November 20, 2003

Mr. L. William Pearce
Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Post Office Box 4
Shippingport, PA 15077

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) - BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1) RE: CYCLE 16 (SPRING 2003) STEAM GENERATOR VOLTAGE-BASED REPAIR CRITERIA, 90-DAY REPORT (TAC NO. MC0249)

Dear Mr. Pearce:

By letter dated July 24, 2003, (ADAMS accession number ML032100660) FirstEnergy Nuclear Operating Company (FENOC) submitted the "[BVPS-1] Cycle 16 Voltage-Based Repair Criteria, 90-Day Report" (90-Day Report). Included as Appendix A to this report was the FENOC response to Enclosure 3 of an RAI issued by the Nuclear Regulatory Commission (NRC) on June 4, 2003 (ML031550196). This RAI contained follow-up questions about mix residual signals discussed during the 1R15 refueling outage steam generator inspection conference calls (ML031710065) and the steam generator reports from the licensee's previous steam generator tube inspections (ML030030573). The licensee had previously responded to Enclosures 1 and 2 of the June 4, 2003, RAI by letter dated July 18, 2003 (ML032040546).

The NRC staff has reviewed the FENOC July 24, 2003, letter and has identified additional information needed to complete its review. Questions pertaining to the BVPS-1, 90-Day Report and questions concerning FENOC's response to Enclosure 3 of the June 4, 2003, RAI are provided in Enclosures 1 and 2, respectively.

As discussed with and agreed to by your staff, we request your response within 90 days of receipt of this letter. If you have any questions, please contact me at 301-415-1402.

Sincerely,

/RA by RGuzman for/

Timothy G. Colburn, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-334

Enclosures: 1. RAI - BVPS-1 90-Day Report
2. RAI - June 4, 2004, RAI Response

cc w/encls: See next page

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ADAMS Accession Number: ML033070299 *Input provided. No substantive changes made.

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REQUEST FOR ADDITIONAL INFORMATION (RAI)

BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1)

"CYCLE 16 VOLTAGE-BASED REPAIR CRITERIA

90-DAY REPORT"

DOCKET NO. 50–334

1. At Diablo Canyon, Unit 2, several large bobbin voltage indications were detected during its steam generator (SG) tube inspections during its 2003 refueling outage. As a result of these findings, the licensee performed more extensive rotating probe inspections than previously performed so as to assist in determining whether certain axial outside diameter stress corrosion cracking (ODSCC) indications may be prone to significant bobbin voltage growth during the course of the next cycle (refer to Information Notice (IN) 2003-13).

   Given the findings at Diablo Canyon, Unit 2, discuss the +Point results, if any, for the larger voltage indications left in service during the 2003 refueling outage (1R15). Also, discuss whether the indications with the largest growth rates in Cycle 15 were inspected with a rotating probe during the current (2003) and/or the previous (2001) outage. Discuss any observations from the rotating probe profiling of these indications, the bobbin and rotating probe voltages of these indications, etc. For example, did the indications with the largest bobbin voltage growth rates have large rotating probe amplitudes (when compared to the bobbin amplitude) at the beginning of the cycle (i.e., during the 2001 outage (1R14))? Did the rotating probe data acquired at the beginning of the cycle (i.e., during the 2001 outage) indicate the flaw was nearly through-wall and the subsequent rotating probe data at the end of the cycle (in 2003) indicate the flaw had penetrated through-wall?

2. According to the "[BVPS-1]Cycle 16 Voltage-Based Repair Criteria 90-Day Report" (90-Day Report), the End-of-Cycle (EOC) 15 measured voltages were bounded by the voltage distributions projected using both probability of detection = 0.6 and probability of prior cycle detection, except for one indication in SG A. Discuss the reason for the voltage under prediction for this indication. Discuss any corrective actions that were taken in response to these findings.

3. Section 3.3 of the 90-Day Report, "Probe Wear Criteria," states that only 6 of the 628 new indications found in the EOC 15 inspection were in tubes inspected with a worn probe during the EOC 14. While this is a low absolute number of new indications in tubes previously inspected with a worn probe, compare the percentage of tubes that failed the probe wear check (in 1R14) and had new indications detected in the 1R15 inspection to the percentage of tubes that passed the probe wear check (in 1R14) and subsequently had new indications detected in the 1R15 inspection. The Nuclear Regulatory Commission (NRC) staff's concern is illustrated in the following hypothetical example. Suppose 20 new indications were detected during an outage. Further, suppose 10 of these new indications were associated with a probe that failed the probe

wear check in the previous outage and 10 were associated with a probe that passed the probe wear check during the previous inspection. If 100 tubes were inspected with a worn probe and 10,000 tubes were inspected with a probe that passed the probe wear check, 10% of the intersections inspected with the worn probe contained indications at the next outage while only 0.1% of those inspected with a “non-worn probe” had new indications. This may indicate the alternate probe wear criteria is causing degradation to be missed. Were any new indications detected with new probes that were not detected with worn probes?

4. In Figures 3-5 and 3-6 the cumulative probability distributions for the BVPS-1 Cycle 14 and Cycle 15 growth rate data are provided. These figures show, in part, the cumulative probability of observing various negative growth rates. Per Generic Letter (GL) 95-05, negative growth rates should be included as zero growth rates in the assumed growth rate distribution. Confirm that negative growth rates were included as zero growth rates in the growth distributions used in the Monte Carlo calculations.

5. Table 7-1 provides a summary of calculations for tube leak rate and tube burst probability. The staff notes two burst probability values were inadvertently omitted from the table. Please provide these values. Table 7-1 indicates that leak rates and burst probabilities were calculated using both Cycle 13 and Cycle 14 growth data and the largest values for the burst probability and leakage were listed. Clarify why, in some instances, the largest values for the burst probability and leakage are not associated with the growth distribution that resulted in the largest EOC voltage.

   In Table 7-1, the Addendum 4 database was used for determining the projected probability of burst (POB) and leakage values for EOC-15, and the Addendum 5 database was used for determining the actual POB and leakage values for EOC-15. Please discuss whether the use of these different databases had any affect on your assessment of whether the methodology is conservatively projecting the EOC conditions. If use of the different databases can not be demonstrated to provide equivalent results, please provide a set of calculations in which the projected and actual EOC conditions are assessed using the same database.

   The NRC staff recognizes your limiting projected leak rates and tube burst probability are well below the allowable main steam line break leakage and the NRC reporting guideline for tube burst probability. However, one of the purposes of this assessment is to evaluate whether the methodology is resulting in conservative projections so that timely corrective action can be taken.

6. You indicated that the growth rate for a deplugged tube returned to service shows an increased growth rate during the first cycle then exhibits normal growth thereafter. Please discuss whether you have any insights as to why this occurs.

REQUEST FOR ADDITIONAL INFORMATION (RAI)

BEAVER VALLEY POWER STATION, UNIT NO. 1 (BVPS-1)

"CYCLE 16 VOLTAGE-BASED REPAIR CRITERIA 90-DAY REPORT" (90-DAY REPORT)

APPENDIX A - RAI RESPONSE

DOCKET NO. 50–334

Based on a review of Appendix A to the licensee's 90-Day Report, the Nuclear Regulatory Commission (NRC) staff has concluded that additional clarifications are necessary in order to ensure the NRC has a clear understanding of the licensee's technical basis for addressing mix residuals. We have attempted to summarize the issue from a broad perspective and then focus on some specific questions.

A large mix residual as defined by the NRC is one which can result in a 1-volt outside diameter stress corrosion cracking (ODSCC) indication (as measured by the bobbin coil) being missed or misread. As a result, a large mix residual represents a condition by which a 1-volt or greater flaw signal may not be detected or is misread by the bobbin coil analyst because of the residual signal. This appears to contradict the licensee's descriptions of a true mix residual as one in which a tube support plate intersection has a non-perfectly formed ODSCC signal in the mix channel but a signal response in the 200 kHz (page A-2) or one that may contain ODSCC (page A-4).

Since mix residuals can represent an inspection challenge to the bobbin coil, the NRC staff in Generic Letter (GL) 95-05 indicated that all intersections with large mix residuals should be inspected with a rotating probe. The purpose of this guidance was to ensure that ODSCC indications (1 volt or greater) were being detected at these locations and subsequently repaired.

Based on the information you provided, it appears that at a support plate residual (SPR) amplitude of 1.5 volts can result in ODSCC indications in excess of 1 volt not being identified from the bobbin coil data analysis. This is supported by the solid diamonds in Figure A-1. In other words, SPR amplitudes of 1.5 volts can mask ODSCC flaws in excess of 1.0 volts. These results appear to question the adequacy of the licensee's criteria for identifying intersections with large mix residuals as defined by the NRC. Certainly, these results indicate, at a minimum, the need to perform rotating probe inspections at all locations where the residual signal exceeds 1.5 volts to ensure that 1-volt flaws are being identified consistent with the guidance in GL 95-05.

In order to assess the adequacy of the criterion being used at BVPS-1, it would appear (based on the NRC staff's understanding of the data) that intersections with residual signals less than 1.5 volts should be inspected with a rotating probe to confirm that ODSCC indications in excess of "1 volt" (as measured by bobbin) are not being missed.

Specific questions related to Appendix A are provided below. In all cases, when a reference is made to a question number, it refers to the question number shown in the FirstEnergy Nuclear Operating Company letter dated July 24, 2003 (ADAMS accession number ML032100660).

1. In the response to question 1, a distinction is made between SPR signals and the residual component of a clearly formed ODSCC signal. It is not clear to the NRC staff why there is a distinction between these two categories as discussed below. It is the NRC staff's understanding that the computerized data screening (CDS) should be identifying all mix residual signals in excess of 1.5 volts. In addition, it is the NRC staff's understanding that the bobbin coil manual data analysis (primary and secondary analysis) may result in a distorted support plate intersection (DSI) being called at this location. As a result, the NRC staff would expect CDS to identify an SPR and the manual data analysis, when appropriate, to call a DSI. The SPR would then be converted to a DSI. In the cases where a DSI is called based on the manual analysis and an SPR is called from CDS, it indicates (to the NRC staff) that the distortion introduced into the signal as a result of the residual (or other interfering signals) was not significant enough to prevent the detection of this particular flaw at this particular location. However, it does not indicate that this will always be the case. This is supported by the data in Figure A-1. Please clarify why you draw the distinction between these 2 cases. Are all support plate residual signals in excess of 1.5 volts being called by CDS? If not, why not.

2. The question 1 response indicates that 115 signals initially called SPR by CDS were reclassified as part of the manual analysis process. Please clarify whether these 115 signals were called DSI based on the original bobbin coil data analysis (consistent with the methodology described in question 1) or whether the SPR triggered another analysis of the bobbin coil data and this resulted in the indications being called DSIs. If the latter was true, why were these indications missed during the initial bobbin coil data analysis and what actions were taken to prevent recurrence.

3. Appendix A indicates that 388 of the 1228 SPRs in excess of 1.5 volts were ultimately determined to contain flaws (i.e., DSI signals). Does the 388 include the 115 indications that were originally called DSIs based on the bobbin analysis? If so, is the NRC staff correct in assuming that 273 flaws were identified only after the +Point exams were performed? Is the NRC staff correct in assuming that since only 1056 SPRs were inspected with +Point that 57 were dispositioned as not containing a flaw based on bobbin coil data alone (1228 - 115 - 1056 = 57)?

4. In the response to question 2, please clarify the second sentence in the second paragraph. If the sentence is implying that the support plate residual is not affecting the voltage amplitude of the ODSCC flaw in SPRs subsequently reclassified as DSIs following +Point examination, it is not clear how this was determined from this figure. Figure A-1 appears to indicate to the NRC staff that the voltages of DSIs identified through +Point examination of SPRs are similar to the voltages of DSIs identified through bobbin analysis at SPRs. Since for any data point, the bobbin voltage may be affected by the support plate residual, it does not appear that any conclusion could be drawn on whether the voltages reported are not being misread (i.e., are consistent with the voltages used in the leakage and burst calculations). Please clarify.

5. Please clarify that the “DSI Volts” for the “DSI As Reported” indications in Figure A-2 are from the 400/100 bobbin mix channel and that the voltages for the “DSI from SPR using 200 kHz” are from the 400/100 mix channel after locating the flaw on the 200 kHz bobbin channel.

6. In the response to question 3, it is indicated that the SPR measurement from the greater than 1 volt DSIs called from the SPRs (from either bobbin or +Point) ranged from 1.83 to 2.82 volts. This observation does not appear to match Figure A-1 in which the lower SPR voltage range appears to be 1.5 volts. Please clarify.

7. In the response to question 3, it is indicated that the entire DSI population, excluding SPRs subsequently changed to DSI, consists of 3591 indications. Please clarify whether this population includes DSIs that were called from the bobbin data even though the residual voltage exceeds 1.5 volts (similar to questions 1 and 2). If it doesn’t, please clarify how a residual in the 166 tube sample discussed later in the question could have a residual of 3.42 volts.

8. In the response to question 3, it is indicated that a negligible SPR signal can be considered one with no signal response in the 200 kHz bobbin channel. The basis for this statement is not clear. Per GL 95-05, a negligible mix residual would be one that would result in the identification of indications in excess of 1 volt and a reliable voltage measurement of indications greater than 1 volt. Please clarify the basis for the above statement. For example, why weren’t the DSI’s called simply based on analysis of the 200 kHz bobbin data.

9. In the response to question 4, please clarify why the residual signals must always be larger than the DSI ODSCC voltage measurements? If this were the case, are all locations where the ODSCC indication voltage exceeds 1.5 volts (by bobbin) called SPRs by CDS?

10. The intent of question 4 was to ascertain whether there is a difference between the 200 kHz to 400/100 kHz “relationship” for indications with SPRs to those without SPRs. If there was no difference one could argue that the SPR had no effect on the mix voltage. If there was a difference between the relationship (if any), one could argue that the SPR was affecting the 400/100 mix voltage readings. It is not clear from the response why this is an “indirect” comparison. In addition, it is not clear what the intent of evaluating the ratio of the residual voltage to the ODSCC voltage for the two populations indicates with respect to whether 1-volt indications are being missed or misread. Please provide the originally requested plot.

11. In the response to question 4, it is indicated that for the initial SPR sample, the ODSCC component was generally closer to the SPR amplitude than the remainder of the SPR data set. The basis for this observation is not evident from the evaluation of Figure A-3. If this were the case, wouldn’t the line with the open square in Figure A-3 always be greater (i.e. to the left) of the lines for the other two data sets?

12. In the response to question 5, it is indicated that if an SPR is determined to have a flaw and the 200 kHz (bobbin) channel exhibited a signal that could be observed the indication was classified a DSI. If there is an indication in the 200 kHz bobbin channel

wouldn't it be reported as a DSI by the primary and/or secondary analyst? In other words, is the 200 kHz signal readily detectable and just not being reported or is the 200 kHz signal only "detectable" once the +Point data is available? If they are readily detectable, were all 73 indications originally called SPRs in 1R14 and subsequently classified DSIs identified by the primary/secondary analysis team (manual analysis) as DSIs in 1R15? If not, why not?

13. Please clarify that the beginning-of-cycle (BOC) voltage and EOC average voltages for the SPR/DSIs are correct. That is, was the BOC 15 average voltage 0.93 volts and the average EOC 15 average voltage 0.92 volts?

14. Within the population of SPR signals flagged by CDS there is a set of indications called DSI during the manual analysis of the bobbin coil data. Another subset of the SPR signals includes indications not called DSI during initial bobbin coil manual analysis but changed to DSI based on subsequent +Point probe inspection. Discuss whether the detection of the ODSCC indications at SPR locations with a bobbin coil probe is a result of the ODSCC indication being far enough away from the mix residual signal. In addition, discuss whether there is any relationship between the magnitude of the residual signal at the ODSCC indications identified through bobbin coil analysis to the magnitude of the mix at the ODSCC indications identified through +Point data analysis at SPR locations.

15. Regarding the effects of mix residuals on the ability to size ODSCC indications, discuss what testing has been performed to confirm that the mix residual criteria ensures that the voltages of indications greater than 1 volt are not affected by the residual. For example, have the various flaw signals at an intersection with a small mix residual and at a large mix residual been tested to determine the effects on the voltage of the indication?

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