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L-04-115

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1 and No. 2
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Response to Request for Additional Information in Support of 2003 Refueling Outage Steam Generator Inspection Reports

This letter provides the FirstEnergy Nuclear Operating Company (FENOC) response to an NRC request for additional information (RAI) dated August 3, 2004, pertaining to FENOC letters dated April 4, April 15, July 24, and October 9, 2003, and February 12 and March 4, 2004, reports summarizing the Beaver Valley Power Station (BVPS) Unit No. 1 and Unit No. 2 steam generator tube inspections performed at BVPS Unit 1 March 2003 refueling outage (1R15) and at BVPS Unit 2 September 2003 refueling outage (2R10). [TAC Nos. MC2875 and MC2876]

No new regulatory commitments are contained in this submittal. If there are any questions concerning this matter, please contact Mr. Larry R. Freeland, Manager, Regulatory Compliance at 724-682-5284.

Sincerely,

L. W. Pearce

L. William Pearce

Attachments

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Sr. Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

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Letter L-04-115 - Attachment A

REQUEST FOR ADDITIONAL INFORMATION
BEAVER VALLEY POWER STATION UNIT 1 (BVPS-1) AND UNIT 2 (BVPS-2)
2003 REFUELING OUTAGE STEAM GENERATOR INSPECTION REPORTS
DOCKET NO. 50-334 AND 50-412

By letters dated April 4, 2003, Agencywide Documents Access and Management System (ADAMS) accession number ML030980009, April 15, 2003 (ADAMS accession number ML031080137), July 24, 2003 (ADAMS accession number ML032100660), February 12, 2004 (ADAMS accession number ML040490547), and March 4, 2004 (ADAMS accession number ML040700173) FirstEnergy Nuclear Operating Company (licensee), submitted reports for BVPS-1 and 2 summarizing the steam generator (SG) tube inspections performed at BVPS-1 during its March 2003 refueling outage (1R15). Additional information concerning these inspections was summarized by the Nuclear Regulatory Commission (NRC) in a letter dated June 20, 2003 (ADAMS accession number ML031710065). Information provided in the July 24, 2003, and February 12, 2004, letters pertaining to implementation of the voltage-based tube repair criteria for degradation at the tube support plate elevations was reviewed separately.

By letters dated October 9, 2003 (ADAMS accession number ML032880405), and March 4, 2004 (ADAMS accession number ML040700173), the licensee submitted reports summarizing the SG tube inspections performed at BVPS-2 during its September 2003 refueling outage (2R10).

In order for the NRC staff to complete its review, we request you respond to the following questions:

BVPS-1

1. Several tubes were plugged for "axial indications above the hot leg top of tubesheet" region. Most (if not all) of the axial indications are located within the region of the tube from the top of the tubesheet to 4 inches above the top of the tubesheet. Please discuss the nature and cause of these indications (e.g., outside diameter stress corrosion cracking (ODSCC) associated with the sludge pile) and how these indications were detected (e.g., bobbin and/or rotating probe). If these indications were not reliably detected with a bobbin probe, please discuss the basis for limiting the upper extent of your rotating probe examinations to 6 inches above the top of the tubesheet.

Response: These indications are axial ODSCC, and this type of indication has been observed at BVPS for multiple cycles. All axial ODSCC indications are located within the bounds of the historic sludge pile. The sludge pile height has been measured with the bobbin coil probe over the last 3 outages. It was measured as being approximately 4.50 inches in height at its highest point 1R13 (pre chemical cleaning). This sludge pile was effectively removed during chemical cleaning at 1R14. During 1R15 (post chemical cleaning) it was measured as approximately 3.20 inches in

height at its highest point. These (1R15) indicated heights are presumed to be random sludge "collars" rather than an accumulation of sludge build-up. This has been confirmed through visual inspection of the secondary side of the steam generators (S/Gs).

Nonetheless, all inservice hot leg tubes will continue to be inspected with the +Point probe to 6.00 inches above the hot leg top-of-tubesheet (TTS) thus bounding the sludge pile height. When sampling of the cold leg is performed, the +Point probe extent is also 6.00 inches above the TTS.

The +Point probe has detected the vast majority of the indications located at or near the TTS. However, a small percentage of these indications have been detected with the bobbin coil probe.

2. Please clarify the nature and cause of the non-quantifiable indications located above the top of the tubesheet.

Response: Non quantifiable indications (NQIs) may be attributed to outside diameter (OD) deposits, magnetic permeability variations within the tube, or actual tube degradation. All NQI signals are subsequently examined with +Point probes for potential degradation characterization purposes. All NQI signals within 6.00 inches of the top-of-tubesheet are repaired upon detection regardless of the +Point response (i.e., confirmed vs. not confirmed).

3. Please discuss the results of your rotating probe inspections at the top of the cold leg tubesheet. Also, please clarify the nature and cause of the non-quantifiable indication identified slightly above the top of the cold leg tubesheet region in tube R13C55 in SG B.

Response: No degradation was reported from the 20% cold leg TTS Rotating Pancake Coil (RPC) program in S/G "A". The RPC program for the cold leg TTS is rotated between the S/Gs each outage unless the hot leg TTS RPC program results in a C-3 category during the previous outage. Then the cold leg of the affected S/G would be examined as an addition to the rotation schedule.

NQIs are reported from use of the bobbin coil probe. NQIs are subsequently inspected using a +Point probe. R13 C55 in S/G "B" was examined with a +Point probe and no degradation was reported.

R13 C55 was conservatively removed from service per the criteria discussed in the response to Question 2 above. The cause of the NQI is not clearly known; however, it may be attributed to OD deposits, magnetic permeability variations within the tube, or actual tube degradation.

4. In your reports, you indicated that axial or volumetric indications were detected in the U-bend region of several tubes. Please clarify how these indications were detected (e.g., rotating probe) and the nature and location of these indications (e.g., primary water stress corrosion cracking (PWSCC) at the tangent point or at the flank of tube at the apex, etc.). Please discuss whether the location and nature of these indications are consistent with industry expectations for degradation in the U-bend region.

Response: U-bend signals were reported from the +Point probe. One Row 1 tube (R1 C24 in S/G "A") was reported with a circumferential PWSCC indication at the cold leg tangent. Several tubes were reported with volumetric signals in the U-bend region. These locations are likely historical lap signals that were reported as part of the 100% U-bend +Point program. Two tubes (R13 C61 & R17 C22 in S/G "C") were reported with signals suggestive of axial PWSCC. The eddy current characteristics of these signals did not follow classical flaw trends. One tube (R13 C61) had a peak amplitude of 1.27 volts, reported over a 3.00 inch length. This tube was in situ pressure tested to >5000 psi. No leakage was detected The post in situ +Point exam showed no change in the indication from the pre in situ +Point exam. This indication was eventually categorized as an anomaly (i.e., scratch or gouge), and not representative of PWSCC. These three tubes were removed from service.

5. One tube was plugged for an axial indication at an anti-vibration bar dent. Please discuss the size of the ding/dent, the size of the indication, and whether the indication was detected/reported during the standard analysis of the bobbin probe data. Also discuss whether the axial indication was associated with the dent (the dent was reported at AV3+0.15-inches and the axial indication was reported at AV3-0.13 inches).

Response: The axial indication (R42 C28 in S/G "A") is attributed to ding ODSCC. The indication is consistent with a typical "dent" signal. The ding/dent voltage was reported as 4.06 volts from the bobbin coil probe.

Anti-vibration bars (AVBs) are constructed of Alloy 600 material; therefore, a classical "dent" cannot occur. The geometry signal is called a dent only because it is located at the AVB structure. The indication was reported with the +Point probe.

The bobbin coil probe did not report the indication. Utilization of the bobbin coil to screen for dings is only applicable to the freespan region of the tube.

The screening threshold for recording dings/dents is 1.00 volt. A 20% random sample of dings/dents > 2.00 volts but < 5.00 volts located between the hot leg TTS and the third Tube Support Plate (TSP) are examined with the +Point coil. In addition, all dents > 5.00 volts were examined with the +Point coil.

6. One tube was plugged as a result of an obstruction (i.e., other than the one tube plugged for a restriction in a tubesheet sleeve). Discuss the largest size probe that passed through this tube during 1R15, the largest size probe that ever passed through this tube, and the source of this obstruction. Please discuss whether this tube had adequate integrity. Please discuss whether the obstruction was service-induced. If service-induced, please discuss the root cause for the obstruction and how this service-induced condition was factored into your operational assessment.

Response: A large voltage (approximately 26 volts) ding was reported (R26 C62 in S/G "C") from the 0.720 inch bobbin probe. 0.720 inch bobbin probes have been used to examine this tube in past outages. Subsequent +Point testing of this ding showed a permeability (PV) signal coincident with the ding. The length of the PV signal was less than the 100 percent through-wall critical flaw length. There was no distortion of the signal at the edges; therefore, it is unlikely a flaw was present within the PV signal. This tube was preventively repaired.

Based on the 1R15 inspection program for > 5.00 volts dings, there is no basis to assume an indication is present at this location. The dings are not service induced but result from the manufacturing process.

7. Please clarify the term "secondary side anomaly".

Response: The term secondary side anomaly (SSA) is used when no other acronym will suffice. It was used twice in the report submitted to the NRC (R33 C19 in S/G "A" and R39 C62 in S/G "C"). For the case of R33 C19, multiple examinations of an anomalous signal with 0.720 inch and 0.680 inch diameter +Point probes, in addition to a 0.700 inch Ghent probe, did not provide any information that could be correlated. The +Point probes reported a single axial indication (SAI) and no degradation found (NDF), respectively. The Ghent probe also reported NDF. SSA was assigned as the call of record due to the differences of opinion between the analysts. R33 C19 was conservatively removed from service.

For R39 C62, there was no degradation reported in the tube. However, the close proximity to an adjacent tube (R38 C62) could be observed. R38 C62 had a volumetric indication in the freespan area between AVB 3 and AVB 4. Both R38 C62 and R39 C62 were removed from service.

8. A gap was observed along the entire length of the blowdown pipe support-to-tubesheet weld in SG A. Please discuss whether the blowdown pipe support-to-tubesheet weld was inspected in the other SGs in BVPS-1 and 2. If so, please discuss the results. If no inspections were performed, please discuss the technical basis.

Response: The weld was found to be intact for the other support in S/G "A", and for both pipe supports in S/Gs "B" and "C". A vibration analysis of the pipe

was performed and determined that the blowdown pipe/support would remain stable during subsequent operation. During 2R10 at BVPS Unit 2, the blowdown pipe supports in all 3 S/Gs were visually examined. All welds were found to be intact and no degradation was observed.

9. It was indicated that 100% of the inservice sleeves installed at 1R13 were examined during 1R15. Please clarify the types of sleeves installed during 1R13 (e.g., Combustion Engineering tungsten inert gas (TIG) welded sleeves) and the probes used to inspect these sleeves in 1R15. Also, if any sleeves were installed prior to 1R13 or during 1R14, clarify the type of sleeve, the outage in which they were installed, the scope of inspection during 1R15, and the basis for this inspection scope. Please also clarify whether any sleeves have been installed at the tube support plates.

Response: The Westinghouse laser welded sleeve is the only sleeve design installed at BVPS Unit 1 and was only installed during the 1R13 outage. The sleeve joint regions (laser welds and roll expansions) were inspected with a +Point probe. The unexpanded sleeve length between the joints was inspected with a bobbin coil probe. Westinghouse laser weld sleeves are installed at both the tubesheet and at tube support plates. No sleeves have been installed at BVPS Unit 2.

10. In 1R14 and 1R15, sleeves were identified that would not permit the passage of the typical size eddy-current probe. Please discuss the types of sleeves involved in these occurrences, the length of time the sleeves were in service, whether the parent tube was cleaned and inspected at the joints during the installation process, the extent of the obstruction (e.g., tube diameter reduced by approximately 25%), and the location of the "collapse" relative to the tube and the sleeve. Please discuss whether an inspection of the area in which the sleeve joint was established was performed during the outage (with a probe capable of finding axial and circumferential cracks) in which the sleeve was installed. Please discuss your future plans for performing rotating probe examinations of projected tube-to-sleeve joint areas prior to sleeve installation.

Response: Westinghouse laser welded sleeves were involved and had been in service since 1R13 (February 2000). The hardroll joint area of the collapsed sleeves was inspected with a +Point probe during 1R15 as the collapsed area occurred at approximately the mid-length of the sleeve. No degradation was reported. The sleeve installation process, which includes cleaning, was followed. An examination of the area with a rotating probe prior to sleeve installation was not performed.

Based on the visual examinations of the four collapsed sleeves discovered during 1R14, the (worst case) reduction of the tube inner diameter was estimated to be approximately 33% (0.22 inch).

Future sleeve installation (Alloy 800 sleeves) will include a +Point probe examination of the parent tube in the hardroll joint area prior to installation.

11. In 1R15, twenty-eight tubes were identified with axial indications in the parent tube located behind the lower hard roll region of a sleeved tube. Each of these 28 tubes were sleeved in 1R13 and all of these tubes were previously plugged (i.e., they were deplugged and returned to service in 1R13). The plugs were removed by a TIG relaxation process in 1R13 and all indications are coincident with the area where a tube plug was previously installed. Please discuss whether a rotating probe inspection was performed in 1R13 (or 1R14) at the area in which the flaws were eventually found (either prior to or after sleeve installation). Also, please discuss the type of plug that was installed in each of these tubes (e.g., rolled plug, ribbed plug, welded plug, etc.) and whether the indication was coincident with the area in the tube where residual stresses would be expected as a result of the plug installation.

Response: All locations were previously plugged with Framatome roll plugs, some of which had been plugged and deplugged twice. These tubes were originally plugged with Alloy 600 roll plugs that were subsequently replaced with Alloy 690 roll plugs. The deplugging method utilized the TIG relaxation process. Rotating probe inspection of this area was not performed at 1R13 (prior to sleeve installation), as it was neither a requirement of the WCAP nor the SER for sleeving.

From the eddy current method (+Point) applied, it cannot be determined if the signals observed are related to degradation of the parent tube or a permeability effect related to multiple TIG relaxations.

BVPS-2

1. Several non-quantifiable indications were reported in the BVPS-2 SGs. Please discuss whether all of these signals were inspected with a rotating probe. If all were not inspected with a rotating probe, please discuss the technical basis for leaving these indications in service. For those non-quantifiable indications further classified as single volumetric indications, please discuss the cause for these indications.

Response: All NQI signals are subsequently inspected with a +Point probe. Those confirmed as single volumetric indications (SVI) are attributed to either historical laps or loose part wear. All NQI signals within 6.00 inches of the top-of-tubesheet are repaired upon detection regardless of the +Point response (i.e., confirmed vs. non-confirmed).

2. Several tubes had confirmed tube support plate indications while at least one tube had a possible tube support plate indication. Please discuss whether these signals have changed with time.

Response: There is no observable change in these signals over multiple outages.

3. Several single axial indications at the tube support plate elevations were reported in SG C. Please discuss the cause of these indications (e.g., ODSCC). In addition, please discuss whether these indications are at dented tube support plate elevations, and if so, provide the dent voltage.

Response: The cause of the single axial indications is postulated to be axial ODSCC. These are non-dented TSP intersections.

4. During your 2002 SG tube inspections, PWSCC was detected in two tubes at dented hot leg support plate intersections and ODSCC occurred in one tube at a hot leg free span ding. In each case, the crack orientation was in the axial direction. Please discuss the scope and results of any rotating probe inspections performed at dents or dings during your 2003 outage.

Response: All dents > 5.00 volts are inspected with a +Point probe each outage. In 2002 and 2003, all freespan dings > 5.00 volts were inspected with a +Point probe. In addition, a 20% sample of freespan dings and dents > 2.00 volts but < 5.00 volts, located between the hot leg TTS and the third hot leg TSP were inspected with +Point probes. In 2002 and 2003, all bobbin signals with < 55 degree phase angles were inspected with +Point probes. The axial PWSCC signals at support plates had bobbin signals for multiple outages based on history look-ups after the indications had been detected.

For the 2002 inspection (2R09) 2 tubes were found with PWSCC at tube support plates. No PWSCC at tube support plates was reported during 2003 (2R10). No ding ODSCC was reported during 2003 (2R10).

5. One tube in SG C (R45C57) was administratively plugged due to a potential loose part. Please provide the results of any visual examinations performed in this area, if any. Please discuss whether the foreign object, if any, was removed. If a loose part was present and not removed, discuss the results of your assessment, if any, with respect to the effect of this part on the integrity of the neighboring tubes.

Response: A volumetric indication was reported on R45 C58. The part is wedged between R45 C57 and R45 C58. R45 C58 and R45 C57 were removed from service as the part could not be removed and the part had caused degradation of R45 C58. The elevation of the part (18.00 inches above tubesheet) prevented visual inspection. Both tubes were stabilized prior to plugging.

6. Please discuss the axial extent of the rotating probe inspections performed near the top of the tubesheet (e.g., from "x" inches above to "y" inches below the top of the tubesheet). In your October 9, 2003 letter, you indicated that 3 tubes had circumferential indications located above the hot leg tubesheet. Please clarify whether these indications were associated with the expansion transition or were in the unexpanded portion of the tube. Regarding the one circumferential indication identified above the top of the tubesheet in SG C, please clarify the tube in which this indication was located. The NRC staff notes that only one circumferential indication was reported on the "Tubes Removed from Service" list for SG C and this indication appears to be below the top of the tubesheet. If any of the indications were not associated with the expansion transition, please provide the technical basis for the scope of the rotating probe inspections above the top of the tubesheet (i.e., the basis for "x inches" above the top of the tubesheet). Also, please clarify the nature of the indications (e.g., PWSCC, ODSCC).

Response: Unit 2 hot leg TTS +Point examination extent is from 6.00 inches above to 3.00 inches below the TTS. The Unit 2 S/Gs tubesheets are full depth hardroll expanded. While the F* alternate repair criteria is not licensed at BVPS Unit 2, if it were to be applied, the required inspection distance is < 2.00 inches below TTS. Therefore, the 3.00 inches below the TTS is considered conservative.

Only circumferential ODSCC has been reported at Unit 2. The expansion transition can sometimes extend above the TTS. All circumferential indications have been associated with the expansion transition.

The circumferential indication in R4 C50 in S/G "C" was inadvertently reported in Attachment 1 of the October 9, 2004 letter as being above the tubesheet when it is actually 0.04" below the TTS. This indication is considered to be in the expansion transition region.

7. One tube was identified as being plugged for an obstruction. Discuss the largest size probe that passed through this tube during the 2003 outage, the largest size probe that ever passed through this tube, and the source and location (e.g., tube R1C1 at third hot leg tube support) of this obstruction. If the obstruction is service-induced, discuss the cause and any corrective actions taken or planned.

Response: The tube (R10 C35 in S/G "A") in question had intermittent +Point probe translation in the U-bend region. Review of historical bobbin coil data indicates no issues were encountered in past outages. A 0.720 inch bobbin coil probe would pass through the area; however, a 0.680 inch +Point probe would not. The tube was conservatively repaired due to data quality issues.