FENOC
FirstEnergy Nuclear Operating Company

Beaver Valley Power Station
P.O. Box 4
Shippingport, PA 15077

Paul A. Harden
Site Vice President

724-682-5234
Fax: 724-643-8069

June 21, 2010
L-10-175

10 CFR 50.55a

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

SUBJECT:
Beaver Valley Power Station, Unit No. 2
Docket No. 50-412, License No. NPF-73
Supplement to 10 CFR 50.55a Request for Alternative Weld Repair Method for Reactor Vessel Head Penetration J-Groove Welds (TAC No. ME2608)

By correspondence dated November 14, 2009 (Accession No. ML093220057), FirstEnergy Nuclear Operating Company (FENOC) submitted 10 CFR 50.55a Request 2-TYP-3-RV-03, which requested Nuclear Regulatory Commission (NRC) approval of alternative non-destructive examination acceptance criteria for the embedded flaw weld overlay repair method employed to repair the reactor pressure vessel (RPV) head penetration nozzles at Beaver Valley Power Station Unit No. 2 (BVPS-2). The requested duration was the remainder of the BVPS-2 third 10-year in-service inspection interval, scheduled to end in August, 2018. On November 15, 2009 the NRC staff provided verbal authorization of the proposed alternative, but limited the authorization to one cycle of operation. Authorization to use the surface non-destructive examination acceptance criteria of the construction code, in lieu of the previous requirement of no indications, was limited to the alloy 52 weld overlay repair material over the stainless steel cladding on penetration nozzle number 57. This was documented in a letter dated March 12, 2010 (Accession Number ML100680781).

The attached supplement to Request 2-TYP-3-RV-03 provides proposed alternatives to the non-destructive examination acceptance criteria and the filler metal to be used for the part of the repair overlay that extends beyond the J-groove weld and over the stainless steel clad on the inside surface of the reactor vessel head. The alternative acceptance criteria will allow a significant personnel dose savings by utilizing the surface examination acceptance criteria of the original construction code for the required surface examination, and the alternative filler metal will reduce the contaminant level and crack susceptibility.

A047
NRR

Only those sections of Request 2-TYP-3-RV-03 that require modification have been addressed in the attached supplement. The alternatives are proposed for use during the remainder of the current BVPS-2 10-year inservice inspection interval, which ends August 28, 2018. Approval is requested by January 7, 2011, to support the BVPS-2 spring 2011 refueling outage (2R15).

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-761-6071.

Sincerely,

for P Harden

Paul A. Harden

Attachment:
Beaver Valley Power Station Unit No. 2,
Supplement to 10 CFR 50.55a Request 2-TYP-3-RV-03

cc: NRC Region I Administrator
NRC Senior Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(ii)

BACKGROUND INFORMATION

On November, 14, 2009, FirstEnergy Nuclear Operating Company (FENOC) submitted 10 CFR 50.55a Request 2-TYP-3-RV-03 (Reference 1) to update previous approved 10 CFR 50.55a Request 2-TYP-3-RV-01, dated October 9, 2008 (Reference 2), that was approved by the NRC on October 6, 2009 (Reference 3). In the update, FENOC requested Nuclear Regulatory Commission (NRC) authorization to utilize the surface non-destructive examination acceptance criteria of the original construction code versus the previously approved acceptance criteria of no surface flaw indications (referred to hereafter as indications) for the embedded flaw weld overlay repair technique. The duration of the request was the remainder of the Beaver Valley Power Station Unit No. 2 (BVPS-2) third 10-year in-service inspection interval, scheduled to end in August 2018. On November 15, 2009 the NRC staff provided verbal authorization of the proposed alternative, but limited the authorization to one cycle of operation. Authorization to use the surface non-destructive examination acceptance criteria of the construction code, in lieu of the previous requirement of no indications, was limited to the alloy 52 weld overlay repair material over the stainless steel cladding on penetration nozzle number 57 (Reference 4).

This supplement to Request 2-TYP-3-RV-03, proposes the use of alternative surface non-destructive examination acceptance criteria in lieu of that specified in Section 5.2, Item 5 of Request 2-TYP-3-RV-03, and the use of an additional filler metal for the outside diameter and J-groove weld overlay repair methodology described in Section 5.2 of Request 2-TYP-3-RV-03. Specifically the examination methodology would be revised to utilize the surface non-destructive examination acceptance criteria of the original construction code versus the previously approved acceptance criteria of no surface indications for the part of the embedded flaw weld overlay repair that extends past the original J-groove weld onto the stainless steel cladding covering the inside surface of the head. Nondestructive surface examination acceptance criteria for the remainder of the weld overlay shall be PT White. In addition, to minimize the occurrence of indications at the fusion line between the alloy 52M weld filler material and the reactor vessel head cladding, a barrier layer of alloy ER309L weld filler material will be installed between the alloy 52M and reactor vessel head cladding at this location.

Only those sections of Request 2-TYP-3-RV-03 that require modification have been addressed in this supplement.

3.0 APPLICABLE CODE REQUIREMENTS

The following applicable code requirements are identified in addition to those specified in Section 3.0 of Request 2-TYP-3-RV-03.

Subarticle NB-5300 of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Section III, provides acceptance standards for weld repairs performed on ASME components. Paragraph NB-5350 provides liquid penetrant acceptance standards. The specific ASME Code requirements that the proposed alternative requests to use are as follows:

ASME Code Section III, Paragraph NB-5351, "Evaluation of Indications," states that:

(a) Mechanical discontinuities at the surface will be indicated by bleeding out of the penetrant; however, localized surface imperfections such as may occur from machining marks or surface conditions may produce similar indications which are non-relevant to the detection of unacceptable discontinuities.

(b) Any indication which is believed to be non-relevant shall be regarded as a defect and shall be re-examined to verify whether or not actual defects are present. Surface conditioning may precede the re-examination. Non-relevant indications and broad areas of pigmentation which would mask indications of defects are unacceptable.

(c) Relevant indications are those which result from mechanical discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are indications which are circular or elliptical with the length less than three times the width. Indications resulting from nonmetallic inclusions are not considered relevant indications.

ASME Code Section III, Paragraph NB-5352, "Acceptance Standards," states that:

Unless otherwise specified in this Section of the Code, the following relevant indications are unacceptable:

(a) Any cracks or linear indications;

(b) Rounded indications with dimensions greater than 3/16 inch;

(c) Four or more rounded indications in a line separated by 1/16 inch or less edge to edge;

(d) Ten or more rounded indications in any 6 square inches of surface with the major dimension of this area not to exceed 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

4.0 REASON FOR REQUEST

The following paragraphs supplement the information provided in Section 4 of Request 2-TYP-3-RV-03.

For removal or mitigation of defects by welding, American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Section XI, IWA-4411 requires that repair and installation of replacement items shall be performed in

accordance with the owners Design Specification and the original construction code of the component or system. The applicable original construction code acceptance criteria for dye penetrant testing (PT) of the weld overlay repair surface allows rounded indications (less than or equal to 3/16 inch) as stated in Section 3.0 above.

The previously approved 10 CFR 50.55a request (Reference 2) required the entire weld overlay repair surface to be examined by PT with the acceptance criteria of "PT White," that is, no indications. An alternative is being requested because significant radiation dose was estimated to be incurred to satisfy the "PT White" acceptance criteria versus the original construction code acceptance criteria.

The following paragraphs describe the events leading to difficulty in removing indications, the source of the contamination leading to the indications, and radiation exposure associated with the repair activity.

During the BVPS-2 refueling outage in the fall of 2009, ultrasonic examinations performed on penetrations 49 and 57 of the reactor vessel head revealed unacceptable indications in J-groove welds. The indications were subsequently repaired by the embedded flaw weld overlay repair process described in Request 2-TYP-3-RV-01.

Welding was performed using the machine Gas Tungsten Arc Welding (GTAW) process using alloy 52M filler metal. Contamination from impurities in the original reactor vessel head cladding contributed to the indications at the weld periphery. The indications were predominantly located at the toe of the weld, and had an appearance typical of the solidification anomalies (that is, hot cracking) for which alloy 52M welding filler materials are known. In an effort to repair these indications, successive grinding and surface examinations were implemented.

The repeated grinding and welding attempts did not successfully remove all of the fusion boundary indications on penetration 57. Radiation exposure associated with a single weld overlay repair operation is approximately 10,000 mRem. To obtain a weld overlay with no indications (PT White) could require significant additional radiation exposure. It was estimated that an additional expenditure of approximately 10,000 mRem of radiation exposure may have been needed to successfully remove the indications on penetration 57 in order to establish a "PT White" condition.

Use of alternative filler metal is proposed in order to reduce the contaminant level and crack susceptibility in weld overlay repair material located over the stainless steel cladding, and thereby reduce the number of indications.

5.0 PROPOSED ALTERNATE AND BASIS FOR USE

Alternative Nondestructive Examination Acceptance Criteria

The following proposed alternative acceptance criteria supercedes the acceptance criteria specified in Section 5.2, Item 5 of Request 2-TYP-3-RV-03.

Nondestructive surface examination acceptance criteria of the original construction code shall be used for that part of the repair overlay that extends past the toe of the original alloy 600 J-groove weld. Specifically, the criteria, as detailed in ASME Code Section III, 1971 edition, Summer 1972 addenda (original construction code) and presented in Section 3.0, Applicable Code Requirements, shall be used. Nondestructive surface examination acceptance criteria for the remainder of the weld overlay shall be PT White.

The above proposed alternative acceptance criteria applies to the post repair PT referred to in Section 5.2, Item 5, of Request 2-TYP-3-RV-03, and is to be used in lieu of establishing "PT White" conditions on the entire surface of the weld overlay repairs.

Alternative Filler Metal

The following proposed alternative filler metal is to be applied in addition to the weld repair method described in Section 5.2 of Request 2-TYP-3-RV-03.

Prior to application of three alloy 52M repair weld layers on the clad surface, a minimum of three passes (one layer) of alloy ER309L shall be installed at the periphery of the weld overlay (at the repair-to-clad interface).

The alloy ER309L weld passes ensure that the outer pass of the alloy 52M embedded flaw weld overlay repair only contacts the alloy ER309L weld deposit, and does not contact the original clad material. The alloy ER309L weld passes are not permitted to come into contact with the alloy 600 weld. Alloy 52M weld passes do not extend beyond the outermost edge of the alloy ER309L weld passes. This ensures that the entirety of the outer most edge of the alloy 52M weld will rest on the surface of the barrier layer of the alloy ER309L filler and does not contact the stainless steel cladding. However, if unacceptable indications are identified at the periphery of the embedded flaw weld overlay repair during final NDE, and repair welding is required, alloy 52M material may extend beyond the alloy ER309L weld beads to accommodate the repair.

5.3 Technical Basis for Proposed Alternative

The following paragraphs supplement the information provided in Section 5.3 of Request 2-TYP-3-RV-03.

The purpose of the repair overlay welds is to embed and isolate identified flaws in the alloy 600 reactor vessel head penetration tube and/or its alloy 600 (Inconel 182) J-groove attachment weld. The repair overlay welds are not credited for providing structural strength to the original pressure boundary materials.

The weld overlay repair extends a radial distance beyond the toe of the original J-groove welds by a minimum of 1/2 inch. Repair weld overlays are a minimum of three (3) layers in thickness. It is unlikely that indications resulting from the impurities in the original stainless steel cladding will be present in sufficient numbers or volume such that a path for communication of the reactor coolant back to the alloy 600 J-groove is

possible. Additionally, the presence of these small indications in the weld repair deposit would have no propensity to cause crack extension. Therefore, it can be reasonably concluded that the original susceptible material (alloy 600/Inconel-182 J-groove weld) will be isolated from the environment during operation and crack growth and additional crack initiation resulting from primary water stress corrosion cracking will be precluded.

The beneficial effects of the weld overlay repair as detailed in Request 2-TYP-3-RV-03 will not be compromised by the presence of original construction code acceptable indications at the fusion line area of the repair where the weld overlay contacts the original reactor vessel head cladding.

As stated in Request 2-TYP-3-RV-03, successive post repair examinations of the J-groove welds repaired utilizing the embedded flaw weld overlay repair process will be conducted in accordance with 10 CFR 50.55a(g)(6)(ii)(D), which requires implementation of ASME Code Case N-729-1 with certain conditions. The requirements of ASME Code Case N-729-1 include successive post repair surface examinations of the overlay and successive post repair volumetric examinations of the alloy 600 reactor vessel head penetration tubes.

Acceptance criteria of ASME Code Case N-729-1 paragraph 3132.1(b) for surface indications does not require "PT White" conditions. While linear indications detected by surface examination are explicitly unacceptable, rounded indications are acceptable in the absence of other relevant conditions (that is, evidence of nozzle leakage). The acceptance criteria of the original construction code will be utilized for subsequent examinations of repair overlays in the BVPS-2 reactor vessel head. The original construction code acceptance criteria in paragraph NB-5352 states that rounded indications with dimensions greater than 3/16 inch are unacceptable. This original construction code acceptance criteria is considered conservative when compared to the ASME Code Case N-729-1 acceptance criteria that allows rounded indications in the absence of other relevant conditions. The defect evaluation and examination criteria of ASME Code Section XI, 2001 Edition, 2003 Addenda, Paragraph IWA-4422.1(b) permits identified defects to be evaluated to original construction code acceptance criteria.

Use of the alloy ER309L weld barrier for weld overlay repairs will reduce the contaminant level present during installation of the critical alloy 52M outer pass. Specifically, only the first alloy ER309L pass will be fully in contact with the cladding. This first pass, due to its exposure to maximum substrate-related dilution, has the highest susceptibility to cracking. The second alloy ER309L pass will be exposed to substantially lower substrate-related contaminant levels, by virtue of its overlap with the initial alloy ER309L pass. The third alloy ER309L weld pass will also benefit from reduced substrate-related contaminant exposure in the same manner. This alloy ER309L weld sequence will reduce contaminant exposure and crack susceptibility at the outer edge of this weld region.

Repair overlay welds are not credited for providing structural strength to the original pressure boundary materials. The ASME construction code acceptance criteria is based on the finding that any defects identified using this criteria would not significantly impact the structural integrity of the original weld. Therefore, the proposed alternative ASME construction code acceptance criteria and change to the repair method, both described above, provide reasonable assurance of structural integrity.

7.0 PRECEDENT

The last sentence of Section 7.0 in Request 2-TYP-3-RV-03 is superseded by the following. The same flaw repair process described in Request 2-TYP-3-RV-01 will be applied except for the proposed alternative post repair surface examination acceptance criteria and use of alloy 52M and ER309L weld repair material as described above.

8.0 REFERENCES

The following references supplement those listed in Section 8 of Request 2-TYP-3-RV-03.

1. FENOC Letter L-09-309, "10 CFR 50.55a Request for Alternative Weld Repair Method for Reactor Vessel Head Penetration J-Groove Welds," Request 2-TYP-3-RV-03, dated November 14, 2009, Accession Number ML093220057.

2. FENOC Letter L-08-291, "10 CFR 50.55a Request for Alternative Repair Methods for Reactor Vessel Head Penetrations and J-Groove Welds," Request 2-TYP-3-RV-01, dated October 9, 2008, Accession Number ML082900209.

3. NRC Letter Forwarding Safety Evaluation, "Beaver Valley Power Station Unit No. 2 Relief Request No. 2-TYP-3-RV-01 Regarding Alternative Repair Methods for Reactor Vessel Head Penetrations and J-Groove Welds (TAC No. MD9970)," dated October 6, 2009, Accession Number ML092700031.

4. NRC Letter Forwarding Safety Evaluation for Request 2-TYP-3-RV-03, "Beaver Valley Power Station Unit No. 2 Relief Request for Alternative Weld Repair Method for Reactor Vessel Head Penetrations J-Groove Welds (TAC No. ME2608)," dated March 12, 2010, Accession Number ML100680781.