September 13, 2005

Mr. William Levis
Senior Vice President & Chief Nuclear Officer
PSEG Nuclear LLC-X04
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 2, EVALUATION OF STEAM GENERATOR TUBE INSPECTION RESULTS FOR 2003 (TAC NOS. MC2264 AND MC2265)

Dear Mr. Levis:

By letters dated November 17, 2003, February 19, 2004, March 9, 2004, and April 15, 2005, PSEG Nuclear LLC (PSEG), the licensee for the Salem Nuclear Generating Station (Salem) submitted information summarizing the steam generator tube inspections performed at Salem, Unit No. 2, during their fall 2003 refueling outage. This information was submitted in accordance with Technical Specification (TS) 6.9.1.5.b. Additional information concerning these inspections was provided during conference calls on October 24 and October 29, 2003, and in a PSEG letter dated April 15, 2005.

As discussed in the enclosed evaluation, the Nuclear Regulatory Commission (NRC) staff concluded that the licensee provided the information required by the Salem TSs and that no additional follow-up is required at this time. This completes the NRC staff's efforts under TAC Nos. MC2264 and MC2265.

If you have any question regarding this matter, please contact me at (301) 415-1321.

Sincerely,

/RA/

Stewart N. Bailey, Sr. Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-311

Enclosure: As stated

cc w/encl: See next page

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EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STEAM GENERATOR TUBE INSPECTION REPORTS FOR THE 2003 OUTAGE

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 2

DOCKET NO. 50-311

1.0 INTRODUCTION

By letters dated November 17, 2003 (ML033290440)[1], February 19, 2004 (ML040620694), and March 9, 2004 (ML040760608), PSEG Nuclear LLC, the licensee for Salem Nuclear Generating Station (Salem), Unit No. 2, submitted information summarizing the steam generator (SG) tube inspections performed at Salem, Unit No. 2 during their fall 2003 refueling outage (2R13). Additional information concerning these inspections was obtained during conference calls on October 24 and 29, 2003, and is summarized in a Nuclear Regulatory Commission (NRC) letter dated April 27, 2004 (ML040800008). On March 21, 2005 (ML050190178), the NRC staff issued a request for additional information regarding the reports submitted by the licensee. A response to this request was subsequently submitted on April 15, 2005 (ML051160266). Given that the next refueling outage (2R14) at Salem, Unit No. 2 was being conducted at nearly the same time that the response to the request for additional information was received, the NRC staff factored the questions into their discussions with the licensee during the outage (refer to ML050630434).

2.0 BACKGROUND

Salem, Unit No. 2 has four Westinghouse Model 51 SGs. Each SG contains approximately 3400 mill annealed Alloy 600 tubes. Each tube has a nominal outside diameter of 0.875 inches and a nominal wall thickness of 0.050 inches. The tubes were explosively expanded (WEXTEX) at both ends for the full length of the tubesheet and are supported by a number of carbon steel tube supports with round shaped holes. The hot-leg temperature is approximately 595 EF.

3.0 TECHNICAL EVALUATION

The licensee provided the scope, extent, methods, and results of their SG tube inspections in the documents referenced above. The licensee also described corrective actions (i.e., tube plugging or repair) taken in response to the inspection findings.

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[1] Documents with ML numbers can be viewed in the NRC's Agencywide Documents Access and Management System (ADAMS) at www.nrc.gov/reading-rm/adams.html

As a result of the review of the reports, the NRC staff has the following observations:

1. In SGs designed by another vendor, cracks have been observed to initiate in wear scars. Given the limited ability to distinguish a crack from a wear scar with the bobbin coil, some plants inspect all bobbin indications which they suspect are a result of wear with a rotating probe. These rotating probe examinations are performed to confirm that the bobbin indication are actually a result of wear and not some other degradation mechanism (e.g., cracks or a combination of a crack within a wear scar). Since bobbin indications attributed to wear scars are sized and left in service, if the bobbin indication is actually a result of a crack within a wear scar (or is simply a crack), the size of the flaw may be underestimated (since the method for sizing a crack and wear may differ). If the flaw is severe enough, it may no longer meet the structural integrity performance criteria at the end of the next operating interval.

   Of the 601 anti-vibration bar wear indications detected at Salem, Unit No. 2 in 2003, only 44 were inspected with a rotating probe. These examinations verified that the reported indications displayed a volumetric response and were not crack-like. Although no crack-like indications have been detected in wear scars in model 51 SGs similar to Salem, Unit No. 2 (to the NRC staff's knowledge), the operating experience at other plants indicate the potential for cracks to develop in wear scars. Given the goal to ensure tube integrity for all tubes, it is important to have a high degree of confidence that indications are appropriately classified (e.g., as either wear, cracking, or cracking in combination with wear) so that they are appropriately sized and dispositioned.

2. Several crack-like indications have been found at dented locations during recent inspections at Salem, Unit No. 2. Both axially and circumferentially-oriented crack-like indications have been detected. As of 2R12 (2003), there were approximately 21,000 dents at tube supports and approximately 900 dings in the free span portion of the tube. Of the 21,000 dents, approximately 33% were greater than 5 volts. Of the 900 dings, approximately 19% are greater than 5 volts. During 2R13, not all dents or dings greater than 5 volts were inspected with a rotating probe, although all dents at the lower tube supports greater than 1 volt on the hot-leg were inspected.

   It is known that temperature and stress affect a tube's susceptibility to cracking (i.e., a larger dent at a lower temperature may be as susceptible to stress corrosion cracking as a smaller dent at a higher temperature). Given the temperature dependence of cracking, more indications are typically found at the lower (hotter) tube support plate elevations on the hot-leg side of the SG. However, there have been numerous instances where cracking has not progressed through the SG based on temperature considerations alone (e.g., consider any tube where cracking was observed at the second hot-leg support before it was observed at the first hot-leg support). This is a result of the complex dependency of the operating environment (including temperature), the tube material, and the stresses which affects a tubes susceptibility to cracking. As a result, by not routinely inspecting all dented/dinged locations with a probe capable of finding the forms of degradation potentially affecting the tube at these locations, tube integrity analysis may become a challenge. This consideration has led many licensees to inspect all dented/dinged locations greater than some voltage threshold with a rotating probe to confirm the absence of cracking at these locations. During 2R13, a sampling approach was used to inspect the dented/dinged locations at Salem, Unit No. 2 and only a few (approximately 4) flaws were detected at

these locations.

4.0 CONCLUSION

Based on a review of the information provided, the NRC staff concludes that the licensee provided the information required by their TSs. In addition, the staff concludes that there are no technical issues that warrant follow-up action at this time since: (1) additional tube inspections have been performed subsequent to the submittal of these reports, (2) the inspections appear to be consistent with the objective of detecting potential tube degradation and (3) the inspection results appear to be consistent with industry operating experience at similarly-designed and operated units. Given that the licensee has performed another inspection of the SG tubes in 2005 (i.e., superceding the 2003 inspections), additional review of the issues discussed above may be performed as a result of the staff's review of the reports that will be submitted (in accordance with the TSs) summarizing the results of the 2005 inspections.

Principal Contributor: K. Karwoski

Date: September 13, 2005