

## Attachment C

### Review of EPRI SGMP Responses to NRC RIS 2000-22 and NRC Lessons Learned Report

#### Issue 1 from RIS 2000-22:

Consideration of relevant operating experience and appropriate diagnostic, corrective, or compensatory measures to ensure tube integrity.

#### Issue 2 from RIS 2000-22:

Assessment of the root causes of all degradation mechanisms at a plant and appropriate diagnostic, corrective, or compensatory measures to ensure tube integrity.

#### Industry Response (Summary):

Adequate industry guidance has been issued to address these issues.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

#### Staff Evaluation:

The EPRI tube integrity assessment guidelines, Section 3 and Appendices A and B, currently only provide general guidance pertaining to these issues. The SGMP Information Letter dated September 27, 2000 contains useful information which should be incorporated into the guidelines, but again is still very general. The guidance is not of sufficient detail to enable the user to anticipate or recognize the many types of degradation mechanisms or developing failure mechanism precursors such as those at Indian Point 2 prior to the 2000 failure event.

The tube failure events at Ginna in 1982 and at Indian Point 2 in 2000 could have been prevented had there been a better understanding of the root causes associated with previously observed degradation.

EPRI and other industry and NRC publications do provide useful information on these issues as is noted in the guidelines. The staff believes that the industry should consider development of detailed guidelines for performing degradation assessments which pulls this information together.

In summary, the staff believes that more detailed industry guidance is needed relative to these issues and, therefore, these issues remain open. Such guidance would be expected to further enhance the effectiveness of utility programs to ensure tube integrity. These issues do not pose a significant safety concern, given current regulatory requirements and current industry practices for ensuring SG tube integrity. The staff considers these issues to be medium priority. These issues are not expected to impact the staff's review of the NEI SG generic change package.

Review of EPRI SGMP Responses to NRC RIS 2000-22

## and NRC Lessons Learned Report

### Issue LL 2e and 2f from Lessons Learned Report:

Industry should update the EPRI SG Examination Guidelines to incorporate guidance on how to evaluate flow slots for hour-glassing and the impact of hour-glassing on PWSCC in low row u-bends.

### Industry Response (Summary):

Existing industry guidance is adequate. Although guidance does not exist which explicitly addresses hour-glassing, the tube integrity assessment guidelines require a degradation assessment, which includes identifying previously identified and potential degradation forms that affect the tubing, support structures, pressure and leak boundaries. Such a degradation assessment would identify the conditions necessary to cause hour-glassing. A detailed explanation of steam generator tube denting, tube support plate cracking, flow slot hour-glassing, and inner radius u-bend PWSCC is available in the EPRI Steam Generator Reference Book TR-103824, Section 8.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

### Staff Evaluation:

The staff believes the industry guidelines for degradation assessment are too general to ensure that licensees will recognize or anticipate conditions such as the hour-glassing condition which led to the tube failure event at Indian Point 2. The licensee's mantra was that it was fully following applicable guidelines both before and after the failure event. However, subsequent to the event, the licensee learned of hour-glassing at the top-most support only after being urged by NRC to use a measuring implement rather than simply relying on visual observations with a remote camera.

More detailed guidance is needed to ensure that all potential degradation mechanisms are considered in the degradation assessment and that potential precursor conditions are recognized. For example, guidance is needed with respect to implications of denting, denting thresholds at which hour-glassing poses a potential concern, and methods for detecting hour-glassing at the top-most support.

The staff acknowledges that EPRI and other industry and NRC publications do provide useful information on these issues as is noted in the guidelines. The staff believes that the industry should consider development of detailed guidelines for performing degradation assessments which pulls this information together.

In summary, the staff believes that more detailed industry guidance is needed relative to this issue and, therefore, this issue remains open. Such guidance would be expected to further enhance the effectiveness of utility programs to ensure tube integrity. This issue does not pose an immediate or significant safety concern in-of-itself, given the heightened awareness of licensees to NDE data quality issues (another important causal factor related to the Indian Point event) and current industry efforts to update the

guidelines to incorporate data quality criteria. The staff considers this issue to be medium priority. This issue is not expected to impact the staff's review of the NEI SG generic change package.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2I from Lessons Learned Report:

When a new type of steam generator tube degradation occurs for the first time, licensees should determine the implications on steam generator condition monitoring and operational assessments (e.g., potential for the tube to rupture before the leaking such as at the apex of a small radius u-bend).

Industry Response (Summary):

The industry has developed new guidance relative to this issue. For newly active degradation modes that were not considered to be potential degradation mechanisms in the degradation assessment, the licensee should enter the issue in their corrective action program at a significance level that requires a root cause analysis to be performed. Additional general guidance to this effect is provided. Degradation that was expected but not previously active that was addressed in the plant specific degradation assessment and inspection plan does not need to be entered into the plant corrective action program.

No immediate industry actions are necessary.

Future action to be tracked by SGMP: SGMP will issue an industry letter providing the above guidance by August 31, 2001.

Staff Evaluation:

U-bend PWSCC was an expected degradation mechanism at Indian Point 2. However, u-bend PWSCC driven by stress induced by flow slot hourglassing was not anticipated at Indian Point 2. The licensee assumed incorrectly that the u-bend PWSCC found in 1997 was the expected form of PWSCC. Thus, this finding would not likely have entered the corrective action program under the industry's new guidance. Issues 1 and 2 from RIS 2000-22 capture the Indian Point situation.

The new industry guideline is clearly worthwhile and on this basis the staff concludes that issue LL 2I is closed.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue 3 of RIS 2000-22:

Data quality depends on the degree to which the eddy current signal from a flaw can be masked or distorted by signals from sources other than the flaw. Data quality directly affects the ability to detect and size flaws. The signals from sources other than the flaw are often called "noise". The amplitude of the noise signal and signal-to-noise ratio are important measures of data quality.

Issue LL 2a from Lessons Learned Report:

The industry should update the EPRI PWR SG Examination Guidelines to incorporate data quality criteria. Guidelines should explicitly discuss how to identify excessive noise in the data, how to identify the source of the noise, and what to do about the noise after the source is identified.

Industry Response:

Specific and detailed requirements for data quality parameters are in preparation for inclusion in Revision 6 of the examination guidelines.

No immediate industry actions are necessary.

Future actions to be tracked by SGMP: Issue Revision 6 of the PWR Steam Generator Examination Guidelines by January 2002.

Staff Evaluation:

Draft guidelines for inclusion into Revision 6 of the EPRI examination guidelines are under staff review. The staff considers this to be an open and high priority issue since poor data quality can significantly degrade the effectiveness of inservice inspection, condition monitoring, and operational assessment. This issue does not pose an immediate safety concern. Based on staff discussions with a number of licensees, the high noise levels seen at Indian Point 2 are not typically seen elsewhere in the industry. The SGMP has alerted the industry to the issue and provided general guidance in its information letter dated September 29, 2000. In addition, feedback from licensees during outage phone calls indicates they are aware of the industry and taking steps to ensure adequate data quality. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2b of Lessons Learned Report:

Industry should consider the issue of noise in newer tubes in the revision to the EPRI SG Examination Guidelines.

Industry Response:

The EPRI SG examination guidelines provide that qualification data sets should be representative of those in the field in terms of noise and signal to noise.

The industry has developed guideline manufacturing specifications for Alloy 690 SG tubing, with minimum allowable S/N ratio of 15:1. Improvements in materials and manufacturing processes in recent years have typically produced tubes with S/N ratios of 30:1 for pilgered tubes and 50:1 for drawn tubes.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The industry is requested to provide additional information with respect to its response. These questions relate to tube noise (e.g., inner diameter surface irregularities), rather than noise not related to the tubing itself such as surface deposits or noise associated with electronics.

1. What is the range of plant average S/N ratios with Alloy 600 MA tubing? How much S/N variability among tubes at a plant is typically observed?
2. Same questions for Alloy 600 TT.
3. Same questions for Alloy 690 TT.
4. What is the range of the average S/N ratios for the tubes used for the various ETSS data sets
5. Are there plants where the average S/N ratio is less than the average S/N ratio for the ETSS qualification data sets? If so, are the affected utilities obliged to supplement the ETSS data set for their application? Are the guidelines specific on this point?

The staff acknowledges that the EPRI examination guidelines contain general guidelines concerning the need for qualification data sets to incorporate noise levels which are representative of those in the field. The above information will provide the staff with additional insight on the variability of tubing noise seen throughout the industry and how the industry is actually handling this issue under the guidelines.

The staff considers this to be an open, high priority issue with no immediate safety concerns. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2c of Lessons Learned Report:

The EPRI Guidelines should address noise minimization techniques such as filtering algorithms.

Industry Response:

The EPRI SG examination guidelines currently consider filtering algorithms as essential variables which must be demonstrated through the Appendix H technique qualification.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The staff concludes that the guidelines do address noise minimization techniques and, thus, this issue may be considered closed.



Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue 4 from RIS 2000-22:

Non-destructive examination (NDE) qualification programs that include tube samples representative of those in the field.

Industry Response:

The EPRI PWR SG Examination Guidelines adequately address this issue.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The staff acknowledges that the guidelines do address this issue. The staff also acknowledges the industry's intent to further strengthen the guidelines to this effect in Revision 6 of the guidelines.

The staff's long standing concern in this area is that a number of Appendix H qualification data sets did include EDM notches to simulate cracks; this despite the fact that the Appendix H guidelines have provided that the data set should be representative of real flaws. The industry was not implementing Appendix H consistent with the Appendix H guidelines.

The industry response states that the EPRI SGMP has been aware of this problem and has had an aggressive program to develop the know-how and to produce realistic cracks in various steam generator locations. U-bend EDM notch samples are currently being replaced with laboratory produced cracks; however, there remains a pending qualification for sleeves that still relies on EDM notches.

The staff concludes that the industry appears headed on a path to resolve this issue. The staff hopes to be able to consider this issue closed once revision 6 to the guidelines has been issued. In the meantime, the staff considers this to be an open, medium priority issue with no immediate safety concerns. This issue is not expected to impact the staff's review of the NEI generic change package.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue 5 from RIS 2000-22:

Site-specific qualifications of generically qualified techniques ensuring an application is consistent with site-specific conditions and that appropriate NDE performance capabilities are considered in operational assessments (e.g., POD of flaws and flaw size measurement error).

Issue LL 2d of Lessons Learned Report:

The licensees should review industry guidelines carefully to ensure that the conditions/assumptions supporting the guidelines apply to their plant-specific situation (for example, site-specific performance demonstrations for examination techniques).

Issue LL 2g of Lessons Learned Report:

Site validation of techniques should be used for each detection technique, focusing on the most challenging areas of degradation.

Industry Response:

Site-specific qualification of techniques and data analysts are addressed in Revision 5 of the EPRI PWR SG Examination Guidelines. The description and details of site-specific qualification will be further strengthened in the forthcoming Revision 6.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The staff concurs that Revision 5 of the guidelines addresses site-specific qualification of NDE techniques and data analysts. The 1997 SG inspection pre-dated revision 5 of the guidelines. These guidelines could have alerted the licensee that the generic Appendix H qualification of the mid-range plus point probe for u-bend inspection might not necessarily apply to the IP-2 u-bends by virtue of the relatively high noise levels at IP-2. However, it would not have guided the licensee to take actions which would have led to the detection of the flaw which subsequently failed in service.

The guidelines appropriately recommend that a supplemental, site-applicable performance demonstration (which may involve obtaining pulled tube specimens) be performed in cases where the generic qualification does not address site-specific conditions. However, in cases where site-applicability of a generically qualified technique cannot be established, revision 5 of the guidelines states that in situ pressure test results may be used to obtain supplemental data supporting tube integrity assessments. Following this guidance and the EPRI SG In Situ Pressure Test Guidelines likely would not have revealed that significant indications were not being detected by the mid range probe at IP-2 and, therefore, would not have averted the

subsequent tube failure event. In general, the staff believes that in situ pressure testing does not provide sufficient evidence in-of-itself that NDE detection capability is adequate to detect significant flaws under site-specific conditions.

The staff also notes that revision 5 of the examination guidelines, and other EPRI guideline documents (i.e., tube integrity assessment, in situ testing) need to provide improved guidance on the necessary attributes of a qualification or performance demonstration in order to quantify NDE detection and sizing performance for purposes of supporting tube integrity assessments. Specific comments in this regard are presented in the staff's paper entitled "Technical Issues/EPRI Guideline Documents."

In summary, revision 5 of the examination guidelines discusses key issues relating to determining the site applicability of generic NDE qualifications. The forthcoming revision 6 of the guidelines is expected to further enhance this guidance, particularly with respect to establishing whether site-specific noise conditions are within that considered in the generic qualification. However, future revisions to the guidelines need to better address the issues as to whether there are acceptable alternatives to the use of site-qualified NDE and, if so, what the alternatives are. In addition, improved guidance is needed to address the necessary attributes of a qualification or performance demonstration in order to quantify NDE detection and sizing performance for purposes of supporting tube integrity assessments.

The staff considers these issues to be open, high priority issues since they pertain to the effectiveness of tube integrity assessments. These issues may be relevant to technical bases for longer inspection intervals which may be proposed by industry in the future. These issues do not pose an immediate safety concern since tube integrity assessment is not a current regulatory requirement. Despite existing shortcomings in tube integrity assessments, tube integrity assessments extend beyond current regulatory requirements and have provided added assurance of SG tube integrity. Thus, these issues do not pose an immediate safety concern. Nor do these issues impact the staff's review of the NEI SG generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2n from Lessons Learned Report:

The data analyst's job is tedious and performed under severe time constraints, and thus prone to the possibility of missing indications. There are data screening computer programs that will enhance (not replace) the detection capability of the analysts in some situations.

Industry Response (Summary):

Adequate industry guidance has been issued to address this issue and includes guidance pertaining to computerized data analysis. As additional experience is gained with analysis algorithms, and with improvements in technology, the use of computer data analysis will increase. The industry guidance will be in time updated to take advantage of the gained experience and improvements in the technology.

There is also guidance on process controls such as the use of independent dual analysis teams with a separate discrepancy resolution team. The guidelines instruct licensees to establish policies on noise levels, music, and work hours. In addition, there is guidance for the licensee to designate an experience analyst, who is not part of the resolution team, to randomly sample the data to ensure that the resolution process was properly performed and that the field calls were properly reported. Each analyst is to receive feedback on missed calls.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

Existing guidelines address the staff's concerns in his area. The staff concludes this issue is closed.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue 7 from RIS 2000-22:

Rigorous analyses of the results of in situ pressure tests that are terminated when leakage exceeds the capacity of the test system.

Industry Response (Summary):

Adequate industry guidance has been issued to address this issue.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The industry response states that the staff's concern stems from termination of a pressure test at ANO-2 without determining whether the burst pressure was actually higher than the maximum pressure reached during the test. The staff's concern was actually different from this. The licensee did in fact perform an assessment to demonstrate that the burst pressure was both higher than the maximum pressure reached during the test and higher than the 3 delta p performance criterion. The staff's concern was that the licensee's assessment was not performed in a rigorous manner. Further, the staff concluded that the tube was actually at the point of incipient burst at the time the test was terminated.

The industry response takes issue with a statement in the RIS that the EPRI in situ test guidelines suggest that margin against burst can be verified by visual or eddy current examination. The industry states that the guidelines only intend that these examinations can be useful in determining if burst or pop-through has occurred. The staff notes that if this is actually the intent of the guidelines, then this should be stated in the guidelines. The staff's characterization of the guidelines is almost a verbatim quote. Section 7.1 of the guideline states:

"If leakage is observed at the proof pressure or prevents attainment of the proof pressure, and sealing bladders are not available due to location or tooling limitations, **structural margin against burst may be verified via visual or ECT examination** or by extrapolation of the leakage data."

The industry response notes that the SGMP interim guidelines on in situ testing, dated October 13, 2000, requires a minimum hold time of two minutes at 3 delta p to provide further assurance of flaw stability and verification that burst has not occurred. The staff believes this recommendation to be entirely appropriate. The difficulty is, however, that Section 7 provides guidance for alternative methods for verifying structural margin in cases of an incomplete pressure test (due to leakage). The staff's paper, "Technical Issues/EPRI Guideline Documents," (provided as a separate attachment) provides extensive comments on these guidelines. These comments expand on the discussion in

the RIS that the guidelines may lead to non-conservative assessments of incomplete test results in terms of burst margins associated with the flaw.

In summary, the staff believes that the EPRI in situ test guidelines may be non-conservative in some cases relative to this issue. The staff considers this to be an open and high priority issue since a non-conservative assessment can undermine the effectiveness of condition monitoring in identifying conditions adverse to quality in accordance with 10 CFR 50, Appendix B, Criterion 16. The staff plans to pursue this issue with industry and is considering having RES do some confirmatory testing with respect to the industry position. The staff does not consider this issue to be an immediate safety concern. The staff believes that it will likely be aware of any in situ pressure tests that are terminated prematurely such that it will have the opportunity to discuss with the licensee its findings relative to the test results. In addition, the NRC baseline inspection program is being revised to take note of such a situation should it arise, again allowing the staff to be aware of the basis for the licensee's dispositioning of the test results. The NEI SG generic change package is not expected to increase risk associated with this issue unless the licensee is planning to operate for a longer inspection interval than is currently permitted by the technical specifications. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue 9 from RIS 2000-22:

Use of a “fractional flaw” method or other similar methods for determining a beginning-of-cycle flaw distribution may lead to non-conservative results when used in conjunction with a POD parameter which varies as a function of flaw size or voltage.

Industry Response (Summary):

The fractional flaw approach is technically valid irrespective of whether a constant or variable POD assumption is employed

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

This is a complex issue as acknowledged by the industry in their response. The staff is reviewing the industry response and has not yet reached a conclusion regarding whether this issue is satisfactorily resolved. The staff considers this issue to still be open.

The staff considers this to be a high priority issue since the methodology is being used today for operational assessment. In addition, resolution of this issue is necessary since operational assessment will constitute an important element of the technical justification should licensees desire extended inspection intervals (relative to current technical specifications) for plants with active SG tube degradation. The NEI SG generic change package is not expected to increase risk associated with this issue unless the licensee is planning to operate for a longer inspection interval than is currently permitted by the technical specifications. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
and NRC Lessons Learned Report

Issue 10 from RIS 2000-22 and LL 2m from Lessons Learned Report:

Benchmarking operational assessment methodologies against actual operating experience to ensure realistic results.

Industry Response (Summary):

Adequate industry guidance has been issued to address this issue.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

Staff acknowledges industry's general guidance to this effect. However, this guidance is not of sufficient detail to guide users from repeating inappropriate benchmarking assessments performed in the past such as the example cited in the RIS.

The staff considers this issue to be open and relatively high priority since it is essential to ensuring the conservatism of the operational assessment. In addition, resolution of this issue is necessary since operational assessment will constitute an important element of the technical justification should licensees desire extended inspection intervals (relative to current technical specifications) for plants with active SG tube degradation. The NEI SG generic change package is not expected to increase risk associated with this issue unless the licensee is planning to operate for a longer inspection interval than is currently permitted by the technical specifications. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis.



Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2i from Lessons Learned Report:

Industry guidelines should caution licensees not to rely too heavily on assessments based on sizing techniques that are not qualified.

Industry Response (Summary):

Adequate industry guidance has been issued to address this issue.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

The industry response does not appear to be entirely consistent with the SGMP information letter dated September 29, 2000. This letter acknowledges outstanding issues pertaining to characterization of NDE performance and states that the industry is reviewing the need for additional guidance in this area. This acknowledgment is made in the context of a POD discussion, but the issues noted apply equally to NDE sizing performance.

The industry response states that some facts cited in the lessons learned report are incorrect; specifically, the maximum crack depth cited for R2C74 (<40%) and the assertion that the tube would not have been expected to leak during in situ pressure testing. (R2C74 at Indian Point 2 exhibited a u-bend indication and developed leakage during in situ testing at 4800 psi.) The industry response states that maximum depth measurement varied between 53 and 85% and would have exceeded the in situ leakage test screening criteria necessitating a leakage test. On the basis of information provided formally to the NRC staff to support ConEd's request to restart Indian Point 2, the staff believes that the cited information in the lessons learned report is correct. Table 3-5 and Figure C.1-11 of ConEd's CMOA report dated June 2, 2000 report show a maximum crack depth of 38% as determined at 400 KHz and 53% as determined at 800 KHz. ConEd and their contractor, Westinghouse, considered the 400 KHz depth measurements to be the most reliable and, thus, used these measurements in the reference CMOA assessment. However, even the 53% maximum depth measurement at 800 KHz is much less than the screening criteria necessitating a leakage test.

The industry response cites a number of guideline provisions for dealing with situations where sizing capability is not characterized. Detailed staff comments concerning these guidelines are contained in a separate attachment entitled "Technical Issues/EPRI Guideline Documents." In summary, the staff finds that the industry guidelines do not provide complete or consistent guidance on how to characterize sizing uncertainty. The staff believes that a site applicable performance demonstration of the NDE system is needed to establish sizing uncertainty. The white paper identifies key elements of such a performance demonstration. The white paper also comments on the industry

guidance concerning the actions to be taken when sizing uncertainty is not characterized.

The staff considers the need for improved guidance for characterizing NDE sizing uncertainty to be a high priority issue since adequate treatment of the uncertainties is essential to ensuring the conservatism of condition monitoring and operational assessments. In addition, this issue directly relates to the effectiveness of condition monitoring in identifying conditions adverse to quality in accordance with 10 CFR 50, Appendix B, Criterion 16. The staff plans to pursue this issue with industry, but does not consider this issue to be an immediate safety concern. The risk implications associated with this issue are limited by virtue of the periodic inspections required by the current technical specifications. The NEI SG generic change package is not expected to increase risk associated with this issue unless the licensee is planning to operate for a longer inspection interval than is currently permitted by the technical specifications. This issue should not impact the staff's review of the generic change package provided the staff can be assured that longer inspection intervals will not be implemented without an adequate technical basis. The staff considers this issue to still be open.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 2j from Lessons Learned Report:

Licenseses should consider the effect of the threshold of detection and sizing accuracy on the growth rate assumptions.

Industry Response (Summary):

Adequate industry guidance has been issued to address this issue.

No immediate industry actions are necessary.

No future action to be tracked by SGMP.

Staff Evaluation:

Sizing uncertainty can increase the uncertainty associated with apparent growth rates established from the NDE results. Treatment of these uncertainties tends to produce a more conservative operational assessment than would be the case if statistical techniques are used to extract sizing uncertainty from the apparent growth rate distribution to yield a "true" growth rate distribution. In this respect the EPRI SG Tube Integrity Assessment Guidelines are conservative.

The staff concurs that this issue is addressed in current guidelines. The staff considers this issue to be closed.

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Issue LL 3a from Lessons Learned Report:

PWR technical specifications (or the regulatory framework currently being developed via the industry initiative) should ensure the technical requirements are strengthened to reflect the current knowledge of the SG degradation mechanisms, examination techniques, and methodology.

Industry Response (Summary):

The industry has submitted the NEI SG Generic Change Package which includes proposed new technical specifics to replace existing technical specifications. The proposed technical specifications are performance based. Details of an SG program intended to ensure these performance criteria will be in the SG program located outside of technical specifications. The SG program will be developed consistent with guidelines in NEI 97-06 and sub-tier EPRI guideline documents. The guidelines are regularly evaluated against new knowledge and techniques and are revised as necessary. These revisions reflect current knowledge of SG degradation mechanisms, examination techniques, and methodologies.

No future action to be tracked by SGMP.

Staff Evaluation:

Existing technical specifications contain prescriptive requirements concerning inspection frequency, inspection sample sizes, repair limits, and repair methods. These requirements are out of date with respect to existing inspection technology and degradation mechanisms and are incomplete. These requirements do not, in-of-themselves, ensure that tube integrity is maintained.

The industry's proposed generic change package would replace the prescriptive requirements in current technical specifications with performance-based requirements. The revised technical specifications would require implementation of an SG program which ensures that performance criteria commensurate with tube integrity consistent with the plant licensing basis are maintained. The technical specifications would require that the condition of the tubing be periodically assessed relative to these performance criteria. This performance based approach is focused on the bottom line; namely ensuring tube integrity is maintained and thus is adaptable to changes in degradation mechanisms and technology. Details of the SG program would be defined outside of technical specifications in accordance with industry guidelines. Industry would be responsible for ensuring that the guidelines are kept up to date.

The NEI SG generic change package is currently being reviewed by the staff. As part of this review, the staff must make a finding that the change package provides reasonable assurance that tube integrity will be maintained. The staff's final safety evaluation approving the generic change package will constitute closure of this issue.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
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Issue LL 3b from Lessons Learned Report:

The industry should assess the adequacy of the technical specification regarding operational leakage limits.

Industry Response (Summary):

The industry is proposing to revise the current 500 gpd technical specification limit (measured at temperature) to 150 gpd (measured at room temperature) as part of the NEI SG Generic Change Package. Adjusting for water density at temperature, the revised limit is equivalent to 195 gpd at temperature. The EPRI guidelines provide for plant shutdown when leakage exceeds 75 gpd. The reduced leakage limit provides added assurance that should leakage occur, the plant will be shutdown before leakage occurs. As indicated by the NRC staff in NUREG 1477 (draft), no limit, no matter how small, will ensure that a tube rupture will not occur.

No future action to be tracked by SGMP.

Staff Evaluation:

Operating experience indicates that degraded SG tubes usually, but not always, exhibit leak before break behavior. There have been 188 unplanned or forced plant shutdowns in the U.S. since 1975 due to SG tube leakage. These unplanned shutdowns typically involve maximum leak rates ranging from 50 to 1000 gpd (0.035 to 0.7 gpm). Only eight of these shutdowns involved a tube rupture or failure event with leak rates exceeding 100 gpm. Effective leakage monitoring in conjunction with implementation of appropriate leakage limits has proven to be an effective approach for minimizing the incidence of tube failure and for providing added assurance of tube integrity. The industry proposal to reduce the technical specification LCO leakage limits and administrative leakage limits will further the effectiveness of these limits in preventing tube ruptures. However, these programs can never provide complete assurance against tube rupture even if the leakage limits are reduced to zero. This is evidenced by the fact that three of eight tube failures in the U.S. occurred without precursor leakage until moments before the event. Precursor leakage at IP-2 prior to the event was extremely low level and trending up very slowly, reaching a maximum value of only 3.4 gpd (per N-16) immediately prior to the event.

The staff is reviewing the industry proposal as part of its review of the NEI SG generic change package. No further action on this operational leakage limit issue is requested by the staff. The staff's final safety evaluation concerning the generic change package will constitute closure of this issue.

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Issue LL 4a from Lessons Learned Report:

The licensees should ensure that contractors supporting the SG examination perform in an acceptable manner. The industry initiative should provide reasonable assurance of contractor oversight by licensees.

Industry Response (Summary):

The next revision of NEI 97-06 will address this issue. In the meantime, the SGMP lessons learned letter dated September 29, 2000 provides guidance for utility oversight of vendor activities relating to tube integrity assessment and inspection. This guidance can be summarized as follows:

- a. Plants should have accessible personnel, knowledgeable in NDE and structural mechanics, who can integrate the inspection results associated with unusual conditions and assess their implications for tube integrity. A Level III inspection analyst should work closely with these personnel.
- b. Strong utility oversight must be instituted in areas of tube integrity assessment and inservice inspection if vendors are used to implement these areas of the utility's SG program. The utility should be actively involved in establishing the program, implementing its requirements, and carrying out its procedures where appropriate.
- c. Utility management has the prime responsibility for providing sufficient resources and support to personnel implementing the SG program.

No immediate industry actions necessary.

Future actions to be tracked by the SGMP: A revision to NEI 97-06 reflecting this guidance will be available by January 2002.

Staff Evaluation:

The SGMP lessons learned letter addresses this issue. Inclusion of this guidance in the next revision of NEI 97-06 will increase the visibility of this guidance and, thus, enhance its effectiveness. Although the guidance is very general, the staff believes it is on target. More detailed guidance would not be expected to add significantly to assurance of adequate contractor oversight. The key to ensuring adequate contractor oversight is management involvement and commitment to this effect by licensees.

The staff concludes that the industry appears headed on a path to resolve this issue. The staff hopes to be able to consider this issue closed once NEI 97-06 is revised appropriately. In the meantime, the staff considers this to be an open, low priority issue with no immediate safety concerns. This issue is not expected to impact the staff's review of the NEI generic change package.

Review of EPRI SGMP Responses to NRC RIS 2000-22  
and NRC Lessons Learned Report

Issue LL 4b from Lessons Learned Report:

In the near term, industry should ensure that lessons learned from the IP-2 experience are being used to ensure that effective SG tube integrity programs are being implemented by licensee implementation of IP-2 lessons learned.

Issue LL 4c from Lessons Learned Report:

In the longer term, industry should also use lessons learned from the IP-2 experience to strengthen the NEI 97-06 initiative. NEI should provide feedback to the NRC on the specific changes to planned to the 97-06 initiative based on the IP-2 experience, including a schedule for implementation of the changes.

Industry Response (Summary):

Industry has provided written responses to the NRC for each of the industry items identified in the NRC action plan, including the IP-2 lessons learned. These responses identify the guidelines that are impacted by each issue. A protocol is being developed for this process that will document the completion of each industry action item.

These issues relate to NEI 97-06 and the sub-tier EPRI guideline documents and to the implementation of these guidelines. As discussed in the industry responses to the action plan issues, the issues are adequately addressed in the most recent guideline revisions or the guidelines will be enhanced to address these issues in future revisions.

The industry initiative on NEI 97-06 requires that each licensee adopt the latest revision of the guidelines unless the licensee develops and documents a basis for deviating from the requirement. Therefore, once the guideline is revised, the revisions will have widespread implementation across the industry.

Revision 2 of NEI 97-06 will provide that NRC will be provided with copies of future revised EPRI guidelines.

The industry has also reviewed available information regarding recent experience from IP-2 and ANO-2. As a result, SGMP issued two letters to the industry which were also provided to the NRC. These included a September 29, 2000 letter concerning lessons learned from recent SG related issues and an October 13, 2000 letter with interim guidelines on in situ pressure testing.

For the past five years, the industry has conducted a steam generator review program that assesses the the adequacy of individual plant SG programs with respect to NEI 97-06 guidance and provides feedback to the plant on needed areas of improvement. This process has been invaluable in providing a means for plants to assess the adequacy of their programs. The results of the SG review visits are summarized annually and are available for utility review.

Immediate Industry Action: Issue the SG Action Plan Protocol.

Future Action to be Tracked by SGMP: Issue revision 2 of NEI 97-06 by January 2002.

Staff Evaluation:

Industry responses to the individual NRC action plan issues, including IP-2 lessons learned, have been reviewed and commented on by the NRC staff. The staff will have the opportunity to observe the licensees' implementation of these guidelines and documented deviations from these guidelines as part of the regional baseline inspection program.

The staff is reviewing the NEI SG generic change package. As part of this review, the staff must make a finding that the change package provides reasonable assurance that tube integrity will be maintained. The staff's final safety evaluation approving the generic change package will constitute closure of these issues (i.e., LL 4b and 4c).