



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

August 19, 2009

Mr. Preston D. Swafford  
Chief Nuclear Officer and  
Executive Vice President  
Tennessee Valley Authority  
3R Lookout Place  
1101 Market Street  
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNIT 2 – REVIEW OF THE 2008 REFUELING  
OUTAGE STEAM GENERATOR TUBE INSERVICE INSPECTION REPORT  
(TAC NO. MD9595)

Dear Mr. Swafford:

By a letter dated August 27, 2008, as supplemented by letters dated November 21, 2008, April 14, 2009 and July 9, 2009, Tennessee Valley Authority (the licensee) submitted steam generator (SG) tube inspection results from the 2008 inspections at Sequoyah Nuclear Plant, Unit 2 (SQN 2). In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized additional information concerning the 2008 SG tube inspections at SQN 2 in a letter dated June 18, 2008, based on the conference call held between the NRC staff and SQN 2 representatives on May 19, 2008.

The NRC staff has completed its review of these reports and concludes that the licensee provided the information required by their technical specifications and that no additional followup is required at this time. The NRC staff's review of the reports is enclosed.

Sincerely,

A handwritten signature in black ink that reads "Siva P. Lingam".

Siva P. Lingam, Project Manager  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-328

Enclosure: Inspection Summary Report

cc w/enclosures: Distribution via ListServ



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REVIEW OF THE 2008 REFUELING OUTAGE  
STEAM GENERATOR TUBE INSPECTION REPORTS  
TENNESSEE VALLEY AUTHORITY  
SEQUOYAH NUCLEAR PLANT, UNIT 2  
DOCKET NO. 50-328

By letters dated August 27, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML082480692), November 21, 2008 (ADAMS Accession Number ML090220276), April 14, 2009 (ADAMS Accession Number ML091050575), and July 9, 2009 (ADAMS Accession Number ML091910483), Tennessee Valley Authority (the licensee) submitted information summarizing the results of the 2008 steam generator (SG) tube inspections performed during cycle 15 refueling outage (RFO) at Sequoyah Nuclear Plant, Unit 2 (SQN 2). In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized additional information concerning the 2008 SG tube inspections at SQN 2 in a letter dated June 18, 2008 (ADAMS Accession Number ML081690168).

The SGs at SQN 2 are Westinghouse model 51 SGs. Each SG contains 3,388 mill annealed Alloy 600 tubes. Each tube has a nominal outside diameter (OD) of 0.875 inches and a nominal wall thickness of 0.050 inches. The tubes are supported by a number of carbon steel tube support plates and Alloy 600 anti-vibration bars. The tubes were explosively expanded into the tubesheet at both ends for the full length of the tubesheet. The U-bend region of the small radius tubes (i.e., rows 1 and 2) were in-situ stress relieved following cycle 6 RFO (the row 1 tubes were plugged following cycle 3 and were unplugged, inspected, and stress relieved following cycle 6).

In addition to the depth-based tube repair criteria, the licensee is also authorized to apply a voltage-based tube repair criteria for predominantly axially oriented OD stress corrosion cracking at the tube support plate elevations. The licensee is also authorized to leave flaws within the tubesheet region in service, provided they satisfy the  $W^*$  repair criterion.

The licensee provided the scope, extent, methods, and results of their steam generator tube inspections in the document referenced above. In addition, the licensee described corrective actions (e.g., tube plugging) taken in response to the inspection findings.

Based on its review of the reports submitted, the NRC staff has the following observations and comments:

- In implementing the  $W^*$  repair criterion, the licensee assigned a leak rate to the indications detected within the top 8-inches of the tubesheet even though the indications were not expected to leak. The NRC staff did not review the appropriateness of assigning the specific leak rate to these indications (i.e., those in the top 8-inches of the tubesheet) since

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such indications are not expected to leak (given a plug-on-detection approach and past operating experience with inspections in the tubesheet region).

- Eight indications of cracking in the free span were detected. These eight indications were located in four tubes. Two of the indications were in-situ pressure tested and no leakage was detected at a pressure of three times the normal operating differential pressure that exists across the tube wall.
- One axial crack-like indication was detected in the U-bend region of a row 8 tube. This tube was in-situ pressure tested and no leakage was detected at a pressure of three times the normal operating differential pressure. Circumferential indications were also detected in the U-bend region of a few tubes.
- Axial crack-like indications were detected near the cold-leg tube end in one tube.
- The tube in row 1, column 32 could not be fully inspected during the 2008 RFO. This tube has a small dent in the U-bend region which stopped the rotating probe from rotating. An adequate inspection was obtained during the previous outage after multiple attempts to perform the inspection; however, similar success was not achieved during this outage despite several attempts to inspect this location. The NRC staff notes that the condition of the tubes must be assessed during each outage in which the tubes are inspected or plugged. Since there was no inspection data at this location, the NRC staff asked how the integrity of this tube was confirmed given that degradation has been observed in the U-bend region at other plants with similar tube material. In response, the licensee indicated that the previous inspection did not indicate any degradation and they have not experienced any tube progressing from "no-detectable degradation" to one which does not have adequate integrity in one cycle. Although the licensee's rationale is plausible, there have been instances at other plants where this has occurred. Since inspection findings can alert the operator to potential adverse trends, it is important to ensure that all tubes have adequate integrity including those that are not inspected. In some cases this may require additional analyses or in-situ testing.
- The licensee re-inspected all tubes with indications greater than 1.5 volts at the tube support plate intersections if the probe failed a probe wear check. Some of these retested tubes had indications less than 1.5 volts. In these cases, the original voltage obtained with the "worn probe" was used in the tube integrity assessment. The NRC staff discussed this issue with the licensee since several of the "less than 1.5 volt" flaw indications reported in their April 14, 2008, letter appeared to be much larger than originally reported. The licensee clarified that the voltages reported for the "less than 1.5 volt" flaw indications are not necessarily the voltage associated with the flaw. In at least one case, it was the voltage associated with the tube support. The NRC staff indicated that the intent of the NRC staff's approval of the probe wear criterion, which is outlined in a February 9, 1996, letter, was to ensure that all of the re-inspected data be re-evaluated, not just the indications which were above 1.5 volts. The purpose of this approach was to confirm the adequacy of the 1.5 volt criterion. The 1.5 volt criterion was based on an assumption/data that indications sized at less than 1.5 volts with a worn probe would not be greater than the tube repair criterion of 2 volts (i.e., if the indication was re-inspected with a probe that passed the probe wear check, it would not be larger than 2 volts).

Based on a review of the information provided, the NRC staff concludes that the licensee provided the information required by their technical specifications. In addition, the NRC staff concludes that there are no technical issues that warrant follow-up action at this time since the inspections appear to be consistent with the objective of detecting potential tube degradation and the inspection results appear to be consistent with industry operating experience at similarly designed and operated units.

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Sincerely,

/RA/

Siva P. Lingam, Project Manager  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

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