Enclosure 3

NRC Staff Comments Pertaining to
EPRI PWR Steam Generator Examination Guidelines,
Revision 6 (draft dated May 8, 2002)

Section 3.3.1, First In-Service Examination of Tubes (All Alloys)

Revision 6 would only require use of bobbin probes even though the guidelines state there are degradation types and locations for which the bobbin is not qualified. It is the staff's position that, consistent with 10 CFR 50, Appendix B, Criterion IX, steam generator inspections should always be performed with techniques and personnel that are qualified for existing and potential degradation mechanisms and their associated locations. Revision 6 does call for a representative sample inspection of abnormal conditions (generally not flaw related) using "other techniques that provide for signal characterization." However, it does not require the use of probes and personnel which are qualified for the detection and sizing of all existing and potential degradation mechanisms and their associated locations.

Revision 5, Sections 5.2 and 6.2, does require the use of probes and personnel which are qualified for the detection and sizing of all existing and potential degradation mechanisms and their associated locations. The basis for backing off from this earlier guidance is not evident.

Section 3.3.10 and 3.3.15, Subsequent Examination of Alloy 800, 600TT, and 690TT Tubing

The two cycle limitation on inspection intervals for SGs with 600TT tubing and three cycle limitation for SGs with 690TT tubing, as proposed in earlier drafts of Revision 6, have been eliminated in the latest draft and replaced by a 48 EFPM limitation for 600TT SGs and 72 EFPM limitation for 690TT SGs. For plants with short fuel cycles, this would allow more than two cycle intervals for 600TT SGs and more than 3 cycles for 690 SGs. For such an approach to be technically defensible, it needs to be demonstrated that SCC growth is dominantly a linear function of time at temperature with little contribution from growth associated with heatup and cooldown cycles.

The latest draft of Revision 6 adds a new provision which states that if damage mechanisms not associated with cracking are active, then three points apply. The first point states that the examination periodicity requirements of Sections 3.3.5, 3.4, 3.5, and 3.6 apply for these damage mechanisms within the critical area. The staff recommends that the words "within the critical area" be deleted. These words imply that a critical area exists for each active mechanism, which may or may not be true. Section 3.3.5 already covers the topic of limiting inspections to a critical area if one exists. No additional discussion of critical areas is needed in this first point.

The second point states that the examination periodicity requirements of this section (i.e., 3.3.10 and 3.3.15) continue to apply at locations other than the critical area. The staff has several comments pertaining to this point. First, it assumes that the active degradation mechanisms affect critical areas. This may or may not be the case. Or, we may have a case where one active mechanism affects a critical area and another active mechanism which does not. This guideline needs to clearly lay out what's to be done if active mechanisms are not confined to a critical area or if some are and some aren't. Second, the staff believes that what

is actually intended by this second point is that inspection for non-active mechanisms would continue to be subject to the requirements of Sections 3.3.10 and 3.3.15.

The second point also raises other questions. Suppose only AVB wear has been determined to be active. During inspections intended to address AVB wear, would licensee's be allowed to limit their analysis of the bobbin data to the AVB intersections, or would they be required to analyze the bobbin data for the entire length of tubing over which data was collected? If so, and if axial cracking is detected at the tube support plate intersections, would licenses be required to expand their inspection for all potential SCC mechanisms and locations with appropriate probes? The staff believes that the license proposal on this second point needs to be beefed up to ensure that the intent of the guidelines is clear. Finally, the staff notes that technology is fast reaching the point, if it hasn't already, that array probes can be used to inspect for all degradation mechanisms at speeds comparable to a bobbin. This being the case, there is little if any additional burden associated with inspecting for all active and potential degradation mechanisms at each inspection.

The third point states that examination of the critical area may be returned to the examination periodicity requirements of this Section (i.e., Sections 3.3.10 and 3.3.15) when ..., or the operational assessment provides a basis for this return. The staff believes operational assessment option to be inappropriate since it is a performance based inspection interval. As discussed in detail in the staff's August 2, 2001 letter to NEI (Accession No. ML012200349), the staff believes that the EPRI steam generator integrity assessment guidelines are not adequate to support performance based inspection intervals.

Section 3.3.11 and 3.3.16, Subsequent Examination of Alloy 800, 600TT, and 690TT Sleeves

These sections need clarification. Sleeves are generally installed at several different inspection outages. Does the "first inservice examination" in the first sentence of these sections refer to the first examination of each sleeve, or does it refer to the first inservice examination of any sleeve of that design and/or material? This needs to be clarified. If these words are to apply to the first inservice inspection of any sleeve, it needs to be clarified whether "of any sleeve" means any sleeve of a given material (e.g., 600TT, 690TT) or any sleeve of a given material and given sleeve design.

In the second sentence, the words "of the sleeves for given material type (600TT or 690TT) and sleeve design" should be added at the end of the sentence. In the third sentence, the words "their steam generator" should be replaced with "each sleeve design and material type." In the fourth sentence, the words "steam generator" should be replaced with "sleeve designs and material types." The second bullet should be revised to say "no SG with [600TT/690TT] sleeves should operate more than [lessor of 2 cycles or 48 EFPM/3 cycles or 72 EFPM] without the sleeves being inspected."

The first sentence of second paragraph should be clarified as to whether "active damage mechanism" refers to tubes or sleeves. Also, the words "associated with cracking" should be deleted.

The staff suggests that the second to last paragraph is not written consistent with industry intentions. For example, if an ODSCC flaw is repaired by sleeving, the paragraph implies that

the entire repaired part of the tube should continue to be inspected consistent with parent tube requirements, irrespective of whether the repaired portion of the parent tube continues to be part of the pressure boundary or not. The staff notes that the repaired portion of the parent tube that remains part of the pressure boundary should be included as part of any inspection of the tube and any inspection of the sleeve.

Sections 3.3.12, 3.3.13, 3.3.18, Subsequent Examination of Plugs or Other Repairs

Staff comments for these sections are analogous to those for Sections 3.3.11 and 3.3.16.

Section 3.3.17, Subsequent Examination of Alloy 690TT Plugs

The latest version of Revision 6 deletes requirements for volumetric examination for alloy 690TT plug designs, even where such examinations are possible. There is no apparent explanation for why the NDE inspection philosophy for 690TT tubing should not apply equally to 690TT plugs. Inspection guidance should be similar to that in Section 3.3.12 for alloy 600TT plugs.

Section 3.4.1, Selection of Periodic Sample

Consistent with Revision 5, this section should state that the minimum 20% sampling requirement applies to all active tubes and sleeves, plugs, and other types of repairs.

The latest version of Revision 6 appears to add a new criterion to inspect all peripheral tubes, etc. as part of the periodic sample to monitor for loose parts. However, the guideline partially negates this improvement by stating that a secondary side FOSAR examination may be used to meet this requirement. The staff notes that experience shows that loose parts may migrate after causing damage to certain tubes. Sometimes, the offending loose part cannot be found after causing the damage. Overall, it is the staff's comment that a FOSAR examination, by itself, does not ensure the absence of loose part related damage.

Although not new in Revision 6, the staff has comments concerning the guidance on temperature sensitive degradation mechanisms. The guidelines state appropriately that the need to examine the cold leg side for temperature dependant mechanisms should depend on the degradation and operational assessment. One might argue that inspections for such mechanisms on the cold leg side need not be performed if no indications from such mechanisms have been seen on the cold leg side. However, once such indications are detected on the hot leg side, they need not reach C-3 numbers before their existence on the cold leg side is a significant probability. C-3 should not be the criterion for looking at the cold leg. Also, given the occurrence of indications on the hot leg, inspections of the cold leg should not be deferred to the next inspection. The recent finding of crack indications on both the hot and cold leg side at Seabrook underscores this point. The experience at McGuire where cracking appeared first on the cold leg side (leading to a tube rupture) must also be remembered. Finally, the staff notes that the very last sentence of Section 3.4.1 can be construed as being inconsistent with Sections 3.3.5, 3.3.10, and 3.3.15 of Revision 6 (assuming that one day there may be qualified techniques for sizing cracks). Given the finding of cracks on the hot leg side, irrespective of number, the cold leg should be sampled for similar cracks at

each inspection to confirm that the critical area is confined to the hot leg side during that outage.

Section 3.5, Inspection Results Categories

The definition of the inspection results category has been relaxed relative to Revision 5 of the guidelines and relative to current technical specifications. Until now, the inspection results category was determined based on the total count of all indications found (and meeting the growth criteria), regardless of how these indications were detected or their location. Revision 6 would determine the inspection results category separately for indications found by different inspection methods and at different locations. For steam generators employing multiple inspection methods and where indications are being found at different locations, Revision 6 substantially increases the number of indications necessary to cause the inspection results category to reach C-2 or C-3 and, thus, to cause an expanded inspection sample to be taken. The staff believes there is no justification which is apparent for this departure from historical requirements and practice. That the guidelines would call for such an approach to be supported by operational assessment does not constitute adequate justification since the tube integrity assessment guidelines do not provide adequate guidance for performing such assessments.

Section 3.6.2, Optional Expansion of the Periodic Sample to a Critical Area

For clarity, this section should define “critical area”, “C-A”, and “buffer zone” or should reference the definitions in Appendix F. In addition, Revision 6 deletes discussion of buffer zones that are critical to their proper implementation. For example, a buffer zone is the tube population immediately adjacent to a critical area. The purpose of a buffer zone is to ensure (through the absence of indications associated with the subject degradation mechanism) that the critical area is correctly defined.

In the first bullet, the words “100% of the active tubes, within the C-A” in Revision 5 are replaced by the words “all of the C-A” in Revision 6. This change results in a more vague criterion. Presumably, it is intended to allow less than 100% inspection, otherwise there would have been no reason for the change. Less than 100% inspection would be contrary to the original intent and philosophy of a critical area inspection. The wording should be changed to the original so there will be no ambiguity regarding the intent of the guideline. The staff has the same comment concerning the second bullet regarding inspection of buffer zones.

Section 3.6.3

This is a new section and addresses expanded inspection samples in response to the finding of loose parts. This section states that if loose parts are detected during the examination, a buffer zone shall be defined and inspected to the extent necessary to bound the loose part. Additionally, a secondary side inspection should be considered. The staff believes this introduces an inconsistency into the guidelines. Section 3.4.1 states that all peripheral tubes should be inspected for loose parts unless secondary side inspection is performed, whereas Section 3.6.3 suggests only tubes near the loose part need be inspected even if no secondary side inspection is performed. These two sections should be revised to be consistent. The wording in Section 3.4.1 is more appropriate since the loose part may have migrated after

having caused damage to peripheral tubes. In addition, the words “buffer zone” in the first sentence of Section 3.6.3 should be replaced with the words “critical area.”

Section 5.2, Degradation Assessment

The staff believes this section should be revised to include a clear statement of objectives and purpose. Key comments include the following.

- Revision 5 clearly identifies the primary purpose of degradation assessment:
  - to assess the types of existing and potential degradation mechanisms that could affect the steam generator tubes over the steam generator lifetime.
  - to ensure that inspection techniques and personnel used for the detection and sizing of flaws are appropriate for all existing and potential degradation mechanisms.

  Revision 6 makes it less clear that this is a primary purpose. Nowhere does Revision 6 state that inspection techniques and personnel shall be utilized during inspections, at appropriate intervals, which are appropriate for all existing and potential degradation methods which may occur over the life of the steam generator.

- The only specific mention of potential degradation mechanisms in Revision 6 is that “historical information from other utilities shall be used in the evaluation of potential degradation mechanisms.” This implies there should be an evaluation for potential degradation mechanisms, but such potential mechanisms are limited to mechanisms which have been observed by other utilities. The staff believes this to be incomplete. Potential mechanisms are those which may potentially occur over the lifetime of the plant, irrespective of whether such mechanisms have been experienced by other utilities. Each licensee should consider not only experiences of other utilities, but the design, material susceptibility, stress levels, temperature, environmental factors, etc. when evaluating potential degradation mechanisms which may occur over the lifetime of the plant. Interestingly, prior to the recent finding of cracks at Seabrook, no other US utilities had reported such cracks in the past in alloy 600TT tubing such as is used at Seabrook. Yet alloy 600MA, 600TT, and 690TT tubing is known to be susceptible to stress corrosion cracking, and the potential for such cracking can be aggravated by high stress, high operating temperatures, adverse environment (such as off-nominal chemistry), micro-structural variability associated which tube fabrication and heat treatment, etc.

- Revision 6 does have a paragraph that states the degradation assessment shall include and document various degradation mechanisms at all susceptible locations to determine if an inspection is necessary. Taken literally, it is not clear to the staff what this sentence is requiring. Is this sentence referring to degradation mechanisms which have been observed at the subject plant? At other plants? Which might potentially occur over the lifetime of the plant? This paragraph is less clear than the words contained in Revision 5.

Appendix F - Definition - Critical Area

The definition in Appendix F needs clarification to ensure that the user of the guideline does not mis-interpret its definition. What needs to be clarified is that a critical area must be shown to fully bound the region of the tube bundle affected by the degradation mechanism. As discussed in draft Regulatory Guide DG-1074, technical justification for a critical area should include either (1) that the essential contributing factors of the subject degradation mechanism are unique to the critical area or (2) that the indications found by initial sampling are of sufficient number and spatial distribution to provide a strong empirical basis for the critical area.