. Inspection requirements may be completed at the refueling outage immediately after the midpoint or the end of a period provided the refueling outage immediately after the midpoint or end of the period is closer than the refueling outage immediately preceding it. In addition, n~~N~~o SG shall operate for more than 48 effective full power months or two refueling outages (whichever is less) without being inspected.]

TSTF–449 Tube Inspection Sampling Plans

Straw man for revised Insert 5.5.9.d.2 (690TT)

[2. Inspect ~~100% of the~~ SG tubes at fixed sequential periods of 144, 108, 72, and, thereafter, 60 effective full power months (EFPM). The first sequential period shall be considered to begin after the first inservice inspection of the SGs. ~~In addition~~During the 144, 108 and 72 EFPM periods, inspect 50% of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50% by the refueling outage nearest the end of the period. During the 60 EFPM periods, inspect 100% of the tubes by the refueling outage nearest the end of the period. Inspection requirements may be completed at the refueling outage immediately after the midpoint or the end of a period provided the refueling outage immediately after the midpoint or end of the period is closer than the refueling outage immediately preceding it. In addition, n~~N~~o SG shall operate for more than 72 effective full power months or three refueling outages (whichever is less) without being inspected.]

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Update of Impact Assessments of Non-Pressure Loads on Degraded Tube Leakage Integrity

Jim Begley

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Overview

- *Phase 1, Initial Evaluation of the Impact of Combined Loads on Leakage Integrity, August, 2005*
- *Phase 2, Results of an Experimental and Analytic Study of the Effect of Bending, Pressure and Tensile Loads on SG Tube Leakage Integrity, July, 2006.*
- *Present Update, Revised Impact Reports*

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Issues of Interest

- Combined loads are only an issue for circumferential degradation
- Non-pressure loads can cause through-wall tearing of partial depth degradation to create leakage paths (pop-through)
- Non-pressure loads can increase crack opening areas thereby increasing leak rates

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Ligament Pop-Through

Ligament Pop-Through Model

Generic pop-through equation = $\sigma_{nom} M = \sigma_{flow}$

where:

$$M = \frac{\left(1 - \frac{d}{F\ t}\right)}{\left(1 - \frac{d}{t}\right)}$$

d/t is the fractional crack depth

$\sigma_{flow} = \alpha(\sigma_{yield} + \sigma_{ultimate})$

$\alpha = 0.6$ for pressure and tensile loading

$\alpha = 0.72$ for bending

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Ligament Pop-Through, cont.

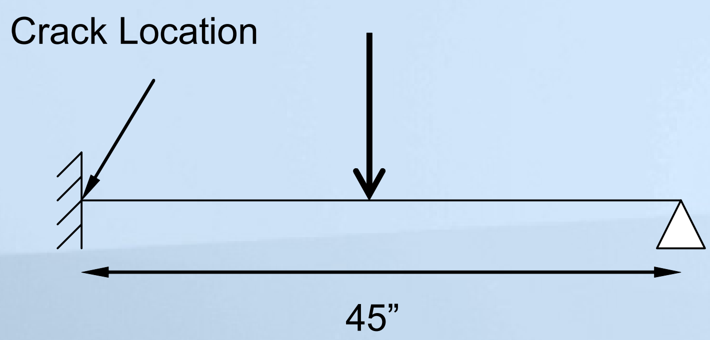
$$F_p = 0.8875 + 0.1312\left(\frac{2a}{\sqrt{R_m t}}\right) + \frac{0.1125}{\exp\left(\frac{2a}{\sqrt{R_m t}}\right)}$$ **for pressure**

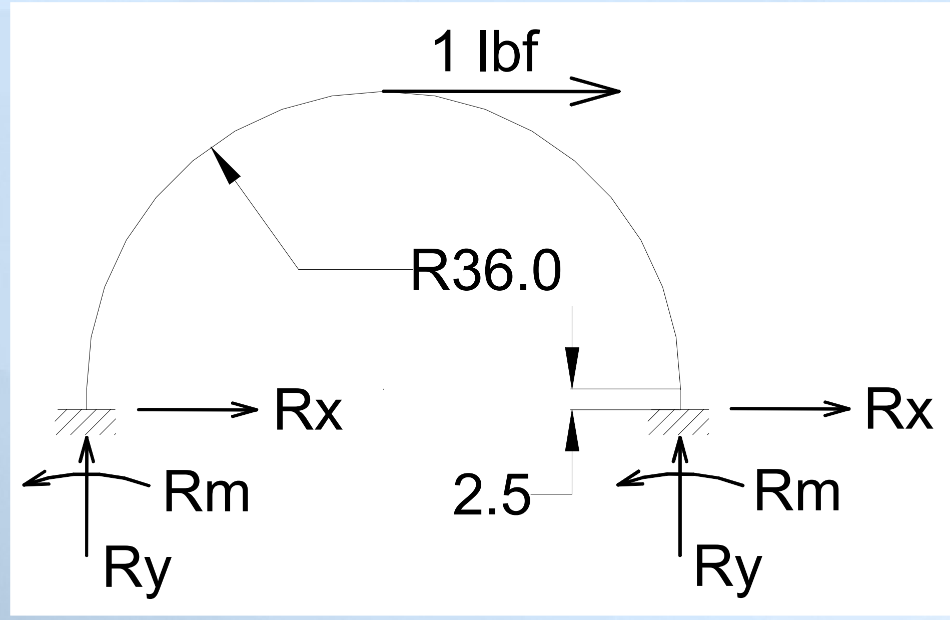
$$F_f = 1.0 + 7.5\left(\frac{\theta}{\pi}\right)^{\frac{3}{2}} - 15.0\left(\frac{\theta}{\pi}\right)^{\frac{5}{2}} + 33.0\left(\frac{\theta}{\pi}\right)^{\frac{7}{2}}$$ **for tension**

$$F_b = 1.0 + 6.8\left(\frac{\theta}{\pi}\right)^{\frac{3}{2}} - 13.6\left(\frac{\theta}{\pi}\right)^{\frac{5}{2}} + 20.0\left(\frac{\theta}{\pi}\right)^{\frac{7}{2}}$$ **for bending**

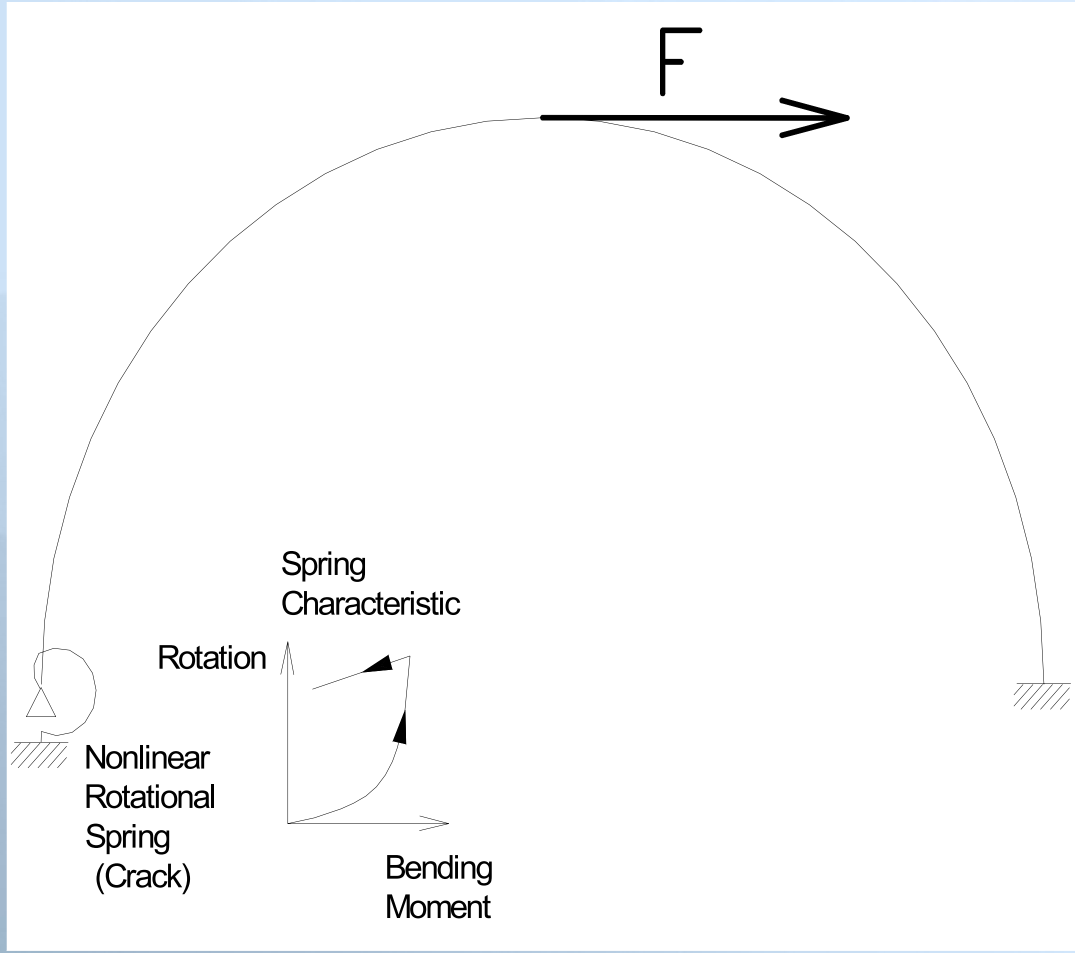
Rm = mean radius
t = wall thickness
***a* = one-half crack length**
Θ = one-half crack angle

Effect of Bending Loads on Crack Opening Areas

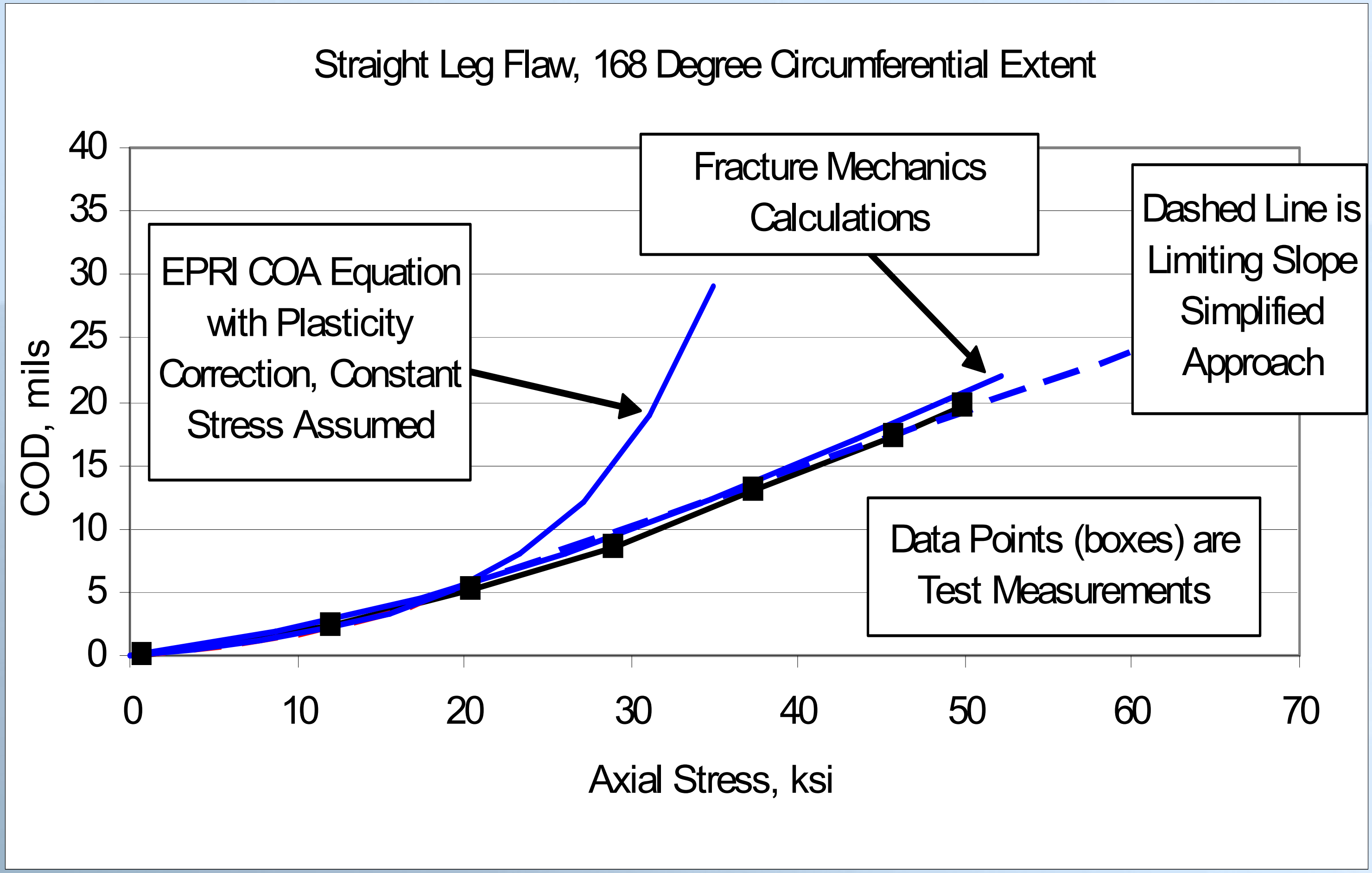




Effect of Bending Loads on Crack Opening Areas, cont.



Effect of Bending Loads on Crack Opening Areas, cont.



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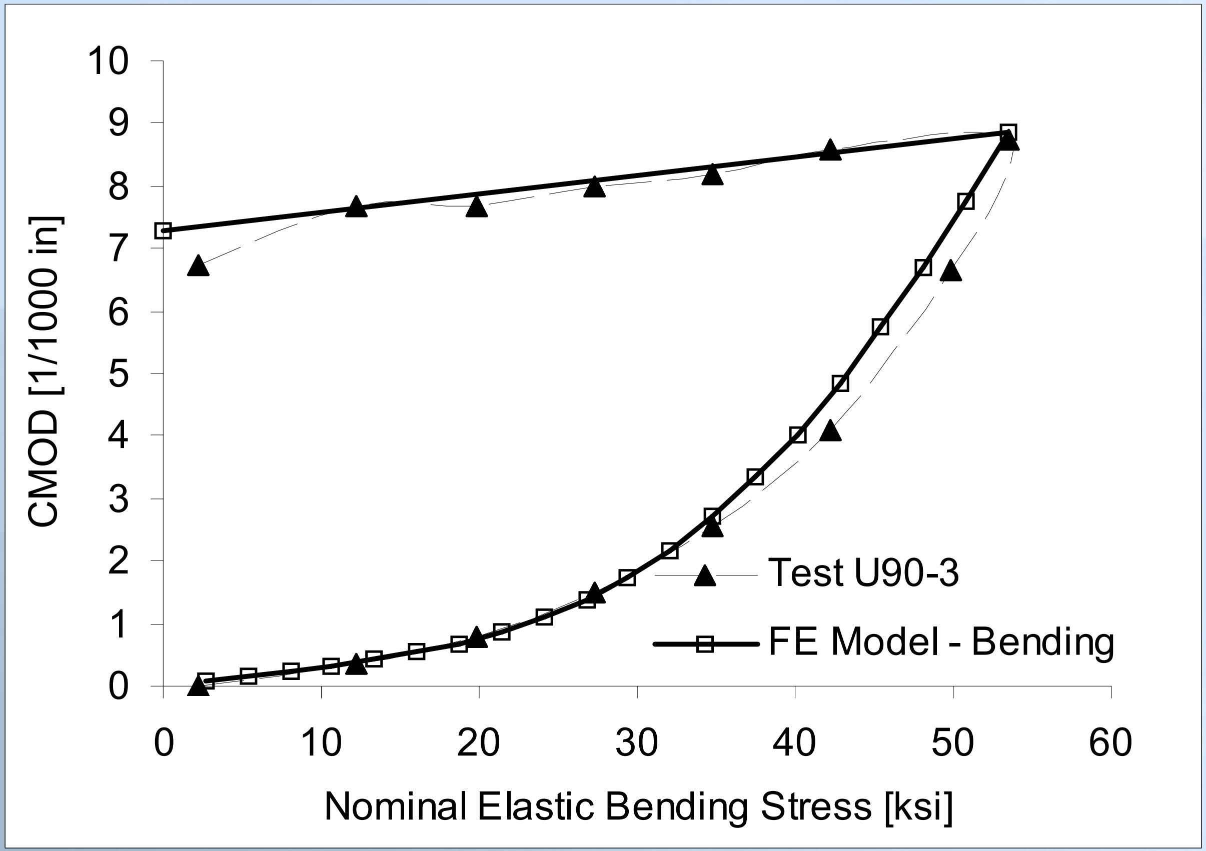
Effect of Bending Loads on Crack Opening Areas, cont.



Graph by Babcock and Wilcox, Canada

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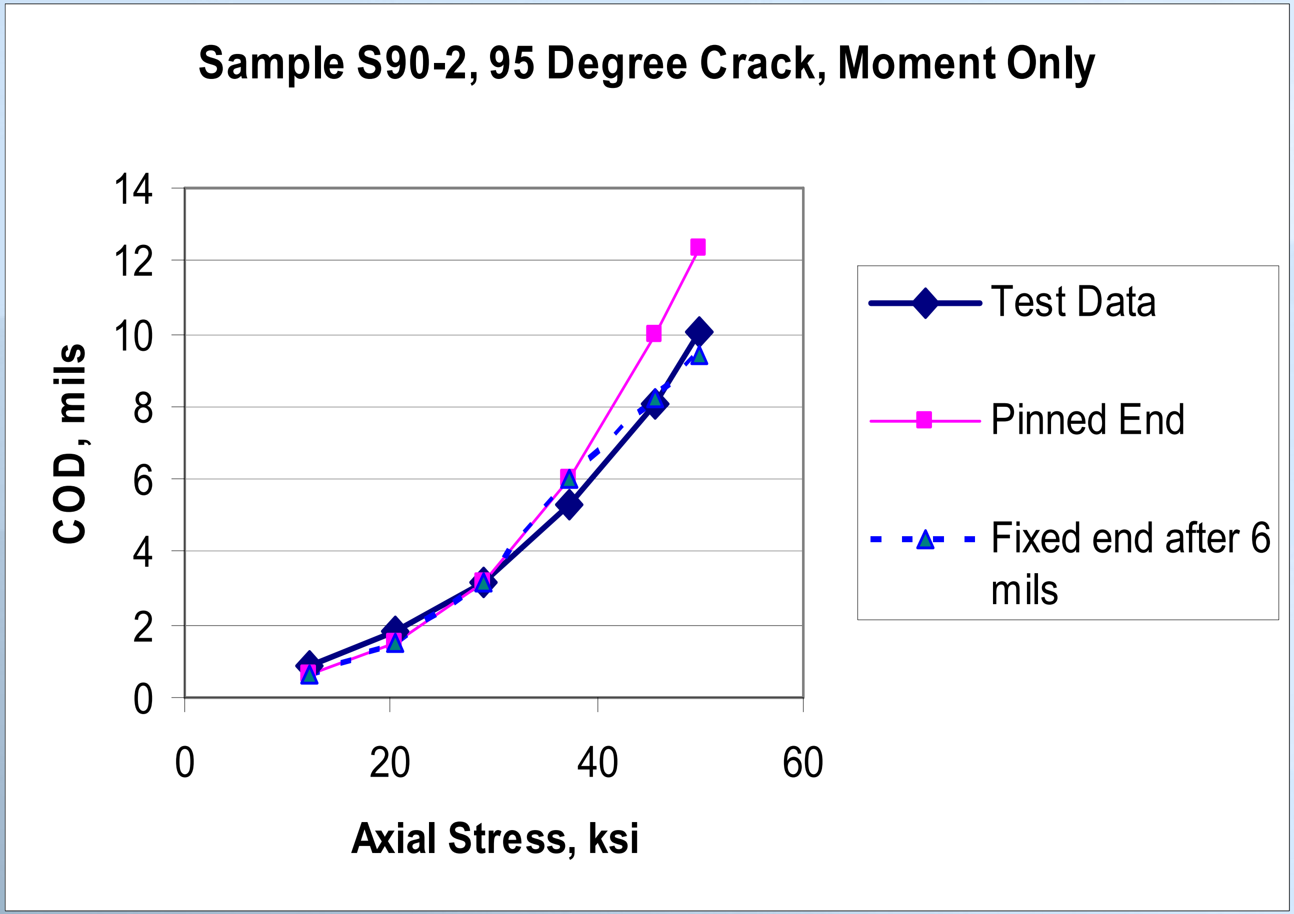
Effect of Bending Loads on Crack Opening Areas, cont.



Graph by Westinghouse Electric Company, LLC

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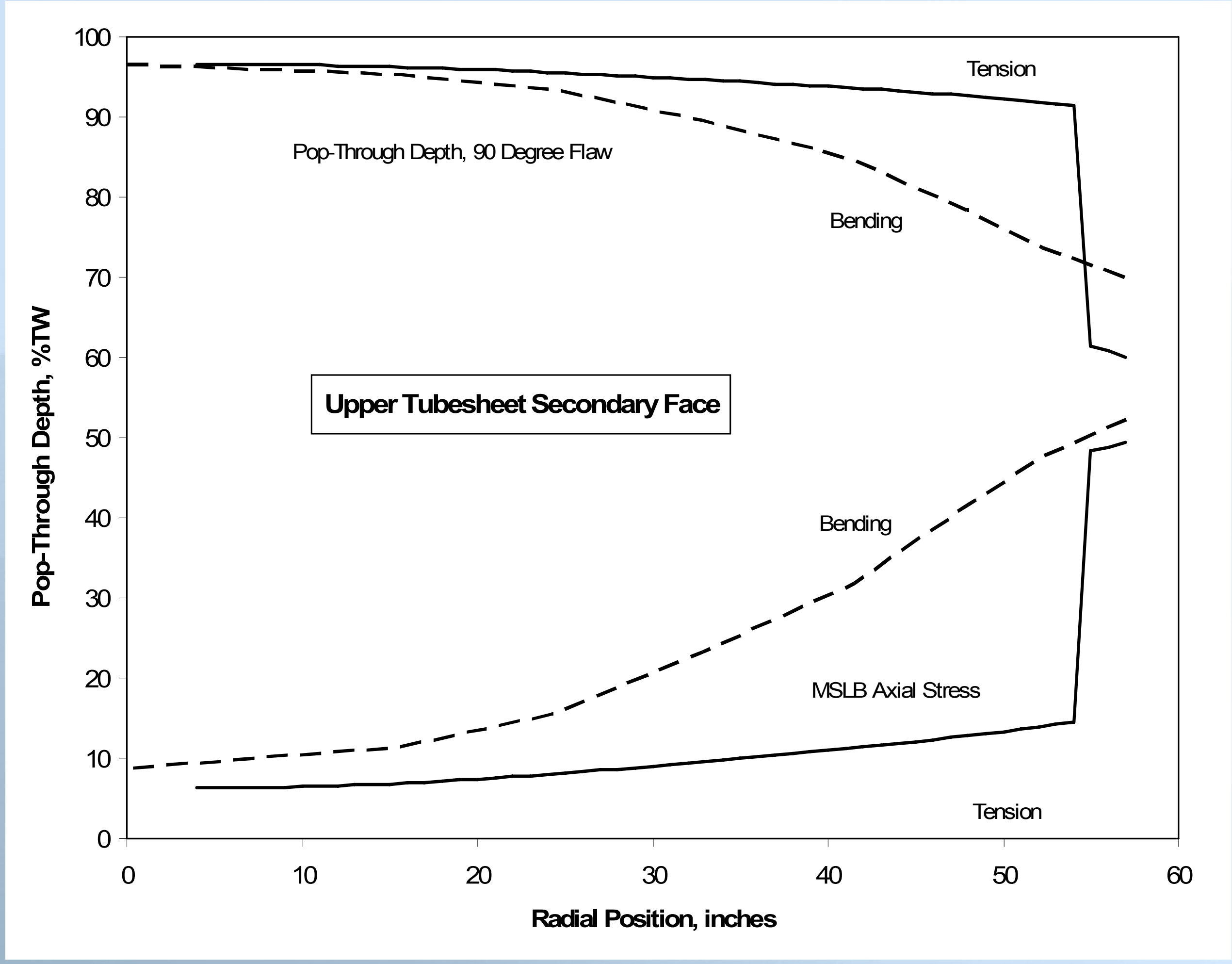
OTSG Tube Ligament Pop-Through, Original Design



OTSG Ligament Pop-Through Critical Depths

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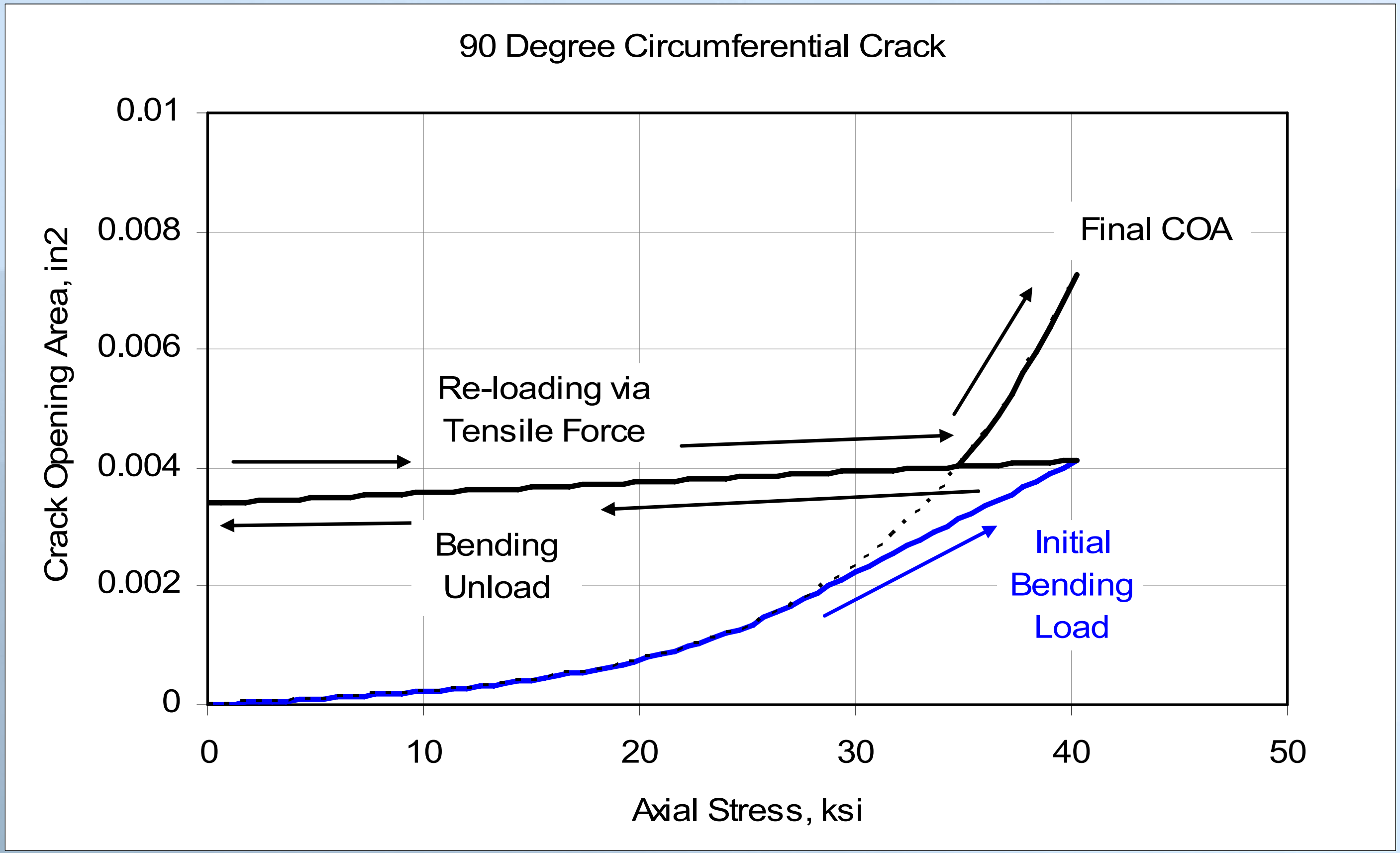
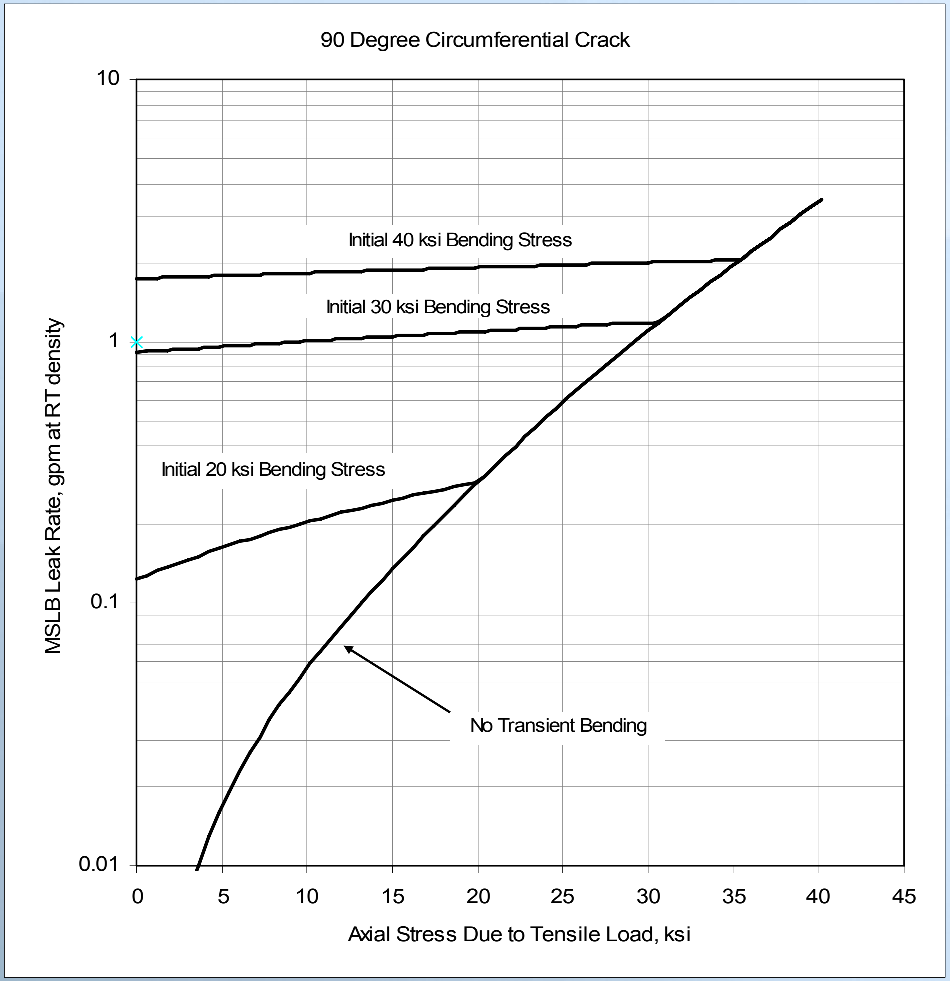
Effect of Bending Loads on Accident Leakage OTSG Original Design

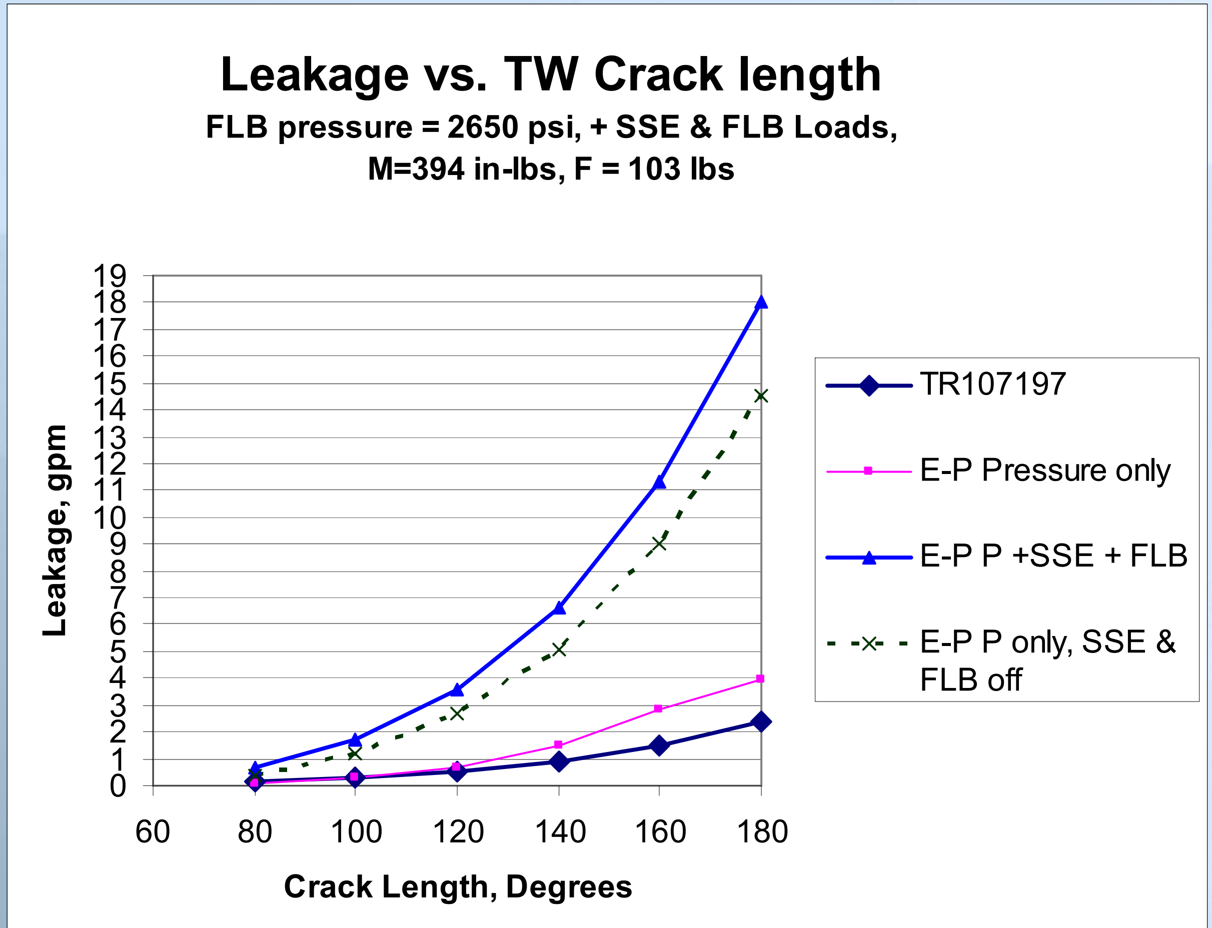


Effect of Bending Loads on Accident Leakage OTSG Original Design, cont.



Effect of Bending Loads on Accident Leakage, RSG's

Large Radius U-Bend, Circumferential Crack, ~15 ksi Outer Fiber Bending Stress



Effect of Bending Loads on Accident Leakage, RSG's

Replacement RSG, Large Radius U-Bend, 90° Circumferential Crack, ~22 ksi Outer Fiber Bending Stress

Event	Leakage due to MSLB Pressure Differential Loading only [gpm]	Leakage during Seismic Event - Combined Loading [gpm]	Leakage after Seismic Event – Combined Loading [gpm]
Main Steam Line Break + Seismic	0.11	1.27	1.13
Main Steam Line Break following Normal Operation + Seismic	0.11	1.14	0.96

Conclusions, OTSGs

- The only significant bending loads for OTSGs occur in original design OTSGs and then only in the upper span during the initial blow down during a MSLB.
- The effect of bending loads in the upper span on ligament pop-through and leakage can be more limiting than the axial load effect.
- However, based on historical inspection data for OTSGs, observed flaw sizes and locations are such that bending loads have not been limiting in original design OTSGs and will not be limiting in replacement OTSGs.

Conclusions, RSGs

- Relatively high bending stresses under accident conditions occur only in the U-Bend region
- Bending loads can reduce circumferential degradation depths leading to pop-through
- If throughwall circumferential degradation develops, bending loads can increase accident leak rates by about a factor of 5
- However, circumferential degradation must be located at intrados or extrados regions of U-Bends to be affected by bending loads. Historical inspection data for RSGs, shows that observed flaw sizes and locations are such that bending loads have not been limiting and are not expected to be limiting in the future.

Overall Conclusions

- At present, there have been no observed circumferential degradation sites that are both capable of leaking and located in high bending stress regions
- Industry has strengthened the basis for evaluating the effects of combined loads on leakage integrity and issued interim guidance on April 23, 2007
- Low bending stresses can cause small increases in leak rates for circumferential degradation and must be included in leakage integrity evaluations
- Report will be submitted to the NRC

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Steam Generator Tools for Integrity Assessment Project

Helen Cothron

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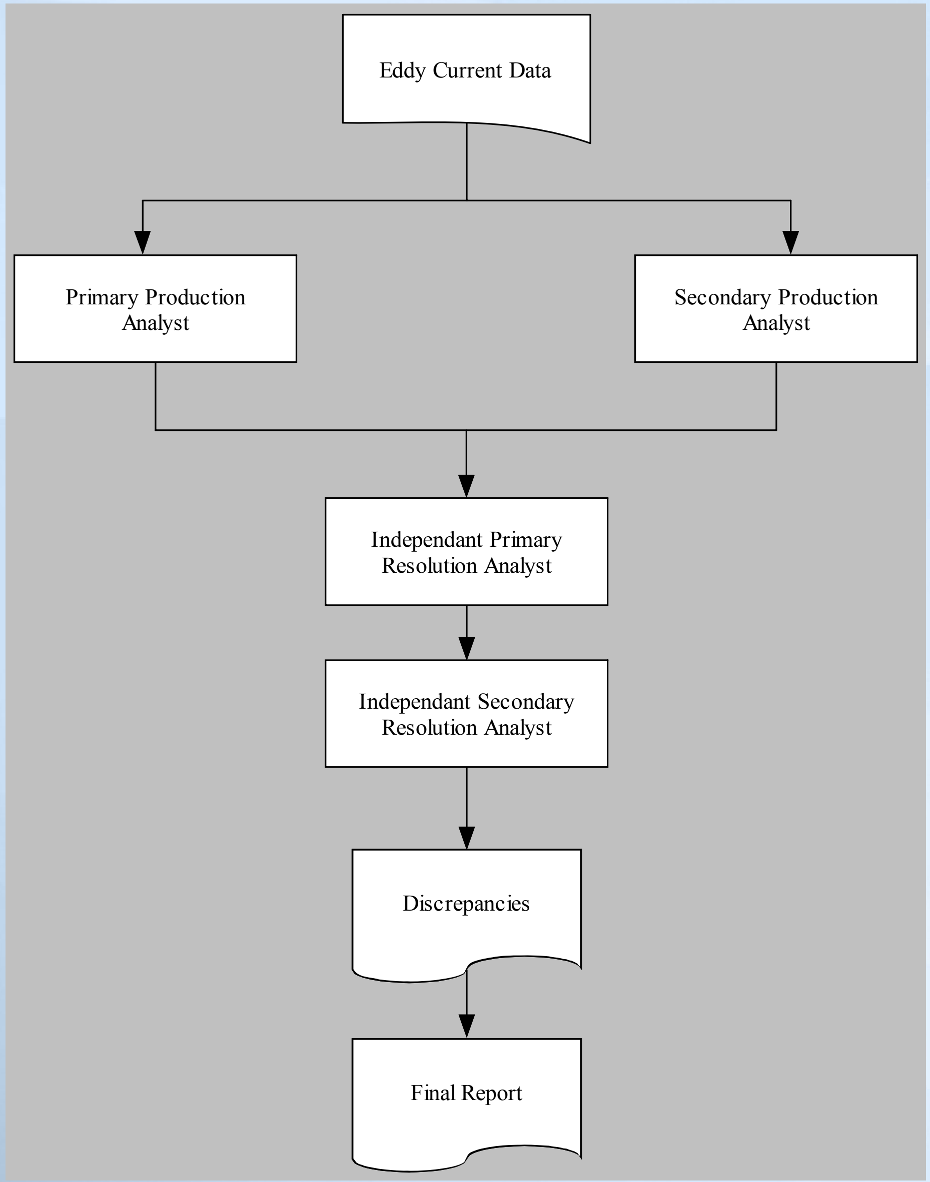
Tools For Integrity Assessment

- Joint effort between the NDE and Engineering communities to improve the reporting of performance indices for available eddy current systems
- Gather all available eddy current and metallurgical data from pulled tubes and laboratory samples
- Provide for technique and analyst uncertainties for detection and sizing of flaws
- Begin with one damage mechanism and develop tools to allow the continuation of the process
- Test protocols and procedures through a pilot program
- Assess the effect of eddy current noise on detection and sizing

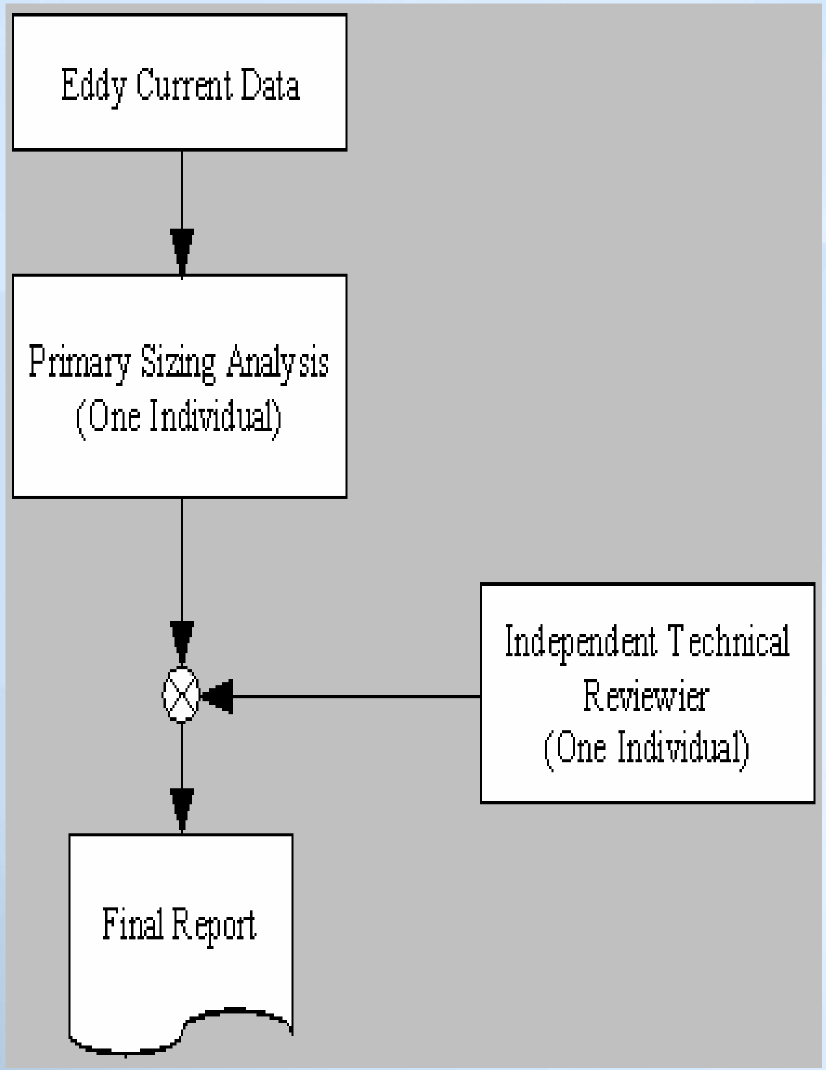
Performance Demonstration Detection

- 10 analyst teams
  - Minimum of Four Data Analysts per team
  - Primary & secondary production analysts
  - Primary & secondary resolution analysts
- Guidelines and Training provided by EPRI NDE Center
- Test data for axial ODSCC between top of the tubesheet and the U-Bend
  - Bobbin - 99 Cal groups
  - Rotating - 47 Cal groups



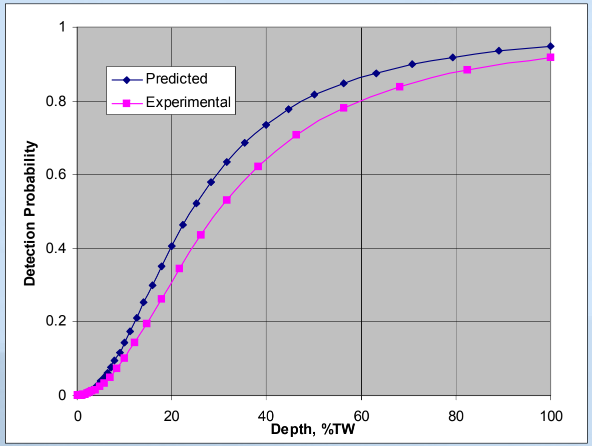
Performance Demonstration Sizing

- Two individuals per team
  - Primary sizing analyst plus independent technical reviewer
- Guidelines and Training provided by EPRI NDE Center
- Used plus point cal groups

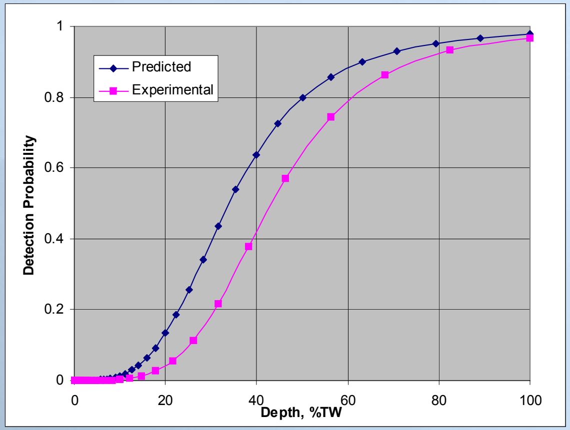


MAPOD Validated – Bobbin Data

- Pre-performance test predictions
- While not all data is bounded, the Model Assisted POD (MAPOD) predictions are statistically very close to actual results
- Variables can now be adjusted to more closely predict future experiments



Tab 1



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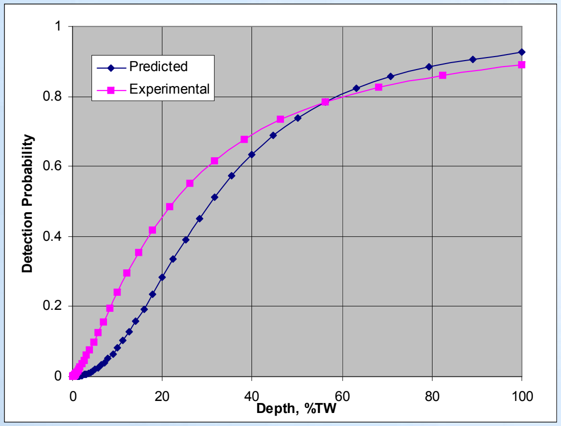

Tab 3

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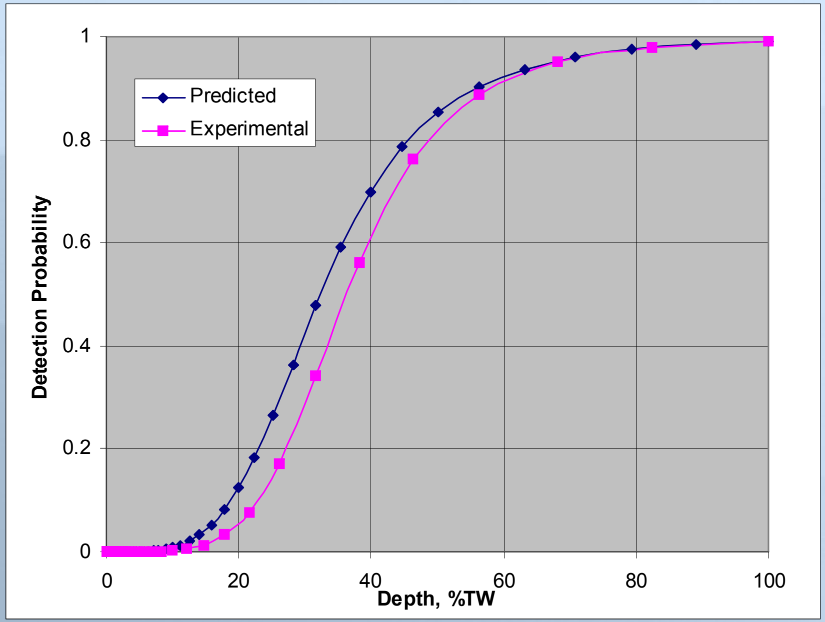
MAPOD Validated - +Point Data

Tab 4



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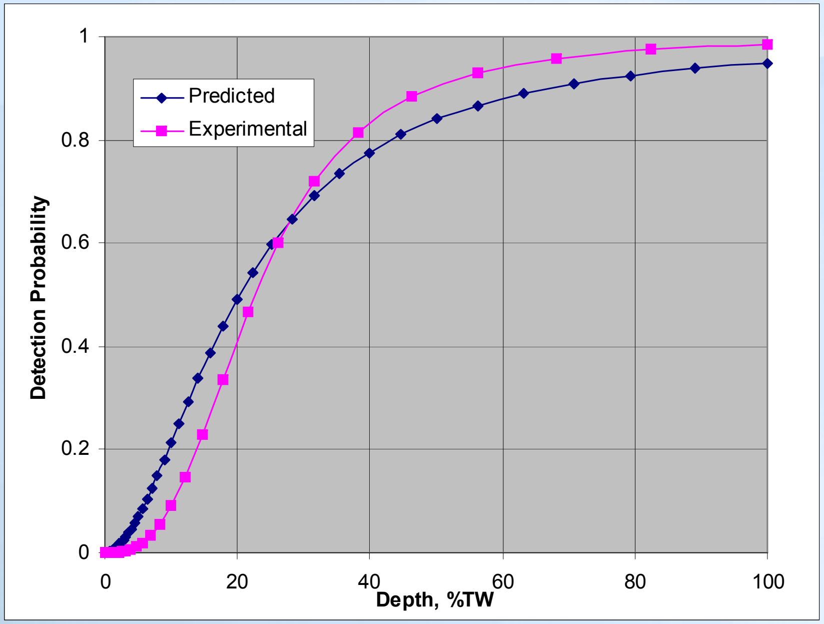

2001 Noise Issues Addressed by Ad Hoc Committee

- Industry needed requirements for noise evaluations to support tube integrity assessments
  - First attempt by Examination Guidelines lacked tools to implement and did not include appropriate area of interest
    - Areas in the SG tubing are different when evaluating noise
- Available techniques for defining acceptable noise levels
  - Comparisons of noise levels with BOC acceptance criteria
    - Plant specific development of acceptable noise voltage levels
  - Comparisons of noise levels with detection qualification data
    - Use of RMS does not lend itself easily to tube integrity parameters
    - Revision 6 of the Examination Guidelines was focused on data quality in choosing RMS
  - Electronic addition of indications to plant specific noise levels to demonstrate detection of required signal voltages or flaws and provide datasets for POD determination
- No generic answer

Noise Pilot Study

- Objectives of the Pilot Study
  - Test tools during an inspection
  - Assess adequacy of automated noise analysis software
  - Assess Window and Step Size for Noise Analyses
  - Compare noise distributions for two consecutive outages to develop guidance on frequency for assessing changing conditions
  - Compare various sample sizes with total SG noise distribution to support guidelines on sample size requirements
  - Assess the need to adjust POD curves during the outage

Noise Pilot Study

- Work Performed
  - Analyzed noise for pilot plant's prior outage
    - Debugged noise monitoring software,
    - Trained NDE analysts on new software
  - Developed POD predictions for current outage using prior outage noise distributions and tested applications of model assisted POD (MAPOD) simulator
  - Completed noise analyses during outage
    - Further assessed software and its capability for real-time use
    - Developed noise distribution requirements
  - Reviewed experience and provided recommendations for software enhancements, window sizes, step sizes, etc.

Conclusions/Recommendations of Noise Pilot

- Software enhancements are necessary prior to general industry applications
  – Integrate noise software with the rest of the eddy current acquisition and data management software
  – Integration of the current three software programs into a single package recommended to reduce manual file manipulations
  – An additional pilot project is recommended to further test and enhance software before requiring broad industry implementation
- Negligible differences in noise distributions from the two outages
  – Supports assessment of full noise distributions only when significant change in secondary side conditions is experienced (major chemistry excursion or chemical cleaning)
  – Supports validity of applying prior cycle noise data for POD predictions
  – Supports one time baseline noise analysis with trigger values and sample measurements to monitor noise for changes with time
- Developed sample sizes for noise monitoring

Conclusions/Recommendations of Noise Pilot

- Recommendations on window width, step length, and measurement spans
- One-time 100% noise measurement in the area of interest for bobbin
  - Set trigger values for outage inspection based on noise level found to yield acceptable PODs
  - Develop PODs for each area of interest
- Baseline POD for Plus Point established with a minimum sample
- Measure noise during inspections on 100% of tubing but evaluate and store results for only those areas that exceed trigger values
  - If trigger values are exceeded the data must be evaluated for potential impact to POD
    - MAPOD will be a useful tool in recalculating POD

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Accomplishments 2001-2006

- Study of noise resulted in development of software spec for noise monitoring and a pilot project to test the software
  - Published pilot results, lessons learned, and recommendations
    - Beaver Valley-1 Noise Pilot Project Results, Experience, and Recommendations, November 2006, Report #1012985
  - Developed revision 0 and subsequently revision 1 of the noise software spec
- Study of POD and sizing uncertainty issues resulted in a performance demonstration pilot
  - Published protocols and procedures for data acceptability, data sufficiency, peer review, and performance demonstration for detection and sizing
    - Tools for Integrity Assessment Project Technical Report, December 2006, Report #1014567
  - Created software and users manuals for development of detection and sizing indices, for monitoring eddy current noise, for noise adjustment, and for modeling probability of detection
  - Completed a performance demonstration for axial ODSCC
    - Results will be published in ETSSs 2007

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Future Work

- Developing prototype for noise monitoring software
  - Will lead to plan for commercialization
- Evaluating circumferential and axial PWSCC as next damage mechanism for performance demonstration
  - Further validate MAPOD software
- Develop implementation plan

Technical Issue Tracking

Gary Boyers

Tom Bipes – Issue 1, 6 and 11

Gary Boyers - Issue 2 and 3

Helen Cothron – Issue 4, 5, 7, 8, 9 and 10

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Industry/NRC Technical Issue Tracking

- Since 2000, the NEI SGTF has maintained a Technical Issue Tracking List
  - List contains 94 tracking items – based on
    - NRC letters/correspondence
    - RIS 2000-22
    - IP2 STGR Lessons Learned Report
    - Industry/NRC meetings
  - Tracking list formed the basis for TSTF-449, NEI 97-06 Rev 02 and EPRI Guideline Revisions
  - All items are closed or tied to existing programs
    - Industry recommends closing this list and developing a protocol to address new and ongoing issues

Industry/NRC Technical Issue Tracking

- July 2006 – Initial discussion on 11 technical issues for follow up
- Today's presentation updates these issues
- Objective – discuss status, future actions, and protocol for tracking & closure

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NRC Issue #1 – Guidance on Site Qualified Techniques

- *Examination Guidelines provide little detail on how to site validate techniques*
- *Not clear what is needed to conclude that a technique to be applied at a site is equivalent to a generically qualified ETSS*
  - *Is it permissible to site validate a technique if the generically qualified technique is operated outside the range of essential variables specified in the ETSS?*
  - *What level of rigor is needed to demonstrate a technique is site validated?*
  - *Are there any limits on when a generically qualified technique must be requalified?*
  - *Is more detailed guidance being developed in this area?*

Issue #1 Response
Guidance on Site Qualified Techniques

- Site Validation (Section 6.2.4)
  - Reference PWR SG Examination Guidelines, Revision 6, 1003138
  - Reference SGMP Interim Guidance Letter dated March 16, 2004
- Comparison of:
  - Essential variables
  - Degradation signals
  - Extraneous test variables
    - Denting
    - Deposits
    - Tube geometry
    - Noise
- Assessment of potential impact of noise on POD
- Review is prepared or reviewed by the utility-designated QDA and approved by the individual(s) responsible for SG tube integrity for use in the DA.
- Comparison and/or requalification may be done at the utility, vendor, or industry level.

Issue #1 Response
Guidance on Site Qualified Techniques

- Site Validation does not provide a means for deviation from use of qualified examination techniques
  - Section 6.2.1 requires the use of techniques that meet the minimum acceptance criteria of Appendix H or J as applicable
  - Section 6.2.6 allows the use of non qualified techniques, but only for diagnostic purposes to aid in the evaluation of a specific condition or mechanism

NEI

Issue #1 Response
Guidance on Site Qualified Techniques

- Appendix H.3.2 Essential Variable Ranges
  - *Any two techniques with the same essential variables are considered equivalent. Equipment with essential variables that vary within the tolerances specified in Section H.4 is considered equivalent. When variations in the technique allow more than one value or range for an essential variable, technique qualification shall be repeated at the minimum and maximum value for each essential variable with all other variables remaining at their normal values.*
  - *When the method does not specify a range for essential variables and establishes criteria for selecting values, the criteria shall be demonstrated for essential variables such as frequency calculations and sample rates.*
- Appendix H.3.3 Requalification
  - *When a change in an acquisition technique or analysis technique causes an essential variable to exceed a qualified range, the acquisition or analysis technique shall be requalified for the revised range.*

Issue #1 Response
Guidance on Site Qualified Techniques

- Appendix H.4 Essential Variable Tolerances
  - There is guidance within Appendix H for comparison of specific essential variables for determination of equivalence:
    - H.4.1 Instruments and Probes
    - H.4.1.1 Cable Length
    - H.4.1.2 Frequency
    - H.4.2 Computerized System Algorithms
    - H.4.3 Calibration Methods
    - H.4.4 Sample Rates
- Supplement H1 Equipment Characterization
  - Provides specific measurement attributes one can use in specification of essential variables as well as comparison.

Issue #1 Response
Guidance on Site Qualified Techniques

- The pending draft Revision 7 of the PWR SG Examination Guidelines contains a similar level of detail in this area as compared to Revision 6.

NEI

Issue #1 Response
Guidance on Site Qualified Techniques

- Future R&D Work on Equivalencies
  - Multi year project is under way
    - Objectives
      - Consistent
      - Cost Effective
      - Technical Basis
      - Standardized Process
    - May include
      - "Finger Printing" existing techniques
      - Master sample comparison
    - Project is still in the development stage

NEI

NRC Issue #1 – Conclusions

- *Examination Guidelines provide little detail on how to site validate techniques*
  - Applicable guideline sections referenced
- *Not clear what is needed to conclude that a technique to be applied at a site is equivalent to a generically qualified ETSS*
  - *Is it permissible to site validate a technique if the generically qualified technique is operated outside the range of essential variables specified in the ETSS?*
    - Yes, provided that equivalency is established to the same rigor as Appendix H or J as applicable
  - *What level of rigor is needed to demonstrate a technique is site validated?*
    - Criteria is provided in Section 6.2.4
  - *Are there any limits on when a generically qualified technique must be requalified?*
    - Yes, when an equivalency cannot be demonstrated
  - *Is more detailed guidance being developed in this area?*
    - No, however additional R&D to simplify the process is underway

- Industry recommends closure.

Issue #2
Accident Induced Leakage and Operational Leakage

- Margin between operating leakage limit and accident induced leakage limit
  - Operational leakage limits were established to reduce the frequency of tube rupture
    - No relationship to accident induced leakage limits and, therefore, no guidance exists on determination of margin
    - EPRI Primary-to-Secondary Leakage Guidelines requires plant shutdown within 24 hours after exceeding 75 gpd
    - Affects only a small number of plants – addressed in the LAR process
- Implications of operational leakage on accident induced leakage results in OA
  - EPRI SG Integrity Guidelines, Rev. 2 includes a requirement to revisit OA if operational leakage is more than expected

    . . . if operational leakage is not predicted by the OA, assessment strategies shall be modified accordingly.
- Industry recommends closure

NEI

Issue #3
Determining the Limiting Accident for AILPC

Leakage assumed for accidents varies between accidents and between plants. Need to look at accident leakage limits in the context of the associated accident parameters to determine the limiting accident. Is industry guidance sufficient here?

- Industry guidance issued on April 23, 2007:
  - For plants that assume the same leak rate in each design basis accident (DBA), one AILPC limit shall be established by using the assumed leak rate combined with the highest accident loading condition on the tubing.
  - For plants that do not assume the same leak rate in each DBA, utilities shall use one of the two options below.
    - The loading condition on the tubing for each accident can be evaluated along with the assumed leak rate to define an AILPC limit for each accident, or
    - The lowest leak rate assumption can be combined with the highest tube loading condition to define one bounding AILPC limit
- Industry recommends closure

NEI

Issue #4
Foreign Object Task Force

Results of Foreign Object Task Force. Following several instances of tube degradation as a result of foreign objects (loose parts) in 2004 and 2005, it was the Nuclear Regulatory Commission (NRC) staff's understanding that a Foreign Object Task Force was chartered. The staff is interested in understanding the charter of this task force and its results. The staff is also under the impression that an EPRI report on predicting wear rates from steam generator loose parts was developed. We would be interested in understanding the recommendations of this report.

July 2006 meeting

- Provided the IAGL Rev 2 (including new Chapter 10) to NRC for review
- Industry recommends closure

NEI

NRC Issue #5 – Divider Plate Cracking

Divider plate cracking. Many plants limit the scope of steam generator tube inspections in the tubesheet region. It is the staff's understanding that some of these methodologies, if not all, rely on the divider plate to restrict tubesheet motion. Given the potential for the divider plate welds to crack, the staff is interested in understanding the various tubesheet-to-divider plate and divider plate-to-shell weld configurations (including weld materials) along with any inspection strategies that have been developed/implemented to monitor for cracking. In addition, the staff would like to understand whether the resistance the divider plate provides to the deflection of the tubesheet is necessary in order for the tubesheet stresses to be within the ASME Code, Section III stress limits.

NRC feedback at July 2006 meeting

- Divider plate function is relied on to limit tube sheet deflection in all "*" approaches to tube sheet inspection lengths. Health of the divider plate and welds needs to be verified in inspections if it is credited in the analysis.

NEI

Issue #5
Divider Plate Cracking

- Phase 1 work performed to investigate the consequences of large but not 100% TW cracks in the divider plate (limiting SG model) with respect to TS displacement and stress near/at the crack
  - Compare results of limiting SG model to threshold limits
    - If changes in TS displacement are small (less than 2%) cracking will be judged to be insignificant
    - If crack tip stress intensity was not large enough to grow the crack, no further work warranted
  - Results suggest that crack growth is possible
- The currently observed cracks at EdF plants are all shallow and do not affect the divider plate function or SG operation
- Does not affect SG designs with stay cylinders (CE design)
- Future work
  - Evaluate leakage potential and consequences
  - Assess need for inspections and methods to be applied if required
  - Star analyses are plant-specific

NEI

Issue #6
Measuring Noise in Bobbin/Rotating Coil

Industry method for measuring noise in the bobbin and rotating probe data. Discuss the methods currently being used to measure noise for data quality considerations (for detection and sizing of degradation).

- NRC feedback at July 2006 meeting
  - NRC interested in a schedule for activities addressing this topic. Future meeting to address in detail.
- Industry response
  - Detailed presentation on noise/tools project status

NEI

Issue #7
Correlation of In Situ Pressure Test Results to Operational Leakage

To what extent do guidelines address assessment of any correlation between in situ pressure test results and observed operating leakage? Plants need to assess in situ test results in relation to operating leakage.

- Draft Rev. 3 of the In Situ Guidelines includes the following statement in Section 6.1,
  - If leakage was detected during operation, it's recommended that a reasonable effort be made to correlate the leak rate identified during the leak test to the leak rate detected during operation. Factors that may be considered if a correlation is not established are the difference in thermal expansions and the limitations of the in situ test equipment
- Industry recommends closure pending issuance of Revision 3 of the In Situ Guidelines

Issue #8
Indian Point 2 Lessons Learned

Status of implementing the Indian Point 2 Lessons Learned Task Force recommendations. The staff is interested in understanding what specific changes were made to the industry guidelines to address the recommendations from the Indian Point Unit 2 tube rupture.

- NRC feedback at July 2006 meeting
  - Provide updated status of technical issues
- Industry response
  - NEI provided updated status of technical issues to the NRC
- Industry recommends closure

NEI

Issue #9
Time Dependence of Cracking – ANL Leak Tests

Time dependence of cracking (or flaw growth). Tests at Argonne National Laboratory and recent in-situ pressure test results at Surry Unit 1 indicate that flaws can continue to grow under stable pressure loading conditions. Discuss what efforts are underway to ensure that the in-situ pressure testing guidelines provide sufficient guidance to ensure that flaws are stable prior to concluding an in-situ pressure test.

- Existing guidance for 2 minute hold for structural loads (3dP) considered adequate based on industry database of burst test results and study of pressurization rate effects
  - *Steam Generator Degradation Specific Management Flaw Handbook,* EPRI, Palo Alto, CA: 2001. 1001191
  - *Effect of Pressurization Rate in Degraded Steam Generator Tubing Burst Pressure,* EPRI, Palo Alto, CA: 2001. 1001441

NEI

Issue #9
Time Dependence of Cracking – ANL Leak Tests

- Significant increases in leakage under constant pressure has not been observed in power plants operating with leakage
- When NUREG is published, industry questions with respect to test applicability can be addressed
- Need to see raw data used as basis for NUREG

NEI

Issue #10
Loads to Assess Tube Integrity

Loads used to assess tube integrity. Discuss to what extent the industry guidelines specify that the loading conditions used in assessing tube integrity should be consistent with the NRC approved design and licensing basis (including the NRC approved thermal hydraulic analysis).

- Non-Pressure loads were addressed for structural integrity in interim guidance and subsequently included in the SG Integrity Assessment Guidelines
- Detailed presentation given on the affect of non-pressure loads on leakage
  - Industry guidance forthcoming
- Industry recommends closure

NEI

Issue #11
Use of Control Data & Process Controls

One method for assessing analyst performance during the actual evaluation of the data is to insert control data (e.g., data known to be noisy or flawed) to ensure the analyst identifies this condition. Discuss to what extent the guidelines are being revised to incorporate such a requirement. This control data is sometimes referred to as a "Judas tube". In addition, discuss to what extent guidance exists (or is being developed) for monitoring the consistency of the primary and secondary analyses and when there is a lack of consistency, whether the guidelines call for an investigation of the cause and possibly a tertiary analysis.

NEI

Issue #11
Use of Control Data & Process Controls

- The Examination Guidelines (Revision 6) do contain requirements associated with process control for the purpose of maintaining consistency
  - Section 6.3.2 requires an SSPD prior to each inspection
    - This practice orients the analysts to the site specific analysis guidelines, degradation mechanisms, ETSS's, calling criteria, site rules, etc.
  - Section 6.3.3.2 requires the use of two independent analysis teams.
  - Section 6.3.3.4 requires a resolution process to resolve the differences between the primary and secondary production analyst.
  - Section 6.7 requires an analysis feedback process to ensure that analysts review their missed indications and a sample of their overcalls. This process also provides a protocol for the analyst to dispute the resolution call related to their review with utility or IQDA mediation.
  - Section 2.3 requires that an independent QDA (IQDA) randomly sample inspection results to ensure proper disposition of resolved indications.

NEI

Issue #11
Use of Control Data & Process Controls

- The draft version of Revision 7 to the PWR SG Examination Guidelines has enhanced guidance on the IQDA role
  - All of the functions of the IQDA have been assembled under Section 6.3.3.5
    - Review all repairable calls rejected by resolution
    - Randomly sample resolved results to ensure proper disposition
    - Provide any necessary feedback to the resolution team
    - In the event that the two resolution analysts cannot agree, mediate concurrence or the most conservative result will prevail
    - Monitor data analysis feedback process
    - Randomly sample NDD and NDF calls
- Industry recommends closure

Summary

- SGTF – NRC meeting and communications are very valuable
- Issues open for continuing work
  - 1, 2, 5, 6, 8, 9, 11
  - TSTF 449 tube sampling issue
  - Divider plant cracking assessment
- Recommended closure
  - 3, 4, 7, 10,
  - Re-evaluate question on #10 for industry assessment or plant specific response
- Need agreement on technical issue format and NRC closure
- Future Meetings…..

NEI