

October 9, 2002

Mr. Mark B. Bezilla
Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Post Office Box 4
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SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 1, NUCLEAR REGULATORY
COMMISSION (NRC) STAFF'S REVIEW OF CYCLE 15 STEAM GENERATOR
TUBE INSPECTION REPORT (TAC NO. MB2914)

Dear Mr. Bezilla:

By letter dated January 2, 2002, FirstEnergy Nuclear Operating Company (FENOC) submitted its steam generator tube inspection 90-day report, "Beaver Valley Unit-1 Cycle 15 Voltage-Based Repair Criteria 90-Day Report." The report was submitted in accordance with the guidance in Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking."

In your cover letter, you urged timely completion of the NRC review and approval of a data exclusion criteria for datasets with atypical deep crack morphology, which was submitted to the NRC by the Nuclear Energy Institute (NEI) in September 2001. FENOC's assessment indicates that including certain foreign data in the dataset results in unnecessary conservatism. The NRC staff is currently working with the industry to assess the data exclusion criteria. By letter dated March 27, 2002, the NRC staff recently approved a modification to the GL 95-05 methodology for determining leakage from steam generator tubes during postulated accidents.

M. Bezilla

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As discussed in the report, FENOC assessed the significance of the predominantly axially oriented outside diameter stress corrosion cracking at the tube support plate elevations using an NRC-approved methodology. Based on our review of the material provided by FENOC, we concluded that the results provide reasonable assurance of tube integrity for operating cycle 15 from the application of the GL 95-05 alternate repair criteria. The NRC staff's review of the report is enclosed.

Sincerely,

/RA/

Daniel S. Collins, Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-334

Enclosure: Documentation of NRC Staff's Review

cc w/encl: See next page

M. Bezilla

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NUCLEAR REGULATORY COMMISSION STAFF'S REVIEW
OF THE STEAM GENERATOR 90-DAY REPORT
FIRSTENERGY NUCLEAR OPERATING COMPANY, ET AL.
BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1)
DOCKET NO. 50-334

1.0 INTRODUCTION

By letter dated January 2, 2002, FirstEnergy Nuclear Operating Company (FENOC, the licensee) submitted its steam generator (SG) tube inspection 90-day report, "Beaver Valley Unit-1 Cycle 15 Voltage-Based Repair Criteria 90-Day Report." The report was submitted in accordance with the guidance in Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," dated August 3, 1995. On April 1, 1996, the Nuclear Regulatory Commission (NRC) issued Amendment No. 198, to Operating License No. DPR-66 for Beaver Valley Power Station, Unit 1 (BVPS-1), that changed the technical specifications to implement a 2.0 volt SG voltage-based alternate repair criteria (ARC) in accordance with GL 95-05.

The subject 90-day report contains the licensee's condition monitoring assessment for end of cycle (EOC) 14 and the operational assessment for beginning-of-cycle (BOC) 15. The licensee performed these assessments following an NRC-approved methodology per GL 95-05.

2.0 GENERAL PLANT DESCRIPTION

BVPS-1 has three Westinghouse Model 51 SGs that have 7/8-inch diameter, mill annealed alloy 600 tubes. Additionally, the SGs have drilled hole carbon steel tube support plates.

Prior to NRC approval of Amendment No. 198 for BVPS-1 to implement the 2.0 volt ARC, the licensee had implemented a similar 1.0-volt repair criteria on an interim basis. That interim criteria had been approved by the NRC on February 3, 1995, by Amendment No. 184 to the BVPS-1 operating license.

3.0 REPORT SUMMARY

3.1 Inspection Scope and Results (GL 95-05)

The licensee inspected 100% of the inservice tubes full length with a bobbin coil in all three SGs during the EOC 14 inspection outage. Dented intersections were inspected with a rotating pancake coil (RPC) probe consistent with the methodology described in GL 95-05.

During these inspections, a total of 3533 axial outside diameter stress corrosion cracking

(ODSCC) indications were found by bobbin coil probe in all three SGs, of which 469 were reinspected with the RPC probe, and 436 were confirmed as flaws. The RPC-confirmed indications included 363 indications above 1.0 volt. The largest number of bobbin indications, 1530 indications, was found in SG-A; 188 of those bobbin indications were inspected by RPC, and 182 were confirmed as flaws.

A total of 20 bobbin indications were found above 2.0 volts in all SGs combined, and all but 3 of those indications were inspected with an RPC probe. All RPC-inspected bobbin indications > 2.0 volts were confirmed. The 3 bobbin indications above 2.0 volts that were not RPC inspected could not be inspected by RPC because the tubes have sleeves installed that prevented the passage of the RPC probe. These 3 bobbin indications and the 17 RPC-confirmed indications were removed from service.

RPC inspection at tube support plate (TSP) distorted signal indication locations did not identify any circumferential indications or axial indications extending outside the TSP. RPC inspection of dented intersections also did not show any degradation; either OD or inside diameter initiated.

Three single volumetric indications were found coincident with previously reported distorted signal indications in SG-A, and the tubes containing those indications were removed from service. The source of the volumetric indications were determined to be related to foreign object signals.

A section of tube Row 15, Column 62, in SG-C containing TSP intersections 1 and 2 on the hot leg side was pulled and examined. The TSP 01H intersection contained the largest indication, 5.3 volts, and leakage from that indication under steam line break (SLB) conditions was measured in an elevated temperature (600°F) leak test. The leak testing for the 01H TSP suggests that ductile tearing of a circumferential non-degraded ligament occurred between 2200 and 2480 psi, resulting in a leak rate from 0.013 gpm to 0.11 gpm. The TSP 02H intersection had a 1.29 volt indication that did not leak under SLB conditions. The data were added to the latest industry leak rate database for 7/8-inch tubes and correlations for probability of leakage and leak rate for 7/8-inch tubes were updated by the industry.

3.2. Evaluation of Probabilistic Calculations (GL 95-05)

To demonstrate acceptable tube integrity in accordance with GL 95-05, the licensee determined the conditional probability of tube burst and the tube leak rate during a postulated SLB. The results from these calculations were below the GL 95-05 reporting thresholds. The licensee's calculations are summarized below.

3.2.1 Projected End-of-Cycle Voltage Distribution

The projected EOC-15 voltage distribution was obtained by applying a Monte Carlo sampling process to the BOC-15 voltage distribution, a voltage-growth distribution, and a non-destructive examination uncertainty distribution. The voltage growth distribution used in the calculations considered the growth rate for degradation in active and previously plugged tubes.

3.2.2 Conditional Probability of Tube Burst During an SLB

The licensee projected the tube burst probabilities for EOC-15 in all three SGs to be less than the 1×10^{-2} criteria established in GL 95-05.

3.2.3 SLB Leak Rate Projection

For the operational assessment, the licensee projected the EOC-15 SLB leak rates to be 5.50, 3.84, and 3.40 gpm for SGs A, B, and C, respectively. The projected SLB leak rates are below the accident-induced primary-to-secondary allowable leakage of 14.5 gpm. The predicted leakage shows that the leakage integrity of ODSCC indications should be maintained during the cycle 15 operation.

3.3 NRC Staff Observations

During the course of the review, the NRC staff identified several issues. Since these issues do not affect the overall qualitative assessment of the report, the issues were not forwarded to the licensee for formal response; however, the licensee should consider the following in future evaluations:

- The licensee indicated in its report that until the industry database was formally updated, approved, and issued for use in accordance with the NRC-approved Nuclear Energy Institute (NEI) protocol, the results of evaluations with the newest pulled tube data added to the database were provided for information only. Although a protocol exists for formally updating the database, the NRC staff believes that "significant" tube pull data should be assessed in a timely manner with appropriate corrective actions taken as needed. If the results of the evaluation indicate a potential problem, the problem should be addressed when it is identified rather than waiting for completion of the formal update to the industry data base.
- The licensee indicated that chemical cleaning was performed in the SGs at EOC-14, during the 2001 outage. The licensee's report did not clearly indicate that the chemical cleaning was performed prior to, during, or after the SG tube inspections. As discussed in Section 2.b.2(2) of Attachment 1 to GL 95-05, the effects of chemical cleaning on voltage growth rates need to be evaluated. Depending on the nature and extent of deposits, chemical cleaning may result in changes to voltages and improve detectability of tube flaws. If the voltages for the indications were determined before the chemical cleaning process and this process had the potential to change the voltage, the effects on the tube integrity evaluations would need to be assessed.
- The licensee's report indicated that for 5 of the 6 new indications, BOC voltages were conservatively set to 0.1 volts to maximize growth rate. According to Section 2.b.2(2) of Attachment 1 to GL 95-05, voltage growth rates should only be evaluated for those intersections at which bobbin indications can be identified at two successive inspections, except if an indication changes from non-detectable to a relatively high voltage (e.g., 2.0 volts). Whereas the individual growth rate may be maximized by setting the BOC voltage to 0.1 volts or lower, the distribution of growth rates may be non-conservatively affected by reducing the frequency at which the maximum growth rates are observed.
- The licensee's report indicated that the burst test was performed at 200 pounds per square inch per second; however, the report did not mention whether a foil was used (or

the type of foil) and the implications of its use on the measured burst pressure.

- The licensee indicated that the tube destructively examined was pulled from the top of tubesheet region; however, nondestructive examination did not indicate any degradation in this region. The results of the destructive examination of this region, if any, were not provided in the report. The results would be useful in assessing the adequacy of the inspection.
- The licensee's report postulated that forces required to pull the tube potentially damaged the indication. The report also indicated that chemical cleaning was fairly successful at removing the deposits (except possibly at the first tube support intersection). The details of how the tube pulls were performed were not provided; however, given the relative lack of deposits it is not clear why excessive forces were needed to remove the tube such that the ligaments between the cracks were damaged.

4.0 NRC STAFF'S CONCLUSIONS

The licensee estimated the conditional tube burst probability at EOC 15 for ODS-CC at the TSPs to be below the NRC-reporting threshold. In addition, the estimates of the primary-to-secondary leak rate from the GL 95-05 indications during a postulated SLB break were below the allowable leak rate. The NRC staff identified no major concerns as a result of reviewing the information provided in FENOC's 90-day report for BVPS-1 cycle 15. The NRC staff accepts FENOC's conclusion that there is reasonable assurance of tube integrity for BVPS-1 cycle 15 from the application of the GL 95-05 alternate repair criteria.

Principal Contributor: C. Lauron

Date: October 9, 2002