

December 27, 2004

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

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NOS. 1 AND 2 (BVPS-1 AND 2) -  
EVALUATION OF INSERVICE TESTING (IST) PUMP RELIEF REQUEST NO. 8,  
REVISIONS 1K AND 2I, RESPECTIVELY (TAC NOS. MC3240 AND MC3241)

Dear Mr. Pearce:

By letter dated May 21, 2004, as supplemented July 9, 2004, FirstEnergy Nuclear Operating Company (the licensee) requested relief from certain IST requirements for the 3<sup>rd</sup> and 2<sup>nd</sup> 10-year IST intervals, respectively, for certain pumps at BVPS-1 and 2. The 3<sup>rd</sup> 10-year interval and 2<sup>nd</sup> 10-year interval, respectively, for BVPS-1 and 2 IST programs are based on the 1989 Edition of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code). For IST of pumps, Section XI of the ASME Code, Subsection IWP, references the 1987 Edition through 1988 Addenda of OM-6 Standard, "Inservice Testing of Pumps in Light-Water Reactor Power Plants." The licensee proposed an alternative vibration alert limit of 0.50 in/sec in lieu of the requirements specified in Table 3a of the OM-6 Standard.

The Nuclear Regulatory Commission (NRC) has completed its review of the relief request and the proposed alternative. As described in the enclosed safety evaluation, the NRC staff has concluded that the licensee's proposed alternative is authorized pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(i) on the basis that it provides an acceptable level of quality and safety.

If you have any questions regarding this approval, please contact the BVPS-1 and 2 Project Manager, Mr. Timothy G. Colburn, at (301) 415-1402.

Sincerely,

**/RA by Richard Guzman for/**

Richard J. Laufer, Chief, Section 1  
Project Directorate I  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket Nos. 50-334 and 50-412

Enclosure: Safety Evaluation

cc w/encl: See next page

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\*No substantive changes made

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PUMP RELIEF REQUEST NO. 8, REVISIONS 1K AND 2I

BEAVER VALLEY POWER STATION, UNIT NOS. 1 AND 2 (BVPS-1 AND 2)

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NOS. 50-334 AND 50-412

1.0 INTRODUCTION

By letter dated, May 21, 2004, as supplemented July 9, 2004, FirstEnergy Nuclear Operating Company (FENOC), the licensee, submitted Pump Relief Request No. 8, Revisions 1K and 2I, requesting relief from certain inservice testing (IST) requirements for various pumps at BVPS-1 and 2. Pump Relief Request No. 8, Revision 1K, is applicable to BVPS-1, and Pump Relief Request No. 8, Revision 2I, is applicable to BVPS-2. BVPS-1 and 2 are in their 3<sup>rd</sup> and 2<sup>nd</sup> 10-year IST intervals, respectively. The BVPS-1 third 10-year IST interval program and BVPS-2 second 10-year IST interval program are based on the requirements in Section XI of the 1989 Edition of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code). For IST of pumps, the ASME Code, Section XI, Subsection IWP references the 1987 Edition through the 1988 Addenda of Operations and Maintenance (OM)-6 Standard, "Inservice Testing of Pumps in Light-Water Reactor Power Plants."

In Pump Relief Request No. 8, the licensee has proposed a vibration alert limit of 0.50 in/sec for various pumps in lieu of the requirements specified by Table 3a of the OM-6 Standard.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations*, (10 CFR), Part 50, Section 50.55a, "Codes and standards," requires that IST of ASME Code, Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Code and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to Sections (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making necessary findings. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to ASME Code

requirements which are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, "Guidance for Inservice Testing at Nuclear Power Plants."

BVPS-1 and 2 are in their third and second 10-year IST intervals, respectively, and must comply with the requirements of the 1989 Edition of the ASME Code, Section XI, Subsection IWP for pumps and Subsection IWV for valves. Subsection IWP specifies requirements for IST of pumps and references Part 6 of the ASME Code/American National Standards Institute (ANSI) OM-6 for IST of pumps.

By the letter dated May 21, 2004, FENOC proposed alternatives to the requirements of the ASME Code, Section XI, for BVPS-1 and 2 for their third and second 10-year IST interval programs. The BVPS-1 third 10-year IST interval is from September 20, 1997, through September 20, 2007. The BVPS-2 second 10-year IST interval is from November 18, 1997, through November 18, 2007. The NRC's findings with respect to authorizing alternatives and granting IST relief requests are discussed below.

### 3.0 TECHNICAL EVALUATION

The licensee's regulatory and technical analyses in support of its requests for relief from ASME OM-6 Code IST requirements are described in the licensee's submittals dated May 21, 2004, and July 9, 2004. The licensee submitted two separate No. 8 Relief Requests (Revisions 1K and 2I) for BVPS-1 and 2; however, because the relief requests request the same vibration alert limit, both relief requests have been reviewed jointly. A description of the relief request and the NRC staff evaluation follows.

#### 3.1 Pump Relief Request No. 8

The licensee has requested relief for the pumps listed in Table-1 from the requirements of OM-6, paragraph 4.3, "Reference Values." Paragraph 4.3 requires that the reference values shall be determined from the results of preservice testing or from the results of the first inservice test. Reference values shall be at points of operation readily duplicated during subsequent tests. All subsequent test results shall be compared to these initial reference values or to new reference values established in accordance with Paragraph 4.4 and 4.5.

Table-1, Pump Numbers

<u>BVPS-1</u>		<u>BVPS-2</u>	
1-CH-P-2A	1-QS-P-4A	2-CHS*P21C	2-QSS*P24A
1-CH-P-2B	1-QS-P-4B	2-CHS*P22A	2-RHS*P21A
1-EE-P-1A	1-QS-P-4C	2-CHS*P22B	2-SWS*P21B
1-EE-P-1B	1-QS-P-4D	2-EGF*P21A	
1-EE-P-1C	1-RH-P-1A	2-EGF*P21B	
1-EE-P-1D	1-RH-P-1B	2-EGF*P21C	
1-FW-P-3A	1-WR-P-1A	2-EGF*P21D	
1-FW-P-3B	1-WR-P-1B	2-FWE*P23A	
	1-WR-P-1C		

OM-6, Part 5, "Testing Methods," Paragraph 5.2(d), "Test Procedures" states that vibration (velocity) shall be determined and compared with the corresponding reference values. All

deviation from reference values shall be compared with the limits given in Table 3a and corrective action taken as specified in Paragraph 6.1. This request applies only to vibration testing.

### 3.1.1 Licensee's Basis for Requesting Relief

The licensee states:

In accordance with 10 CFR 50.55a(a)(3)(i), relief is requested on the basis that the proposed alternative would provide an acceptable level of quality and safety.

The above pumps in the BVPS-1 and BVPS-2 IST Programs have at least one vibration reference value ( $V_r$ ) that is currently less than 0.05 in/sec [inches per second]. A small value for  $V_r$  produce small a acceptable range for pump operation. The ASME [Code, Section] XI Acceptable Range limit for pump vibrations from Table 3a of OM-6 is  $\#2.5 V_r$ . Based on a small acceptable range, a smooth running pump could be subject to unnecessary corrective action if it exceeds this limit. Per OM-6, Paragraph 6.1, "Acceptance Criteria," if deviations fall within the alert range of Table 3a, the frequency of testing shall be doubled until the cause of the deviation is determined and the condition corrected.

For very small reference values for vibrations, flow variations, hydraulic noise, and instrument error can be a significant portion of the reading and affect the repeatability of the subsequent measurements. Also, experience gathered by the BVPS Predictive Maintenance (PdM) Group has shown that changes in vibration levels in the range of 0.05 in/sec do not normally indicate significant degradation in pump performance.

In order to avoid unnecessary corrective actions, a minimum value for  $V_r$  of 0.05 in/sec is proposed. This minimum value would be applied to individual vibration locations for [the] pumps [listed in Table-1] with reference vibration values less than 0.05 in/sec. Therefore, the smallest ASME [Code, Section] XI Acceptable Range limit for any IST pump vibration location would be no lower than 2.5 times  $V_r$  or 0.125 in/sec, which is within the "fair" range of the "General Machinery Vibration Severity Chart" provided by IRD Mechanalysis, Inc. Likewise, the smallest ASME [Code, Section] XI Alert Range limit for any IST Pump vibration location for which the pump would be inoperable would be no lower than 6 times  $V_r$ , or 0.300 in/sec.

ASME [Code, Section] XI, Table IWP-3100-2, "Allowable Ranges of Test Quantities," specifies a vibration Acceptable Range limit of 1.0 mil for a displacement reference value  $\#0.5$  mils. In velocity units, a displacement reference value of 0.5 mils is equivalent to 0.047 in/sec for an 1800 rpm pump

and 0.094 in/sec for a 3600 rpm pump. The effective minimum reference value proposed (0.05 in/sec) for smooth-running pumps is roughly equal to the ASME [Code, Section] XI IWP reference value for an 1800 rpm pump and more conservative than the reference value for a 3600 rpm pump. Without this relief,

the ASME [Code, Section] XI Acceptable Range limit for some extremely smooth running pumps is reduced by as much as a factor of 10.

In addition to the requirements of OM-6 for IST, the pumps in the BVPS-1 and BVPS-2 IST Programs are also included in the BVPS PdM Program. The BVPS PdM Program currently employs predictive monitoring technique such as: vibration monitoring and analysis beyond that required by OM-6, bearing temperature trending, oil sampling and analysis, and/or thermography analysis as applicable.

If the measured parameters are outside the normal operating range or are determined by analysis to be trending towards an unacceptable degraded state, appropriate actions are taken that may include: increased monitoring to establish rate of change, review of component specific information to identify cause, and removal of the pump from service to perform maintenance.

It should be noted that all of the pumps in the IST Program will remain in the BVPS PdM Program even if certain pumps have very low vibration readings and are considered to be smooth running pumps. Using the provisions of this relief request as an alternative to the specific requirements of OM-6 identified above will provide adequate indication of pump performance and continue to provide an acceptable level of quality and safety.

### 3.1.2 Alternative Testing

The licensee proposes:

Pumps with a measured reference value below 0.05 in/sec for a particular vibration measurement location will have subsequent test results for that location compared to an ASME [Code, Section] XI [OM-6] Acceptable Range limit of 0.125 in/sec and an ASME [Code, Section] XI [OM-6] Alert Range limit of 0.300 in/sec (base on a minimum reference value 0.05 in/sec).

In addition to the Code requirements, all pumps in the BVPS-1 and BVPS-2 IST Programs are included in and will remain in the BVPS PdM Program regardless of their smooth running status.

### 3.1.3 Evaluation

OM-6 Standard, paragraph 4.6.4, "Vibration Measurement," requires that measurements of each centrifugal pump be taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions on each accessible pump-bearing housing. The measurement is also required to be taken in the axial direction on each accessible pump thrust-bearing housing.



The OM-6 Standard also requires for vertical-line shaft pumps that the vibration measurements be taken on the upper motor-bearing housing in three orthogonal directions including the axial direction. These measurements are required to be compared with the ASME Code vibration acceptance criteria as specified in Table 3a of OM-6 to determine if the measured values are acceptable.

Table 3a of the OM-6 Standard states that, if during an inservice test, a vibration measurement exceeds 2.5 times the reference value ( $V_r$ ), previously established as required by paragraph 4.3, the pump is considered in the alert range. The frequency of testing is then doubled in accordance with paragraph 6.1, "Acceptance Criteria," until the cause of the deviation is determined and the condition is corrected and the vibration level returns below the alert range. Pumps whose vibration is recorded to be 6 times  $V_r$ , are considered in the required action range and must be declared inoperable until cause of the deviation has been determined and the condition is corrected. The vibration reference values are required by paragraph 4.3 to be determined when the pump is in good condition.

For pumps whose absolute magnitude of vibration is an order of magnitude below the absolute vibration limits in Table 3a, a relatively small increase in vibration magnitude may cause the pump to enter the alert or required action range. These instances may be attributed to variation in flow, instrument accuracy, or other noise sources that would not be associated with degradation of the pump. Pumps that operate in this region are typically referred to as "smooth-running." Based on a small acceptable range, a smooth-running pump could be subjected to unnecessary corrective action.

The ASME OM Code Subgroup on Pumps has tried numerous times to implement a Code change to establish test requirements for a class of pumps, defined as smooth-running. These requirements focused on selecting a minimum vibration to be specified in the proposed Code change that would assign the minimum reference values. The Code committees have not reached a consensus on the appropriate minimum reference value or on whether this approach would be sufficient to determine degradation in safety pumps during testing. In addition, the Code committees have discussed what other types of pump monitoring activities should be included as compensatory requirements for testing of smooth-running pumps.

At a plant, previously authorized to use the smooth-running pump methodology as described above, the minimum reference value was 0.1 in/sec. However, a pump bearing at this plant experienced significant degradation even though the vibration was below the minimum reference value in the proposed alternative. If the current Code requirements been in place, the bearing vibration level for this pump would have exceeded the alert range. The degradation was discovered during vibration monitoring for a predictive maintenance program. The experience at this plant indicates that a simple minimum reference value method alone would not be sufficient to determine pump degradation.

The licensee's alternative combines the minimum reference value method with the monitoring of all the IST pumps listed in Table-1 using a predictive maintenance program even if certain pumps have very low vibration readings and are considered to be smooth-running pumps. The licensee will assign a vibration reference value of 0.05 in/sec to any pump bearing vibration direction where, in the course of determining its reference value, has a measured value below 0.05 in/sec. Therefore, the acceptable range as defined in Table 3a will be less than or equal to 0.125 in/sec and the alert range will be 0.125 to 0.30 in/sec.



The licensee's proposal also describes the predictive monitoring program for all IST Program pumps considered important to safe and reliable plant operation. The licensee states the BVPS-1 and 2 Predictive Maintenance Program goes beyond the IST requirements for pumps. The program includes bearing temperature trending, oil sampling and analysis, and

thermography analysis. The licensee states that if the measured parameters are outside the normal operating range or are determined by analysis to be trending towards an unacceptable degraded state, appropriate actions will be taken. These actions include increased monitoring to establish the rate of degradation, review of component-specific information to identify cause, and removal of the pump from service to perform maintenance. The proposed alternative is consistent with the objective of IST which is to monitor degradation in safety-related components.

Based on the minimum vibration reference value method and the proposed predictive maintenance program, the NRC staff finds that the alert and required action limits specified in the relief request will address previously undetected acute pump problems and provide an adequate indication of pump performance. The licensee's predictive maintenance program is designed to detect problems involving the mechanical condition in advance of when the pump reaches its overall vibration alert limit. Therefore, the licensee's proposed alternative will provide an acceptable level of quality and safety.

#### 4.0 CONCLUSIONS

Based on a review of the information provided by the licensee, the NRC staff concludes that the licensee's proposed alternative to the ASME Code vibration requirements of OM-6, paragraph 4.3, is authorized pursuant to 10 CFR 50.55a(a)(3)(i) in that the alternative provides an acceptable level of quality and safety.

#### 5.0 REFERENCES

1. U.S. Nuclear Regulatory Commission, "Guidance on Developing Acceptable Inservice Testing Program," Generic Letter 89-04 through Supplement 1, April 4, 1995.
2. U.S. Nuclear Regulatory Commission, "Guidance for Inservice Testing at Nuclear Power Plants," NUREG-1482, April 1995.
3. Letter, L. William Pearce, FirstEnergy Nuclear Operating Company, to NRC, "Request for Review and Approval of Relief Request 8, Revisions 1K and 2I, Addenda 1 for Beaver Valley Power Plants, Units 1 and 2 associated with third and second 10-Year Interval Inservice Testing Program," dated May 21, 2004.
4. Letter, L. William Pearce, FirstEnergy Nuclear Operating Company, to NRC, "Response to Request for Additional Information Regarding third and second 10-Year Interval Inservice Testing Program Pump Relief Request No. 8, Revision 1K, and 2I for BVPS Units 1 and 2." July 9, 2004.

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Date: December 27, 2004

