



Steam Generator Technical Issues

SGTF/NRC Meeting
July 12, 2005



Agenda

- Introduction – Jim Riley
- AILPC Bending Load Project Update – Jim Begley
- Tools for SG Integrity – Helen Cothron
- Recent Industry Guidance – Forrest Hundley
- SG Examination Guideline – Scott Redner
- Integrity Assessment Guideline – Helen Cothron
- Technical Issue Tracking – Kevin Sweeney
- Summary



Introduction

- Purpose of meeting is to provide NRC with an update of significant industry projects
- To review/close out previous technical task list maintained by NEI SGTF
- To discuss protocol for discussion and resolution of technical and regulatory industry issues post-GLCP





AILPC Bending Load Study

Jim Begley



AILPC Bending Load Study

- NRC draft Generic Letter asks plants to verify “leakage integrity” in the presence of non-pressure related loads
 - GDC-2, *Design bases for protection against natural phenomena*, requires that the safety function be maintained with consideration of “appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena”
- Leakage integrity assessment for AILPC does not consider bending loads associated with external events



AILPC Bending Load Study

- SGMP has conducted a study to determine the effects of bending loads on leakage and how to evaluate them
 - Results for bending loads with circumferential degradation
 - ◆ RSGs are affected in high row U-bends
 - Only a concern for significant circ cracks on extrados and intrados of tube
 - ◆ Original design OTSGs are affected in the upper span
 - ◆ Impact on leakage has been quantified



AILPC Bending Load Study

- Study found, as with SIPC, not a safety issue
 - Limited to circumferential flaws
 - Industry has not experienced circumferential degradation capable of leaking in high bending stress areas
- Interim guidance under development based on study results
 - [AILPC study results](#)





Steam Generator Tools for Integrity Assessment Project

Helen Cothron



Goals of the Tools for Integrity Assessment Project

- 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 affect of eddy current noise on detection and sizing



Accomplishments of the Project

- Gathered and assembled all known pulled tube data
- Created protocols and procedures for data acceptability, data sufficiency, peer review, and performance demonstration for detection and sizing
- 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



Accomplishments of the Project

- Using axial outside diameter stress corrosion cracking (ODSCC) as a pilot degradation mechanism, performed a peer review, a performance demonstration, and a follow-up peer review
 - Objective to issue performance indices for axial ODSCC between the tube sheet and the upper tube support plate and a new appendix for the Examination Guidelines on performance demonstrations



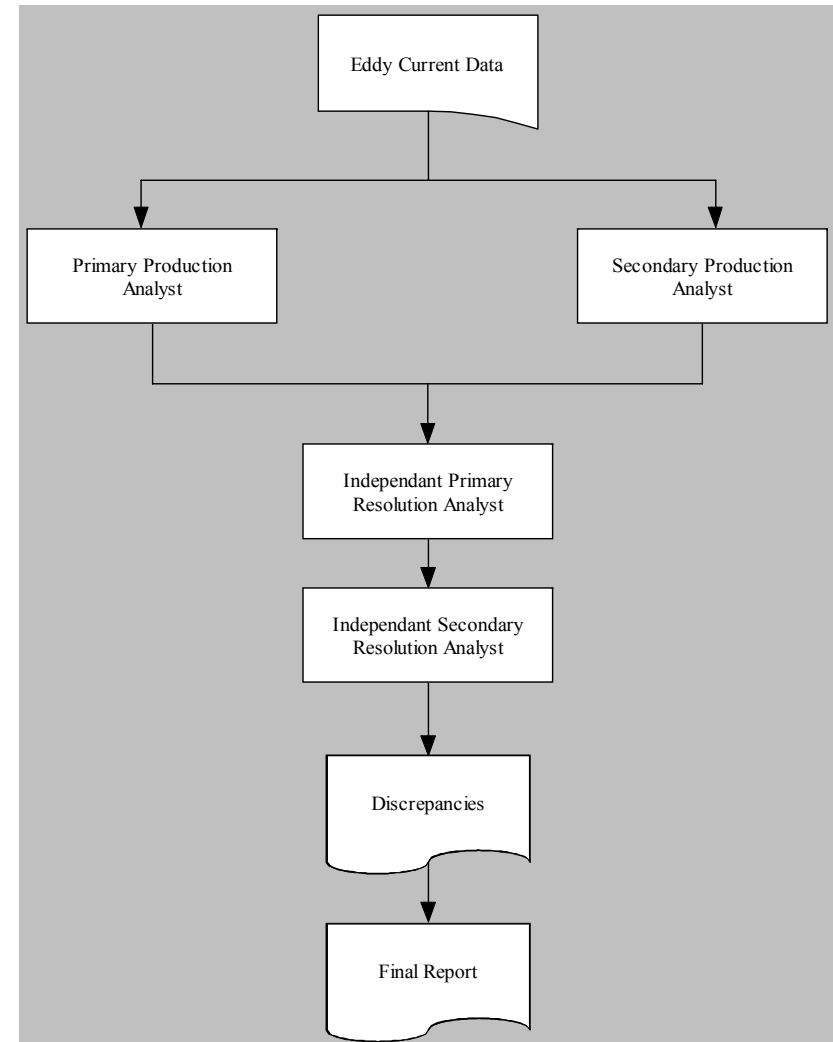
Accomplishments of the Project

- Validated Berens model for predicting detection for axial ODSCC
 - Plant-specific noise distribution is used as an input to the model
 - Still need to validate for PWSCC
 - Conducted training classes
- Performed a pilot study to test noise measuring tools and probability of detection modeling
 - Need to develop tools for data management
 - Lessons learned fed back to software vendor



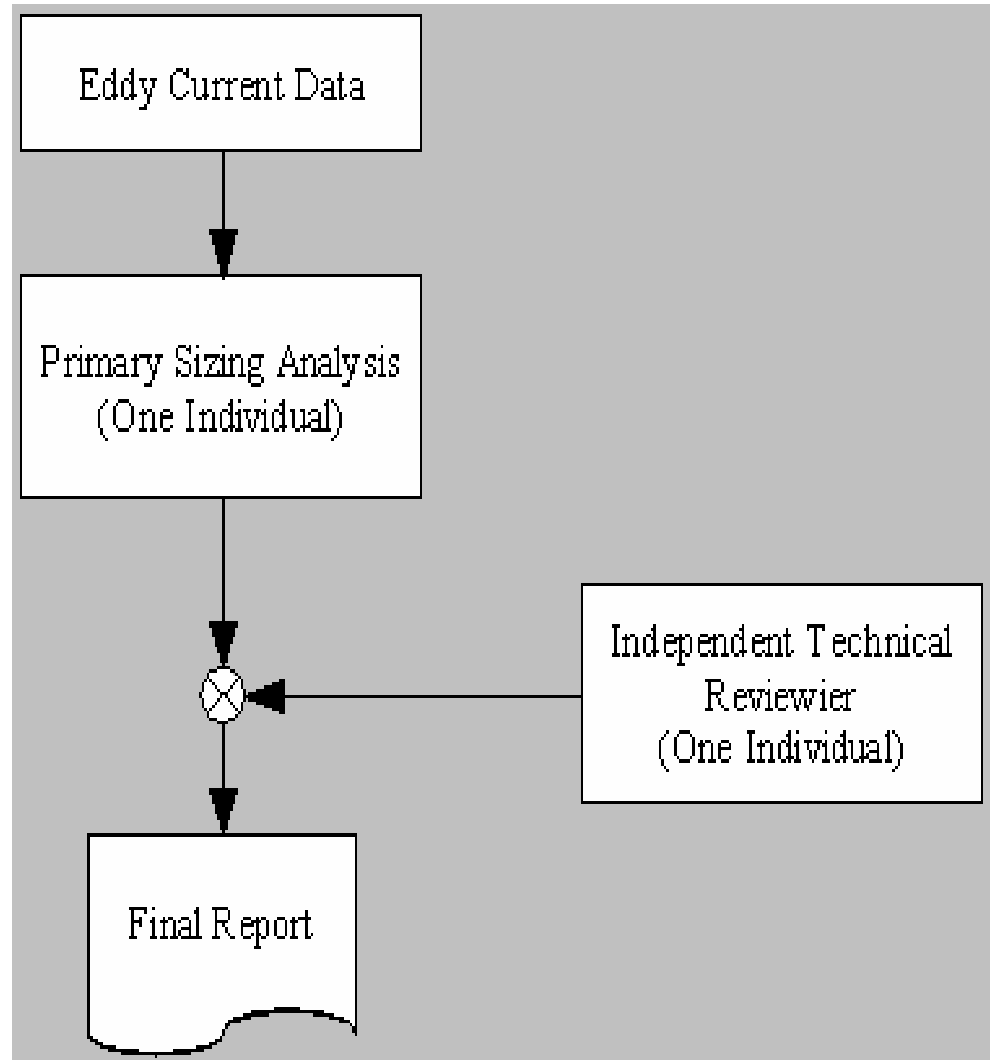
Performance Demonstration Detection Team Organization

- 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
 - Bobbin - 99 Cal groups
 - Rotating - 47 Cal groups



Performance Demonstration Sizing Team Organization

- Two individuals per team
 - Primary sizing analyst plus independent technical reviewer



Performance Demonstration Data Set Description

- 3 Bobbin Coil Data Sets
 - Predominantly drilled support plate data
 - Predominantly Westinghouse plant freespan data
 - Mixture of Combustion Engineering and Babcock & Wilcox freespan data and sludge pile data
- 2 +Point Coil Data Sets
 - Predominately sludge pile data
 - Predominately freespan data



Future Work

- Complete sizing evaluation
- Issue ODSCC axial performance indices
- Issue interim guidance on performance demonstration
- Pursue modifications to noise measurement software through vendor
- Perform another pilot project
- Issue interim guidance for noise adjustment
- Perform performance demonstration for PWSCC
- Predict results of the performance demonstration using probability of detection modeling
- NDE Center use existing tools to update performance indices for all degradation mechanisms





Industry Guidance

Forrest Hundley



Recent Industry Guidance

■ Current Guidelines

- NEI 97-06, SG Program Guidelines, Revision 2, May 2005
- PWR Steam Generator Examination Guidelines: Revision 6, 1003138, October 2002
- PWR Primary to Secondary Leakage Guidelines, Revision 3, 1008219, December 2004
- PWR Secondary Water Chemistry Guidelines – Revision 6, 1008224, December 2004
- PWR Primary Water Chemistry Guidelines: Volume 1, Revision 5 -- Volume 2, Revision 5, 1002884, September 2003
- Steam Generator Integrity Assessment Guidelines: Revision 1, TR-107621-R1, March 2000
- Steam Generator In Situ Pressure Test Guidelines: Revision 2, 1007904, August 2003
- Steam Generator Management Program Administrative Procedures, Revision 1, 1011274, November 2004



Recent Industry Guidance

- Active Interim Guidance

Subject	Number	Date
Adverse Trend of Foreign Objects in Steam Generators	SGMP-IG-05-04	Nov 18, 2005
Identification of "Mandatory", "Shall" and "Recommended" Elements for Revision 5 of the EPRI PWR Primary Water Chemistry Guidelines	SGMP-IG-05-03	Oct 18, 2005
Communicate Issuance of NEI 97-06R2 & Gaps Between R2 and Current Guidelines	SGMP-IG-05-002	Oct 10, 2005
Revised Structural Integrity Performance Criterion (SIPC)	SGMP-IG-05-001	Jan 17, 2005
EPRI SG In Situ Pressure Test Guidelines, Revision 2, Chapter 10	SGMP-IG-04-002	May 11, 2004
Steam Generator Examination Guidelines Rev 6, Sections 6.2.4, 6.3.3.3, 6.5 and Appendix H Supplements H1 and H2	SGMP-IG-04-001	March 16, 2004
Three Mile Island Tube Sever Event	-	Aug 18, 2003
Steam Generator Tube Leak at Comanche Peak Unit 1		April 22, 2003
New Degradation Mechanism		Aug 31, 2001



Information Letters

- Issued to communicate significant and new SG operational experience
- Most recent examples
 - TSTF 449-Normal Operating Leakage LCO vs. Accident Analyses Assumptions (SGMP IL 06-01)
 - Catawba Unit 2 Tubesheet Degradation Issues (SGMP IL 05-01)





SG Examination Guidelines Revision 7

Scott Redner



SG Examination Guidelines Rev 7

■ Status

- Revision 7 work began January 2005
- Committee structure included both utilities and vendors
- Final draft by end of July 2006 (industry comment)

■ Overview of Changes

- Incorporated mandatory, shall and recommended statements in accordance with administrative procedure
- Incorporated industry OE and interim guidance from Rev. 6
- Added specific guidance concerning data management



SG Examination Guidelines Rev 7

- Included TSTF-449 sampling requirements (verbatim)
 - Intent of paragraph TSTF-449 d.2 with respect to retroactive application
 - Clarify that d.2 requirements will apply for new degradation found at another plant at start of next period
 - ◆ Current period sampling strategies require a minimum 20% sample at each remaining inspection in the period
- Deleted Section 4, Sampling Requirements for Performance-Based Examinations



SG Examination Guidelines Rev 7

- Removed duplication conflict with other guideline documents
 - NEI 97-06 Revision 2
 - Integrity Assessment Guidelines
 - ◆ Secondary side inspections
 - ◆ Degradation Assessment
- Updated Appendix G degradation mechanisms





Integrity Assessment Guidelines Revision 2

Helen Cothron



Objectives of Guideline Revision

- Support implementation of NEI 97-06 Revision 2
- Provide utilities a recommended methodology for performing integrity assessments
 - Degradation Assessments
 - Condition Monitoring
 - Operational Assessments
- Address NRC and Industry comments



Performance Criteria and Standards

- New section on tube integrity criteria (Chapter 2)
 - The new performance criteria are stated along with a discussion of contributing loads
 - ◆ Appendix A contains the industry backup on the new performance criteria
 - New performance acceptance standards
 - ◆ Acceptance standard for structural integrity:
The worst-case degraded tube shall meet the SIPC margin requirements with at least a probability of 0.95 with 50% confidence.
 - ◆ Acceptance standard for accident leakage integrity:
The probability for satisfying the limit requirements of the ALLPC shall be equal to or greater than 0.95 at 50% confidence level.
 - ◆ A separate EPRI technical report will contain the bases for the change to the acceptance standards



Includes Important Definitions

- Important definitions to the performance criteria are now included
 - Primary membrane stress has been used anywhere yield strength allowables are discussed
 - Primary stress is the stress component developed by an imposed loading that is necessary to satisfy the laws of equilibrium of external and internal forces and moments. The basic characteristic of primary stress is that it is not self-limiting (i.e., deformation will not result in a reduction in load).
 - Secondary stress is a normal or a shear stress developed by the constraint of adjacent material or by self-constraint of the structure. The basic characteristic of a secondary stress is that it is self-limiting. Local yielding and minor distortions can satisfy the conditions that cause the stress to occur and failure from one load application of the stress is not to be expected.



NDE Uncertainties

- New section with results from the Tools for Integrity Assessment Committee on NDE uncertainties, noise, and probability of detection (Chapter 4)
 - Assessments require system uncertainties
 - Appendix B contains a discussion of Model-Assisted POD
- New section on developing growth rates, takes into account the effects of NDE uncertainty (Chapter 5)



Degradation Assessments

- New section with guidance on performing degradation assessments (DA) (Chapter 6)
 - Sources of information listed
 - General discussion of known degradation mechanisms, including hour-glassing
 - Requirement to assess all potential degradation modes.



Degradation Assessments

- Interim guidance for monitoring previously plugged tubes included (TMI tube sever)
- Actions upon finding new degradation
 - ◆ When an unexpected degradation mechanism is found that was not sufficiently addressed in the DA, the mechanism shall be entered into the plant's corrective action program. The corrective actions shall include the inspection requirements for the degradation to support the tube integrity assessments. Inspection requirements are specified in Section 3 of the Examination Guidelines.



Condition Monitoring/Operational Assessments

- Rewrite of CM/OA sections with recommended methodology
 - Consensus of all major vendors
- Clear requirement to perform benchmarking to validate OA methodology
- Requirement to address large leak even if performance criteria have not been exceeded
- Chapters include examples
 - Appendix C contains other examples
 - Separate EPRI Technical report is referenced with examples
 - Workshop planned for August



Secondary Side Maintenance

- New Section on Secondary Side Maintenance
 - Drafted by [Foreign Object Task Force](#)
 - Monitoring and projecting secondary side steam generator conditions for the purpose of developing a strategy for long-term steam generator operability and performance shall be part of the utility's steam generator program.
 - ◆ A secondary side integrity plan requires analysis and trending of chemistry, operational parameters, and inspection data.

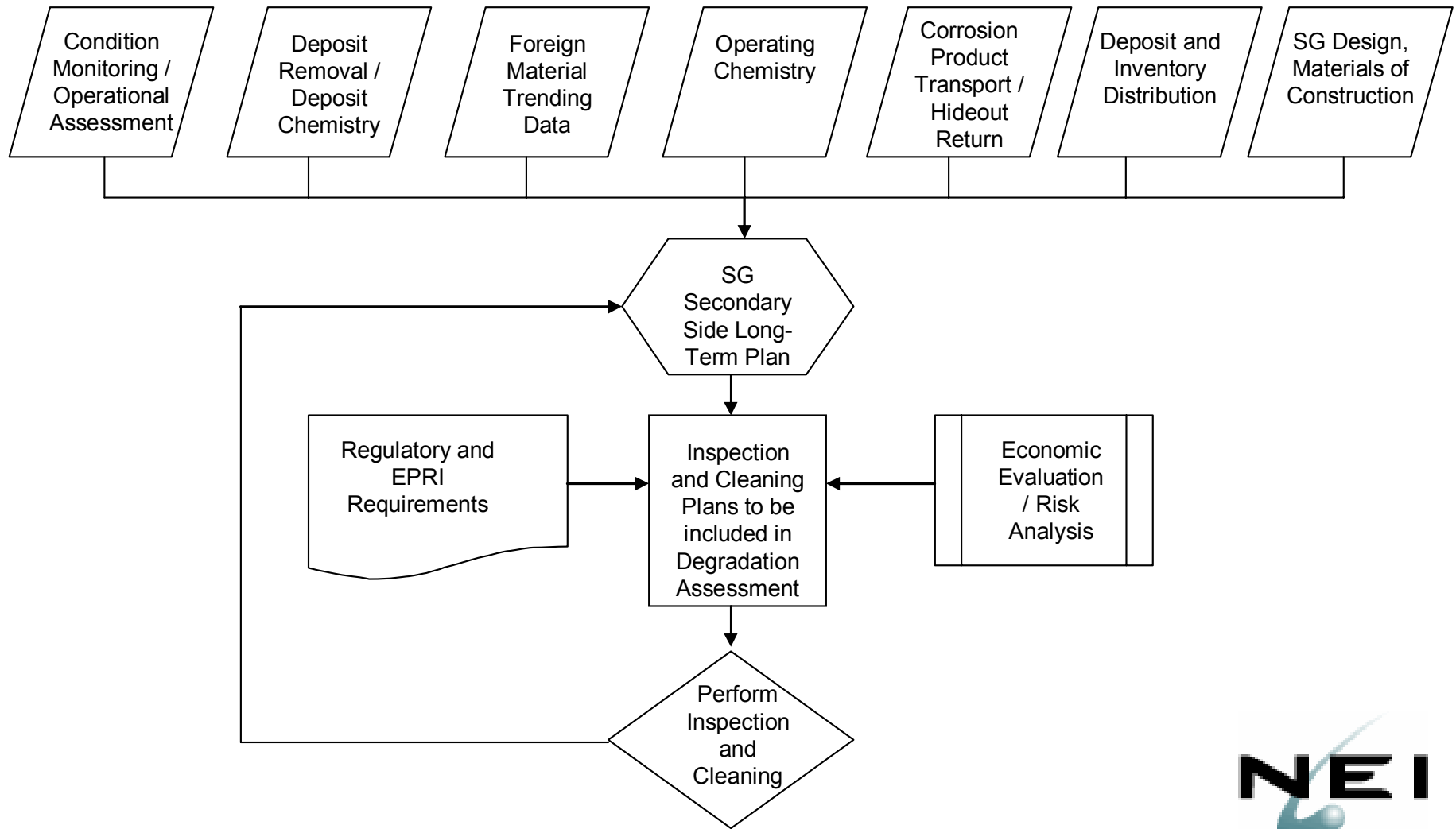


Secondary Side Maintenance

- New Section on Secondary Side Maintenance
 - Outage planning that does not include FOSAR shall include documentation of critical thinking supporting this plan
 - Contingency planning shall include events such as exceeding chemistry guideline limits for an extended period of time or known foreign material in the feed train
 - OE on foreign material events are applicable to all plants, not just sister plants.
 - CM/OA shall include secondary side inspection results



Secondary Side Maintenance



Report Requirements

- Requires updates of SGDD
- Stresses the importance of INPO OE and reporting to the SGMP failures of PC
- Requirement for DA to be completed prior to scheduled SG inspection
- Requirement for CM to be completed prior to Mode 4 after a SG inspection
- Timing of OA based upon results of CM





Technical Issue Tracking

Kevin Sweeney



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
 - Industry position is that all items essentially closed or tied to existing programs
 - ◆ Recommendation is to close list and develop protocol with Staff to address future issues (Afternoon Discussion)



Industry/NRC Technical Issue Tracking

- NEI SGTf has also reviewed draft NRC letter on SG Technical Topics
 - Propose to review in detail in Afternoon Session
 - Preliminary input
 1. Guidance on site qualification of techniques
 - Position – Existing guidance adequate
 2. Guidance ALLPC vs. Operating Leakage LCO
 - Addressed with EPRI Info Letter SGMP-IL 06-01 dated 3/13/06
 - Not issued as interim guidance
 - Suggested a factor of 2 margin between ALLPC and Op. Leakage LCO



Industry/NRC Technical Issue Tracking

- Preliminary input (continued)
 3. Guidance on Limiting Accident for AILPC
 - AILPC updated in TSTF-449
 - Determination of the limiting accident is outside of SG Program scope and related guidance
 4. Foreign Object Task Force
 - Interim Guidance issued 11/18/05 and incorporated in Section 10 of Rev 2 of Integrity Assessment Guidelines



Industry/NRC Technical Issue Tracking

- Preliminary input (continued)
 5. Divider Plate Cracking
 - EPRI E&R IRG has task items in place to evaluate safety consequences
 6. Measuring Noise in bobbin/rotating coil
 - EPRI Examination Guideline and Tools for Integrity
 7. Correlation of in situ pressure test
 - In situ pressure test is meant to support condition monitoring, not to validate operational leakage (many variables differ, difficult to correlate low leakage)
 - Guidelines do require adjustments for certain conditions (e.g., temperature, locked tube supports)



Industry/NRC Technical Issue Tracking

- Preliminary findings (continued)
 8. Indian Point 2 Lessons Learned
 - Industry position is that all LL items addressed and incorporated into TSTF-449 and industry guidance
 - Guidance for accounting for noise is in development (tools for integrity assessment)
 9. Time dependence of cracking
 - Addressed in In Situ Guidelines with respect to pressurization rate and hold times
 - Not an issue at 3NODP



Industry/NRC Technical Issue Tracking

- Preliminary findings (continued)

- 10. Loads to assess tube integrity

- Addressed in non-pressure load program (SIPC and AILPC)
 - Information included in EPRI Guidance and Performance Criteria

- 11. Use of control data to assess ECT effectiveness

- Existing program/guidance considered adequate
 - Addressing analyst performance in other ways (analyst feedback, noise / flaw injection option, QDA and SSPD requirements)
 - No plans to incorporate “Judas Tube”



Summary

- Effect of bending loads on AILPC
 - Not a safety issue
 - Interim guidance will be issued
- Tools for integrity assessment project continues
- Revision 2 of Integrity Assessment Guidelines to be issued this month
- Draft revision 7 SG Examination Guidelines completed this summer
- Agree on remaining technical issues to be addressed – NRC letter
- Future meeting plans...





NRC Feedback



Industry/NRC Technical Issue Tracking

1. Guidance on equivalency acceptance standards
 - How far can qualification variables be extended for site qualification?
 - Acceptance criteria for demonstrating equivalency of multiple parameters simultaneously
 - When does the technique need to be requalified?
2. Guidance AILPC vs. Operating Leakage LCO
 - Operating leakage limit should have margin with respect to the accident induced leakage limit
 - Cautionary statement when operating leakage approaches the accident leakage limit with respect to industry monitoring requirements
 - Is industry considering guidance on acceptable margin between the two?
 - Implications of increasing operational leakage on accident induced leakage results in OA? Revisit the OA?



Industry/NRC Technical Issue Tracking

3. Guidance on 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?

4. Foreign Object Task Force

- Information provided and section 10 of the IAGL rev 2 will be reviewed
- OK for now



Industry/NRC Technical Issue Tracking

5. Divider Plate Cracking

- 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.

6. Measuring Noise in bobbin/rotating coil

- NRC interested in a schedule for activities addressing this topic. Future meeting to address in detail.

7. Correlation of in situ pressure test

- 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.



Industry/NRC Technical Issue Tracking

8. Indian Point 2 Lessons Learned

- Provide updated status of technical issues.

9. Time dependence of cracking

- Experience with increasing leakage under constant delta P during in situ test. How can plants assure that the leak will not continue to get worse (that leak has stabilized) if you are still in a dynamic situation when the test is terminated?
- Is the acceptance criteria appropriate for the purpose of the test?



Industry/NRC Technical Issue Tracking

10. Loads to assess tube integrity

- Other loads (in addition to differential pressure) assessed in determining conformance with performance criteria should be consistent with those assumed in thermal hydraulic analysis supporting the accident analysis.
- In assessing structural integrity, it may not be appropriate to credit operator actions to limit assumed loads

11. Use of control data to assess ECT effectiveness

- What processes are in place to monitor the effectiveness of inspections and analysts
 - Follow up on situations where different analysts reach different conclusions from the same data
- Need to look at changes to guidelines (SG Exam GL rev 6 App G and section 6 and interim guidance)



Follow Up

- GLCP status
 - Received 69
 - Started review for essentially all (doing review, addressing RAIs) – no major problems
 - Approved 14
- Prioritize importance of issues
- Start a new table with the 11 issues identified today

