March 15, 2011

MEMORANDUM TO: Robert M. Taylor, Chief
Steam Generator Tube Integrity and
Chemical Engineering Branch
Division of Component Integrity
Office of Nuclear Reactor Regulation

FROM: Andrew B. Johnson, Materials Engineer ***/RA/***
Steam Generator Tube Integrity and
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Division of Component Integrity
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SUBJECT: SUMMARY OF THE FEBRUARY 18, 2011, CATEGORY 2 PUBLIC MEETING WITH THE NUCLEAR ENERGY INSTITUTE (NEI) AND INDUSTRY TO DISCUSS STEAM GENERATOR ISSUES

The industry's Steam Generator Task Force (SGTF) met with U.S. Nuclear Regulatory Commission (NRC) staff on February 18, 2011, at the Nuclear Energy Institute's (NEI) offices in Washington DC. The purpose of the meeting was to discuss a variety of steam generator issues. The topics discussed are summarized in the industry's slides, which are available in the Agencywide Documents Access and Management System (ADAMS) under Accession Number ML110490077. The enclosures provide a list of those in attendance and feedback on the automated analysis of steam generator tube eddy current data. This meeting was noticed as a public meeting and the meeting agenda is available in ADAMS under Accession Number ML110330275. Other than industry representatives, no members of the public were present.

During the meeting there was discussion on a number of steam generator issues. These discussions are summarized below:

- Regarding implementation of the NEI 97-06, "Steam Generator Program Guidelines," Revision 3, the industry indicated it would send interim guidance letters issued to the industry to the NRC through formal letters. Interpretations of the NEI 97-06 guidelines would be sent to the NRC through less formal means (e.g., e-mail).

- Acronyms used in the industry slides include:
  - TAG: Technical Advisory Group
  - EPRI: Electric Power Research Institute
  - SGMP: Steam Generator Management Program

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- EOC: Executive Oversight Committee
- IC: Integration Committee
- PMMP: Pressurized Water Reactor Materials Management Program
- TSTF: Technical Specification Task Force
- RAI: Request for Additional Information
- EdF: Electricity de France
- MW: Megawatt
- PT: Dye-penetrant Testing
- UT: Ultrasonic Testing
- NDE: Non-destructive Evaluation
- ASME: American Society of Mechanical Engineers
- DE: Destructive Evaluation
- SCC: Stress Corrosion Cracking
- MHI: Mitsubishi Heavy Industries
- ETSS: Eddy Current Technical Specification Sheet
- TBD: To Be Decided
- EC: Executive Committee
- TT: Thermally Treated
- ME: Mill Annealed
- PWR: Pressurized Water Reactor
- AVB: Anti-vibration Bar

- The NRC staff indicated that it may issue interim staff guidance to reflect the acceptability of using NEI 97-06, Revision 3 as the basis for an aging management program of steam generators in license renewal applications (since the current version of the Generic Aging Lessons Learned (GALL) report references revision 2 of NEI 97-06).

- The NRC staff indicated that it had completed the technical review of TSTF-510 and that it is currently being processed by other organizations within the NRC. The NRC technical staff indicated it would check on the status of the review since a few plants may wish to take advantage of the revised requirements in TSTF-510 in the near term. The staff encouraged the industry to adopt TSTF-510 to ensure consistent technical specification requirements throughout the industry and asked the industry for their plans (including schedule) for adopting TSTF-510.

- Regarding divider plate cracking, the NRC staff clarified that it was their understanding that all of the 900 MW units with original steam generators, and whose replacement has not been scheduled to date, had been inspected in France (i.e., some 900 MW units with replacement steam generators may not have inspected their divider plates, but will have to inspect those containing Alloy 600).

- Not all of the cracks detected in the divider plates in France have been re-sized using the newly qualified technique. As a result, some of the flaws may be greater than 2 millimeters deep.

- The NRC staff expressed concern regarding the robustness of the finite element analysis used in assessing cracking in the divider plate. Although the finite element models may be useful in developing a better understanding of the divider plate cracking issue, the NRC staff expressed concern regarding the level of knowledge associated with the as-built configuration of the steam generators and whether the industry models could appropriately bound the potential variability which may exist in the fleet (given that detailed records of all repairs and fit-up issues may not have been documented). The staff also indicated that consideration should be given to benchmarking any industry models to the known experience in the field (e.g., reliably predict the findings in France and other countries, as appropriate). Given the potential limitations associated with modeling the divider plates, the NRC staff encouraged the industry to jointly pursue the development of an inspection technique for the divider plate.

- The U.S. industry does not have access to all of the technical details associated with the divider plate cracking observed in France (e.g., the material properties associated with the divider plate assembly and the vendor that supplied the materials).

- The staff encouraged the industry to develop realistic mock-ups of the tube-to-tubesheet weld that would reflect the variability in material compositions of the tube, cladding, and the carbon steel tubesheet to ensure that the minimum chromium concentration that may exist in the weld is determined (note: this assumes all welds were autogenous).

- Regarding the preservice inspection of steam generator tubes, the NRC staff indicated that it wanted to ensure that the preservice inspection requirements for steam generators in both currently operating and new units were adequately addressed in the American Society of Mechanical Engineers (ASME) Code given the current references in Section III of the ASME Code (which would be applicable to newly constructed units). The industry indicated that it was recommending closure to ASME tracking number BC-1340 (which addresses this issue) and that it would track this issue under BC 10-129 which is a tracking number for making generic changes to all the steam generator tube inspection requirements in the ASME Code. The industry also indicated it would bring this issue up at a joint ASME task group looking at similar issues for other components. Given the amount of time to change the ASME Code, the NRC staff indicated it was considering adding a provision to a recently started rulemaking activity for modifying 50.55a to clarify the staff's expectations regarding steam generator preservice inspections until such time the ASME Code could be modified (and the NRC could review and endorse this modification). The industry encouraged the staff to consider the wording in their examination guidelines considering the performance of the preservice

inspection which indicates, in part, that full-length bobbin coil examination of 100% of the tubing in each steam generator shall be performed.

- The NRC staff thanked the industry for conducting a workshop on automatic analysis of steam generator tube eddy current data. Based on this workshop, the NRC provided the industry with some written comments for their consideration in establishing/revising guidance associated with the automatic analysis of steam generator tube eddy current data. These written comments are attached as an enclosure to this summary.

- Regarding the qualification of an inspection technique for outside diameter stress corrosion cracking in the U-bend region of low row tubes, the NRC staff asked the industry if it could provide the eddy current and destructive examination data for these tubes for use in its on-going research program. The industry asked for clarification on which data the NRC was interested in (data from the X-probe, I-probe, and/or +Point coil), and wanted to confirm that the actual data would not be released.

- The industry indicated that it was currently preparing a non-proprietary version of their secondary water chemistry guidelines for transmittal to the NRC.

- Regarding the sharing of operating experience, the NRC staff indicated it was open to process changes and that it recognized the importance of the industry to be able to freely share operating experience amongst themselves.

- The industry indicated that primary side fouling of steam generator tubes is not an issue in the United States. The SGTF will inform industry personnel involved in license renewal, while the NRC staff will inform the NRC license renewal staff.

- The NRC staff indicated that the welded plug collapse at Flamanville was associated with a hole that had been mis-drilled during steam generator tubesheet fabrication. The welded plug on the primary side was fabricated from thermally treated Alloy 600 material. The hole had a sleeve installed in it and this sleeve had a plug installed on the top (secondary side) of the sleeve. Following the meeting, the staff was informed that the sleeve and primary side plug were not associated with one another (i.e., the sleeve was installed above where the plug was located). In addition, the welded plug on the primary side was hollow in the middle (therefore, it could collapse). The staff indicated that this appears to be an issue associated with cracking of Alloy 600. The staff inquired whether any Alloy 600 steam generator tube plugs were still in service. A couple of the participants indicated that they have Alloy 600 plugs in their steam generators and that they inspect/monitor these plugs when the primary side of the steam generator is opened for tube inspections. The staff asked whether the use of Alloy 600 plugs is limited to the few plants with mill annealed Alloy 600 steam generator tubes or whether it was more prevalent.

- The NRC staff indicated that the French have been verifying the positions of their anti-vibration bars in all of their units regardless of the materials of construction of the tube support plates and whether the tubes are dented. This action was in response to their operating experience. At one unit in France, a fatigue failure occurred in a tube that was not dented, there were no excessive deposits, and there was no chimney region in the center of the steam generator. This operating experience potentially questions the adequacy of the actions stemming from Bulletin 88-02 (which was focused on a specific steam generator design with carbon steel tube support plates and dented tubes). The staff indicating that it asked a few units (as part of the NRC inspection program) whether they verified the positions of their anti-vibration bars as a result of operating experience communicated by the industry and the NRC in a couple of information notices. All of the utilities had not confirmed the position of their anti-vibration bars. The NRC staff indicated in the meeting that it was evaluating whether any additional regulatory actions are needed to address this issue.

Project No.: 689

Enclosures:
1. Attendance List
2. NRC Feedback on the Auto-Analysis Workshop

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ADAMS ACCESSION No.: ML110670317

OFFICE	NRR/DCI/CSGB	NRR/DCI	NRR/DCI/CSGB
NAME	AJohnson	KKarwoski	RTaylor
DATE	03/14/2011	03/14/2011	03/15/2011

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Attendance List
February 18, 2011, Meeting with the NEI SGTF and Industry

SGTF/Industry
Helen Cothron, EPRI
Greg Kammerdeiner, FENOC
Scott A. Redner, XCEL
Jim Riley, NEI
Herm Lagally, Westinghouse
Anthony Martin, SNC
Dan Mayes, Duke Energy
Steven Brown, Entergy
Steve Swilley, EPRI
Chris Cassino, Westinghouse
Russell Lieder, Next Era Energy
Jesse Baron, Westinghouse
Roy McGillivray, B&W
Jim Benson, EPRI
Jay Smith, Exelon

Phone Participants
Gary L. Boyers, FPL
Brian Mann, TSTF
Viki Armentrout, Dominion
John Arhar, PG&E
Jeff Fleck, AREVA

NRC
Allen Hiser
Robert Taylor
Ken Karwoski
Emmett Murphy
Greg Makar
Charles Harris
Andrew Johnson
Jason Dykert
Rachel Vaucher

ENCLOSURE 1

Feedback on Automatic Analysis of Steam Generator Tube Eddy Current Data

Minimum false call rate: In establishing the values for the essential variables for an eddy current data analysis algorithm, there is a tradeoff between probability of detection and the false call rate. A higher probability of detection typically results in a higher false call rate. In the generic qualification of an auto analysis algorithm, it would have achieved a certain probability of detection and a certain false call rate. When using this generically qualified algorithm at a specific plant, many of the values for the essential variables may be modified to ensure acceptable site specific performance. It is feasible that the values selected for the essential variables could result in passing the site specific performance demonstration with a much lower false call rate than what was experienced in the generic qualification. This raises the question on whether the algorithm will continue to perform at the "required" probability of detection level when subjected to a much more robust sample of tubes than what would be in a site specific demonstration. This raises the question on whether there should be some minimum false call rate established to ensure the algorithm's probability of detection is not adversely affected (e.g., in the generic and site specific Examination Technique Specification Sheet).

Independence of algorithms: Many of the current and future auto analysis algorithms are (or will be) the result of work sponsored by the Electric Power Research Institute (EPRI) at Michigan State University. This raises the question on whether auto analysis software packages developed by two different vendors will ever truly be independent. How is this issue going to be addressed? What constitutes independence?

Auto Analysis systems only do what they are programmed to do: Despite the results of a degradation assessment, human analysts will identify flaws or off-normal conditions (e.g., the detection of cracks at Seabrook). On the other hand, an auto analysis software system will only identify the types of flaws that it is programmed to detect. As a result, an auto analysis software system only "tuned" to look for wear at structures could miss the onset of new degradation mechanisms. Shouldn't auto analysis software systems be programmed to screen for all types of flaws despite the conclusions of a degradation assessment? Do the guidelines require this?

Detection of non-flaw like signals: Human analysts also identify non-flaw like signals such as manufacturing burnishing marks, dents, dings, and permeability that may affect the quality of inspection by various probe types. Should the auto analysis algorithms also have to demonstrate that it will detect these locations to ensure the proper probes are used to inspect these locations (e.g., identify dents greater than 5 volts to ensure a rotating probe is used to inspect that location, identifying "large" permeability variations to ensure a magnetically biased probe is used)? In addition, identification of potential loose part signals (with no associated wear) has also been an important element of a steam generator tube integrity program. Should the auto analysis algorithms also have to demonstrate that it will reliably detect potential loose parts?

Assessment of "single pass" analysis: There are many ways to compare the results of an auto analysis algorithm with the results of the traditional dual analysis system. Should a standardized method for assessing the results be developed which would include looking at missed calls, false calls, and the severity of these missed/false calls?

Adoption of New Technology: One gains a certain amount of confidence when comparing the results of an auto analysis algorithm to the results of the traditional dual analysis system.

As a result, it raises the question on what needs to be performed when new inspection technology is used for the first time in inspections where single pass auto analysis algorithms are used (e.g., when moving from a bobbin/rotating probe inspection scheme to an array only inspection scheme).

History Comparisons: There is a lot of information that can be gained when comparing current outage data to previous outage data. Ideally, it would be beneficial to compare the actual eddy current data rather than just the reported results. In addition, it would be beneficial to compare the current outage data with the baseline inspection data (to identify slowly developing signals). Should there be guidance "requiring" these comparisons especially when moving to a single-pass auto analysis system?

Algorithm continues to perform throughout analysis process: Calibration checks are periodically performed to ensure equipment continues to perform, as desired. Given the complexity of an auto analysis system which could suffer from hardware or software issues that may not be detected, should there be some guidance on periodically assessing the performance of an auto analysis algorithm to ensure it is performing as desired (e.g., Judas tube, process channel checker).

Qualification Criteria of Operator of Single Pass System: Auto analysis algorithms including a single pass auto analysis system requires special operators. Should special qualification requirements be in place for such operators?

Missed Landmark: Should there be specific guidance on what is to be done if landmark is missing? Should there be guidance requiring assessing whether a group of tubes consistently have landmark locations consistently at one end of the landmark band potentially indicating a support has shifted (e.g., one column of tubes has landmark location consistently at low end of band potentially indicating an anti-vibration bar has shifted).

Landmark Detection Requirements: Landmark detection is necessary for ensuring the proper performance of the algorithms in an auto analysis software package. Should the guidelines require the software packages to appropriately identify the landmarks in the various steam generator designs?

Performance Requirements for Single Pass System: The dual analysis review process was intended to ensure a higher probability of detection than a single analyst system. If a single pass system is implemented, should the performance requirements be more restrictive than the current requirements? That is, shouldn't the performance of a single pass system bound that of a dual pass system?

Low level signals: An algorithm will only flag signals if it meets pre-defined criteria. New degradation may have signals that do not trip these pre-defined criteria for one or multiple cycles. To detect the onset of new degradation, should implementation of a single pass system require the review of some of the signals that are close to the pre-defined criteria to ensure that all signals of interest are being promptly detected (particularly for certain types of degradation mechanisms like axial indications in the free span)? In addition, should single pass systems include internal diagnostic tools that flags the operator that a potential new degradation

mechanism may be occurring which is near the detection threshold (e.g., long axial flaws in the freespan)?

Change in Signal Characteristics: A variety of sorts/algorithms may be applied at a specific location to look for a specific form of degradation. During qualification, one of the sorts/algorithms may be the primary sort/algorithm that identifies a specific form of degradation. If during application of the system, a different sort/algorithm becomes the “primary” detection sort, it potentially raises questions on the performance of the system. Should criteria be established that monitors how flaws are being detected and for identifying when a corrective action (for ensuring adequate detection by the auto analysis algorithm) should be taken?

EPRI Process Changes: The current process for performing eddy current data analysis has been very effective at ensuring tube integrity. It would be beneficial to the staff if the industry would continue to keep us informed of planned changes to this process prior to implementation of this new process.