



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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December 23, 2016

Mr. Marty L. Richey
Site Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Mail Stop A-BV-SEB1
P.O. Box 4, Route 168
Shippingport, PA 15077

SUBJECT: BEAVER VALLEY POWER STATION, UNIT 2 – REVIEW OF THE STEAM GENERATOR TUBE INSERVICE INSPECTION REPORTS FOR REFUELING OUTAGE 18 (CAC NO. MF7472)

Dear Mr. Richey:

By letters dated January 22, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16025A168), as supplemented by letters dated April 6, 2016 (ADAMS Accession No. ML16097A452), and July 14, 2016 (ADAMS Accession No. ML16196A318), FirstEnergy Nuclear Operating Company, Inc. (the licensee) submitted information summarizing the results of the 2015 steam generator (SG) tube inspections at Beaver Valley Power Station, Unit No. 2 (BVPS-2). These inspections were performed during refueling outage (RFO) 18.

BVPS-2 is a three-loop plant with Westinghouse Model 51M SGs. Each SG contains 3,376 mill-annealed Alloy 600 tubes with a nominal outside diameter 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 (TSPs) and Alloy 600 anti-vibration bars. The tubes were roll expanded at both ends for the full depth of the tubesheet. The entire length of tube within the tubesheet was shot-peened on both the hot-leg and cold-leg side of the SG prior to operation. In addition, the U-bend region of the small radius tubes were in-situ stress relieved prior to operation.

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

Based on the NRC staff's review of the information submitted by the licensee, the staff has the following comments and observations:

- A supplemental screening process is used on the bobbin coil data to enhance the detection of axial primary water stress-corrosion cracking (PWSCC) at dented TSP intersections. This supplemental screening process is based, in part, on signal amplitude. Any tube support location with bobbin coil signal characteristics that are within the normal reporting phase analysis window are reported as dents or dings with possible indications. All dents or dings with possible indications are inspected with a rotating probe.

- Rotating probes were used to inspect certain distorted TSP indications (indications of possible flaws in the tube at the TSP elevation). These inspections included tubes that were confirmed to contain axial outside diameter stress corrosion cracking (ODSCC) indications during RFO 16 and RFO 17.
- Two ODSCC indications (one axially-oriented and one circumferentially-oriented) associated with two dings were detected in SG A. The axial indication was slightly above the third hot-leg TSP and was associated with a ding of 6.7 volt. Since the voltage of the indication was greater than 5 volts, it was only reported from the rotating probe data. The circumferential indication was about 40 inches above the sixth hot-leg tube TSP and was associated with a ding of 3.6 volt. Since this indication is circumferentially-oriented, it was only reported from the rotating probe data.
- In addition, one axial ODSCC indication was detected in SG C. This indication was about 0.5 inches above the eighth cold-leg tangent point. The indication was in a tube located in row 9. Initially, this indication was thought to be associated with a ding, but closer scrutiny indicated that the horizontal noise component was associated with the bend tangent (the starting and stopping points of the U-bend former die used during the tube bending process) and not a ding. This indication was reported from the rotating probe data. However, review of the bobbin coil data indicated that a reportable signal was present. The licensee indicated that the indication is associated with a residual scratch or gouge from the original tube bending process. The bending tool die configuration is only applicable to rows 3 to 9. The licensee indicated that analysis of the row 3 through row 9 bending process suggests that such an indication could only exist in these rows. The staff notes that the licensee's rotating probe base scope inspection plan only includes rows 3 through 8 (and not row 9, even though a similar bending process was used in row 9).
- Since the axial ODSCC indication was detected in SG C, all row 9 tubes in SG C were inspected with a rotating probe in RFO 18. Similar rotating probe inspections were not performed in row 9 in the other two SGs. Weaknesses of a sampling strategy when the number of flaws is low, was highlighted in NRC Information Notice 2013-11, "Crack-Like Indications at Dents/Dings and in the Freespan Region of Thermally Treated Alloy 600 Steam Generator Tubing," dated July 3, 2013 (ADAMS Accession No. ML13127A236).
- According to the licensee, the data shows a strong predisposition of ODSCC to occur in the first few hot-leg TSPs, although the mechanism extended to higher TSPs. Only eight indications were detected on the cold-leg side. This distribution is consistent with that observed at other plants and is commonly attributed to the temperature dependence of ODSCC.
- One circumferential PWSCC indication was detected in a tube located in row 3 of SG C. Attempts to stabilize a row 3 tube in an SG mockup failed, so the six tubes surrounding the affected tube were plugged with leak-limiting sentinel plugs.
- Other than the crack indications discussed above, those detected at the expansion transition and those detected in the hot-leg sludge pile, no other free span cracks were identified.

- One tube was in-situ pressure tested due to a potential mixed-mode indication at the top of the tubesheet on the hot-leg side of the SG. There was no leakage and the tube did not burst at a test pressure of 5,150 pounds per square inch. Post-in-situ pressure test inspection of the tube with a Ghent probe led the licensee to believe that the axial component of the mixed-mode indication was most likely a result of a scratch on the outside surface of the tube.
- No tubes were sleeved during RFO 18, and no previously sleeved tubes were plugged during RFO 18. There are 94 inservice tubes with sleeves.
- Possible TSP ligament breaches were reported at two locations. These indications were evaluated by the original equipment manufacturer. This evaluation indicated that all ligament breach extents were acceptable for continued plant operation.

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

If you have any questions regarding this matter, I may be reached at (301) 415-2871 or Michael.Marshall@nrc.gov.

Sincerely,



Michael L. Marshall, Jr., Senior Project Manager
Plant Licensing Branch 1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-412

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