



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 17, 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 - RELIEF
REQUEST 2-TYP-3-RV-04, REVISION 0, REGARDING REPAIR
ACTIVITIES FOR REACTOR VESSEL HEAD PENETRATION
NOZZLES AND ASSOCIATED J-GROOVE WELDS (CAC NO. MF6776)

Dear Mr. Richey:

By letter dated September 30, 2015 (Agencywide Documents Access and Management System Accession No. ML15273A066), FirstEnergy Nuclear Operating Company (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (the Code), Section XI, associated with repair activities for reactor vessel head penetration nozzles and associated J-groove welds at the Beaver Valley Power Station, Unit 2 (BVPS-2).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(z)(1), the licensee submitted Request 2-TYP-3-RV-04, Revision 0, for the use of the proposed alternative on the basis that the alternative examination provides an acceptable level of quality and safety.

The NRC staff has reviewed the licensee's relief request and has determined that the requested alternative will provide an acceptable level of quality and safety, as documented in the enclosed safety evaluation. Therefore, the licensee's request for the use of the above-stated alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the BVPS-1.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

M. Richey

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If you have any questions, please contact the Project Manager, Taylor A. Lamb, at (301) 415-7128 or Taylor.Lamb@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Douglas A. Broaddus". The signature is fluid and cursive, with a large initial "D" and a long, sweeping underline.

Douglas A. Broaddus, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-412

Enclosure:
Safety Evaluation

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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST 2-TYP-3-RV-04, REVISION 0

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION, UNIT 2

DOCKET NO. 50-412

1.0 INTRODUCTION

By letter dated September 30, 2015 (Reference 1), FirstEnergy Nuclear Operating Company (the licensee, FENOC) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) associated with repair activities for reactor vessel head penetration (RVHP) nozzles and associated J-groove welds at the Beaver Valley Power Station, Unit 2 (BVPS-2).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(z)(1), the licensee submitted Request 2-TYP-3-RV-04, Revision 0, for the use of the proposed alternative on the basis that the alternative examination provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

In this relief request, the licensee proposes to use alternatives to the requirements of paragraph IWA-4000 of the 2001 Edition through 2003 Addenda of Section XI of the ASME Code.

Pursuant to 10 CFR 50.55a(g)(4), throughout the service life of a pressurized-water cooled nuclear power facility, components that are classified ASME Code Class 1, 2, and 3 must meet the requirements, except the design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. Further, these regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in paragraph (b) of 10 CFR 50.55a on the date 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

Alternatives to requirements under 10 CFR 50.55a(g) may be authorized by the NRC pursuant to 10 CFR 50.55a(a)(z)(1) or 10 CFR 50.55a(a)(z)(2). In proposing alternatives or requests for relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements would

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result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The regulation in 10 CFR 50.55a(g)(6)(ii)(D) requires pressurized-water reactor (PWR) plants to augment their inservice inspection (ISI) of the RVHP nozzles using ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," with conditions.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the Commission to authorize, the proposed alternative requested by the licensee. Accordingly, the NRC staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(a)(z)(1).

3.0 TECHNICAL EVALUATION

3.1 Licensee Relief Request

FENOC requested relief from the requirements of the ASME Code associated with repair activities for RVHP nozzles and associated J-groove welds at BVPS-2.

3.1.1 Component Identification

2RCS-REV-21 (Reactor Vessel) Head Penetrations, Numbers 1 through 65.

3.1.2 Applicable Code Requirements

The licensee stated that the ASME Code, Section XI, 2001 Edition through 2003 Addenda is the code of record for the ISI and repair/replacement programs.

ASME Code, Section XI, 2001 Edition through 2003 Addenda, paragraph IWA-4000, contains requirements for the removal of defects from, and welded repairs performed on, ASME Code components. Specific requirements are found for defect removal under subparagraph IWA-4421, which states for the removal or mitigation of defects by welding, subparagraph IWA-4411 must be followed. Subparagraph IWA-4411 requires that repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system.

The original Construction Code of the reactor vessel is ASME Code, Section III, 1971 Edition through summer 1972 Addenda. The licensee requested relief from subparagraphs NB-4131, NB-2538, and NB-2539, which pertain to the removal of base material defects prior to repair by welding, and NB-4451, NB-4452, and NB-4453, which pertain to the removal of weld material defects prior to repair by welding.

3.1.3 Licensee's Proposed Alternative

By letter dated April 11, 2003, the NRC staff forwarded the Nuclear Energy Institute generic guidelines on the evaluation of flaws detected in RVHPs (Reference 2). By letter dated July 3, 2003 (Reference 3), the NRC staff approved Westinghouse Topical Report, WCAP-15987-P,

Revision 2, for the repair of degraded RVHP using the embedded flaw process. In lieu of these guidelines and requirements, FENOC proposes to follow the requirements of 10 CFR 50.55a(g)(6)(ii)(D), which specify the use of Code Case N-729-1, with conditions.

As an alternative to the defect removal requirements of ASME Section XI and Section III, the licensee proposes the use of the embedded flaw repair process described in WCAP-15987-NP, Revision 2-NP-A (Reference 4), as detailed in this proposed alternative, for the repair of unacceptable indications in RVHPs and J-groove welds. The licensee stated that design and implementation of the repairs will be consistent with WCAP-15987 and WCAP-16158-NP, Revision 0 (Reference 5). Preservice inspections and ISIs of repairs will be consistent with ASME Code Case N-729-1. The licensee states that pursuant to 10 CFR 50.55a(a)(z)(1), the alternative is proposed on the basis that it will provide an acceptable level of quality and safety while minimizing cumulative occupational radiation exposure [dose].

3.1.4 Licensee's Duration of Relief Request

The licensee states that the duration of the proposed alternative is until the reactor vessel head is replaced. The NRC staff notes that BVPS-2 is in the third 10-year ISI interval, which began on August 29, 2008, and ends on August 28, 2018.

3.1.5 Licensee's Basis for Relief

The licensee states that the purpose of the repair is to embed and isolate identified flaws in the RVHP nozzles and associated J-groove welds. The repair overlay welds are not credited for providing structural strength to the original pressure boundary materials.

The licensee notes that WCAP-15987 describes the embedded flaw repair technique as a permanent repair. The repair is based on the principle that as long as a primary water stress corrosion cracking (PWSCC) flaw remains isolated from the primary water environment, it cannot propagate through the stress corrosion cracking mechanism. The licensee stated that Alloy 690 and Alloy 52 are highly resistant to stress corrosion cracking, as demonstrated by multiple laboratory tests, as well as over 15 years of service experience in replacement steam generators. Since Alloy 52 weldment is considered highly resistant to PWSCC, a new PWSCC flaw would not be reasonably expected to initiate and grow through the Alloy 52 repair weld layers to reconnect the primary water environment with the embedded PWSCC flaw.

The licensee explains that by letter dated February 25, 2011 (Reference 6), NRC staff approved this same repair method for RVHPs and J-groove welds at BVPS-2 for the third 10-year ISI interval, as described in Request 2-TYP-3-RV-03 submitted on November 14, 2009 (Reference 7), as supplemented by letters dated June 21, 2010 (Reference 8), and August 13, 2010 (Reference 9). The only technical difference between the previously submitted request and the current request (2-TYP-3-RV-04) is that preservice and inservice examinations for RVHP outside diameter and J-groove welds will be consistent with ASME Code Case N-729-1, which does not require eddy current testing.

3.2 NRC Staff Evaluation

The NRC staff previously approved a similar alternative repair method for BVPS-2 by letter dated October 6, 2009 (Reference 10), as modified by letter dated February 25, 2011, for the third 10-year ISI interval. The NRC safety evaluations for both of these proposed alternatives remain valid to allow BVPS-2 to use the Westinghouse Embedded Flaw Repair Technique in lieu of the requirements of paragraph IWA-4000 of Section XI of the ASME Code for the third 10-year ISI interval.

The licensee's proposed alternative in Request 2-TYP-3-RV-04 restates fully the original proposed alternative previously authorized by the NRC, with one additional change. The licensee previously stated for repairs on the outside diameter of a RVHP nozzle, or of a J-groove weld, the finished repair would be examined by liquid dye penetrant testing, ultrasonic testing, and eddy current testing to ensure acceptability. The current proposed alternative states that the repair will be examined in accordance with ASME Code Case N-729-1, with conditions as specified in 10 CFR 50.55a(g)(6)(ii)(D).

On September 10, 2008, the NRC amended its regulations to mandate the use of ASME Code Case N-729-1 as conditioned by 10 CFR 50.55a(g)(6)(ii)(D) for the long-term inspection of reactor pressure vessel upper head penetration nozzles and associated J-groove welds, as documented in *Federal Register* Notice 52730, Vol. 73 No. 176. The differences between these regulatory requirements and the previously NRC-approved alternative for BVPS-2 is in two areas: (1) the use of eddy current testing on the inside diameter of the nozzle and ultrasonic testing is not required by ASME Code Case N-729-1, only one of these techniques is required; and (2) the wetted surface examination of ASME Code Case N-729-1 permits either an eddy current examination or liquid dye penetrant examination, but not both. Given that the proposed alternative will follow the methods of examination under ASME Code Case N-729-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(D), which will provide reasonable assurance of public health and safety, the NRC staff finds that the licensee's change to the previously approved use of the Westinghouse Embedded Flaw Technique is acceptable.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative by the licensee in Request 2-TYP-03-RV-04 provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative in Request 2-TYP-3-RV-04, Revision 0, for the third 10-year ISI interval at BVPS-2, which ends on August 28, 2018, or until the replacement of the reactor pressure vessel head, whichever occurs first.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

5.0 REFERENCES

1. Letter from E. A. Larson, FirstEnergy Nuclear Operating Company, to US NRC, "Beaver Valley Power Station, Unit No. 2, Docket No. 50-412, License No. NPF-73, 10 CFR 50.55a Request for Alternative Repair Methods for Reactor Vessel Head Penetrations and J-Groove Welds (Request 2-TYP-3-RV-04)," dated September 30, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15273A066).
2. Letter from R. Barrett, US NRC, to A. Marion, Nuclear Energy Institute, "Flaw Evaluation Guidelines," dated April 11, 2003 (ADAMS Accession No. ML030980322.).
3. Letter from H. N. Berkow, US NRC, to H. A. Sepp, Westinghouse Electric Company, "Acceptance for Referencing - Topical Report WCAP-15987-P, Revision 2, Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations," dated July 3, 2003 (ADAMS Accession No. ML031840237).
4. Westinghouse WCAP-15987-NP, Revision 2-NP-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations," dated December 2003 (ADAMS Accession No. ML040290246).
5. Westinghouse WCAP-16158-NP, Revision 0, "Technical Basis for Repair Options for Reactor Vessel Head Penetration Nozzles and Attachment Welds: Beaver Valley Unit 2," dated August 2008 (ADAMS Accession No. ML082900209).
6. Letter from N. L. Salgado, US NRC, to P. A. Harden, FirstEnergy Nuclear Operating Company, "Beaver Valley Power Station, Unit No. 2 – Relief Request Regarding an Alternative Weld Repair Method for Reactor Vessel Head Penetrations J-Groove Welds," dated February 25, 2011 (ADAMS Accession No. ML110470557).
7. Letter from P. A. Harden, FirstEnergy Nuclear Operating Company, to US NRC, "Beaver Valley Power Station, Unit No. 2, Docket No. 50-412, License No. NPF-73, 10 CFR 50.55a Request for Alternative Weld Repair Method for Reactor Vessel Head Penetration J-Groove Welds," dated November 14, 2009 (ADAMS Accession No. ML093220057).
8. Letter from P. A. Harden, FirstEnergy Nuclear Operating Company, to US NRC, "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," dated June 21, 2010 (ADAMS Accession No. ML101740436).
9. Letter from P. A. Harden, FirstEnergy Nuclear Operating Company, to US NRC, "Beaver Valley Power Station, Unit No. 2, Docket No. 50-412, License No. NPF-73, Supplemental Information in Support of 10 CFR 50.55a Request for Alternative Weld Repair Method for Reactor Vessel Head Penetration J-Groove Welds," dated August 13, 2010 (ADAMS Accession No. ML102300043).

10. Letter from N. L. Salgado, US NRC, to P. P. Sena, III, FirstEnergy Nuclear Operating Company, "Beaver Valley Power Station, Unit No. 2 – Relief Request No. 2-TYP-3-RV-01 Regarding Alternative Repair Methods for Reactor Vessel Head Penetrations & J-Groove Welds," dated October 6, 2009 (ADAMS Accession No. ML092700031).

Principal Contributor: Jay Collins

Date: June 17, 2016

M. Richey

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If you have any questions, please contact the Project Manager, Taylor A. Lamb, at (301) 415-7128 or Taylor.Lamb@nrc.gov.

Sincerely,

/RA/

Douglas A. Broaddus, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-412

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Safety Evaluation

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