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To: Steam Generator Management Program Utility Steering Committees
PMMP Steering Committee
Senior Representatives
Technical Advisory Group (TAG)

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Subject: Steam Generator Management Program (SGMP) Information Letter Concerning Lessons Learned from a Review of Recent Steam Generator Related Issues

References:
1. Letter, David Modeen to NEI Administrative Points of Contact, Approval of Formal Industry Position on NEI 97-06, Rev. 0, *Steam Generator Program Guidelines*, December 16, 1997
2. EPRI Final Report, TR-107621-R1, *Steam Generator Integrity Assessment Guidelines*: Revision 1, March 2000
3. EPRI Final Report, TR-104030, *PWSCC Prediction Guidelines, July 1994*
4. EPRI Final Report, TR-107620-R1, *Steam Generator In Situ Pressure Test Guidelines*, June 1999
5. EPRI Final Report, TR-107569-V1R5, *PWR Steam Generator Examination Guidelines: Revision 5*, September 1997

Introduction

The purpose of this letter is to provide you with timely steam generator information to consider when planning your plant's steam generator inspection, condition monitoring, and operational assessment (see Reference 1). The information presented below was developed under the auspices of the SGMP IIG and its supporting subcommittees from a review of steam generator issues related to the recent event at Indian Point 2, the integrity assessment performed at ANO 2, and the "Summary of 1999 INPO Steam Generator Review Visit Recommendations." Generally, the intent of the review was to identify if there exists a need to modify or at least clarify aspects of industry guidelines referenced in NEI 97-06. Additionally, this review attempted to identify whether broader issues exist beyond those specifically associated with the formal guidance now offered by NEI 97-06 and its referenced documents. It is not this letter's purpose to detail formal, specific changes (e.g., added emphasis, further clarification, provide additional information, etc.) to NEI 97-06 or its referenced guidelines. Such alterations must be developed through the defined protocol established for these documents. Appropriate changes to these documents, if needed, will be made by the applicable NEI and SGMP guideline committees after review of the items presented in this letter. This letter will be reviewed by the applicable committees, and areas where work is required to develop appropriate guidance will be identified and the work scheduled by year-end.

Discussion

Steam generators with degraded tubing present a particularly challenging problem of inspection, condition monitoring, and operational assessment. It is for this reason that industry imposed upon itself, in December 1997, the requirements of NEI 97-06 and its referenced guideline documents. Upon review of these requirements and supporting guidelines, it is concluded that a number of items need to be re-emphasized or further defined and explained. General areas identified from this review include issues associated with degradation assessment/operational assessment/condition monitoring, data quality, probability of detection (POD), in situ pressure testing of tubes, risk analysis, and steam generator program ownership and implementation. Specifics associated with these areas are presented below.

1. Degradation Assessment/Operational Assessment/Condition Monitoring

It is imperative that before a plant outage, the guidance presented in Chapter 3, *Degradation Assessment*, of Reference 2, be fully implemented.

In general, prior to the inspection of steam generators, all required preparatory actions – such as degradation assessment, site-specific performance demonstration for current degradation forms, site technique qualification, set-up of an analyst performance tracking system, review and implementation of current EPRI Examination Technique Specification Sheets (ETSS), and use of proper calibration standards – should be completed. In addition, the following items are emphasized:

a. The degradation assessment must be current with appropriate and accurate incorporation of industry experience associated with the types of degradation that can be expected and their associated growth rates. Arbitrary assumptions on growth rate, intended to substitute for lack of data, may prove inaccurate and non-conservative and must be avoided. Additionally, consideration should be given to potential initiators or accelerators of degradation, such as induced stresses from tube support denting, to accurately anticipate degradation.

b. Degradation growth rate determination should be done using industry-recommended techniques. It is imperative that industry data be reviewed and incorporated where applicable into the development of site-specific growth rate values. The SGMP's Steam Generator Degradation Database can be interrogated to identify plants exhibiting similar degradation forms. These plants should be contacted to obtain growth rate data for these forms of degradation. Additionally, growth rate data for specific degradation forms can be developed or obtained from EPRI reports such as Reference 3.

c. When a new type of degradation is discovered, an operational assessment must be performed using best available, industrywide data. If such data are incomplete, then reasonable, conservative, and technically supportable assumptions must be used in the analysis to allow safe and reliable operation of the plant in its next cycle.

d. Discovery of new degradation of significant extent within a given tube must be screened according to the criteria listed in Reference 4 and appropriate action taken. As indicated in Section 4.3 of this reference, *Additional Screening Considerations,* even if the subject degradation passes the screening criteria, but is considered to be a defect with unusual characteristics, consideration should be given to in situ pressure testing the affected tube.

2. Data Quality

a. Site steam generator examination guidelines should define data quality requirements in measurable terms, such as noise level. An appropriate definition that must be met to ensure detection of degradation at the required level should be developed prior to the inspection. Use of certain types of supplemental inspection techniques may reduce noise, enhance data quality, and exhibit better detection characteristics for a specific degradation mode. If acceptable data quality cannot be obtained for a given tube, the tube should be repaired or removed from service. Successful implementation of a supplemental inspection technique occurred at IP2 this year in their use of the high frequency probe for PWSCC degradation detection. This probe exhibited less sensitivity to noise from external tube deposits and was better able to detect inner diameter initiated tube flaws.

b. Steam generator site-specific examination guidelines should emphasize to the inspection analysts, including the resolution analyst, the potential significance of abnormal signals. Additionally, discovery of such abnormal signals during inspection should be communicated to the person responsible for steam generator integrity assessment.

c. It is emphasized that chosen NDE techniques should be site qualified so that plant conditions and their effect on detection and/or sizing are accurately quantified and accounted for in analysis intended to support satisfaction of NEI 97-06 requirements. For example, if plant conditions are such that acceptance criteria on signal/noise (S/N) cannot be met for a particular inspection device, appropriate adjustment to detection and sizing parameters must be made. The industry is in the process of defining an action plan for developing guidelines for

use in making this adjustment. Interim guidance on adjustments to applicable inspection parameters is expected by March 2001. Additionally, if needed, technical support should be solicited from the EPRI NDE Center.

3. Probability of Detection

a. Prior to an outage, steam generator conditions should be checked against the "NDE technique performance database" developed under Appendix H (see Reference 5). This database presents, for each NDE technique, an Examination Technique Specification Sheet (ETSS) that lists a technique's essential variables and assumptions. The performance database also includes raw eddy current data that can be analyzed to conduct probe comparisons of signal interference such as tube-induced eddy current noise. Steam generator conditions should be checked against this information to ensure that variables like probability of detection and measurement uncertainty are not unacceptably altered by significantly different conditions. If these conditions result in unacceptable values for variables important to "tube integrity assessment" analysis, use of alternative inspection techniques or appropriate adjustments to the subject variable (e.g., POD) and/or integrity analysis become necessary. The industry is continuing to develop appropriate guidelines for how these adjustments are made. Further guidance on this subject will be provided in the next revision (i.e., Revision 6) of Reference 5. In the interim, conservative engineering judgment and appropriate technical justification for applied adjustments should be incorporated in the integrity assessment. Additionally, confirmation of conformance to Appendix H essential variables and assumptions should be performed during the inspection. It is recommended that utility personnel contact the EPRI NDE Center for help, if needed, in the areas of POD adjustment and essential variable confirmation.

b. It must be noted that POD is a function of both technique and analyst performance uncertainty. Technique and analyst data for defining system POD performance are provided in the EPRI database. Guidance for development of this system POD is provided in Section 4.3 of Reference 2. However, because of recent questions received on this topic, industry will review and, if necessary, further develop these guidelines. In the interim, technical support should be solicited from SGMP personnel at the EPRI NDE Center and in Palo Alto.

4. In Situ Pressure Testing of Tubes

a. It is noted that selection of qualified NDE techniques for steam generator inspection is guided by the requirement to satisfy the performance criteria of NEI 97-06 as discussed in Reference 2. This requirement may need to be extended

further when in situ pressure testing of tubes is required. In situations of relatively difficult flaw evaluation with large uncertainty, it is recommended that supplemental NDE techniques and specialized data review be used to provide an improved, overall characterization of suspected flaws in tubes identified for in situ pressure testing. Some guidance in this regard is provided in Section 5.1 of Reference 4.

b. If in situ burst pressure testing of a given tube results in leakage to the extent that pump capacity is exceeded, an appropriate bladder should be located at the flaw and the tube re-tested as discussed in Reference 4.

c. Several issues regarding Reference 4 developed during the inspection and evaluation of steam generators at one plant. These issues involved the correct use of in situ pressure test results in bounding-type integrity analysis and application of an appropriate temperature correction in determining in situ test pressure. These issues were submitted to the NEI Review Board, which clarified the applicable guidance provided in Reference 4. It is emphasized that if there is a problem in interpreting NEI 97-06 or its referenced documents, the NEI Review Board should be consulted about the issue in an expeditious manner. This is especially true if the issue is associated with References 2 and 4 because of the potential for errors or misinterpretations having a significant impact on condition monitoring and operational assessment. Additionally, it is recommended that utilities periodically review the information available on the NEI Web site dealing with resolution of NEI 97-06 issues offered by the NEI Review Board. This review will help ensure that the best and latest industry guidance is being factored into steam generator inspections and tube integrity analysis.

5. Risk Analysis

a. If the performance criteria of NEI 97-06 cannot be satisfied or adequately evaluated when performing an operational assessment for a given plant operating time, risk analysis may be another way to support the operational assessment. However, it must be recognized there presently are limitations regarding the capability of available risk analysis and associated methodology. At present, industry has not provided sufficient and/or complete guidelines to follow for this type of analysis, although at least one plant has successfully used risk analysis (with NRC approval) to support extended steam generator operation with reduced tube structural integrity margin. One other plant does not appear to have been completely successful in using risk analysis to justify extended operation with reduced tube structural integrity margin. Preliminary risk analysis performed to date by the SGMP for industry has only been developed in support of alternate repair criteria that meet the performance criteria of NEI 97-06. This subject will be reviewed by the appropriate SGMP committee to identify further work in this area for 2001.

6. Steam Generator Program Ownership and Implementation

a. It is recommended that plants should have accessible personnel, knowledgeable in NDE and structural mechanics, who can integrate inspection results associated with unusual conditions and assess their implications for tube integrity. Poor quality data must be efficiently identified, rejected, and alternative inspection techniques identified and used to obtain good data for degradation detection and integrity assessment. It is recommended that a Level III inspection analyst work closely with these personnel.

a. Strong utility technical oversight must be instituted in the areas of tube integrity assessment and in-service inspection if vendors are used to implement these elements of the utility's steam generator program. This recommendation is made because of the importance of the program in establishing safe and reliable operation of the plant's steam generators. It is recommended that the utility be actively involved in establishing the program, implementing its requirements, and carrying out its procedures where appropriate.

c. Utility management must recognize that it is their prime responsibility to provide sufficient resources and support to personnel implementing a plant's steam generator program so that the referenced guidelines in NEI 97-06 are appropriately implemented and associated requirements met.

Finally, a general comment is noted. During resolution of plant issues, questionable tube burst test data were generated. Test results suggested that tube burst pressure was a function of the pressurization rate. Because of potential ramifications these data may have on generic industry tube burst correlations used in alternate repair criteria, industry initiated a pro-active investigation to resolve this issue with the NRC. This investigation is presently in progress. An interim recommendation for changes to Reference 4 will be provided by September 30, 2000. This issue clearly highlights the continuing need for utilities to review their actions in support of their steam generator integrity assessment to identify, in a timely manner, any issues that may generically impact industry. This will allow the SGMP to address these issues in an expeditious manner for industry and the NRC.

Conclusion

Based on this review, it is concluded that all of the areas noted in the above bullets are addressed to varying degrees in the guideline documents referenced in NEI 97-06.

During development of NEI 97-06, it was recognized by its authors that the referenced guidelines allow for flexibility within each site-specific steam generator program so that improvements in techniques and methodologies for managing steam generator degradation

can be realized and formal guidance enhanced. In this context, it does appear that certain areas of these documents can be improved or strengthened with further emphasis as to their importance (e.g., site-specific inspection technique qualification). In certain cases, the addition of more detailed information on how to implement a given recommendation or requirement – such as, a data quality specification and a methodology for its implementation, a POD defined from uncertainties associated with technique and analyst performance, and changes to proof test pressurization rates – is also appropriate. Industry is presently working on these issues and specific guidance will be provided as it is developed and approved.

As noted earlier, Revision 6 to Reference 5, which will offer guidance on some of these issues, is expected to be issued in March 2001. In the interim, technical support should be solicited from the EPRI NDE Center. Additionally, interim guidance on adjustments to a POD and development of a system-related POD is expected by March 2001.

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