



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

February 17, 2016

Mr. Joseph W. Shea
Vice President, Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 1 – ALTERNATIVE RELIEF
REQUEST 1-ISI-27 FOR RELIEF FROM THE REACTOR VESSEL
CIRCUMFERENTIAL WELD EXAMINATION REQUIREMENTS OF THE ASME
CODE (CAC NO. MF6401)

Dear Mr. Shea:

By letter dated June 26, 2015, as supplemented by letters dated October 27, 2015, and November 18, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML15181A448, ML15300A472, and ML15338A221 respectively), Tennessee Valley Authority (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI reactor vessel (RV) circumferential weld examination requirements at the Browns Ferry Nuclear Plant (BFN), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested relief from RV circumferential weld examination requirements, as an alternative, on the basis that the alternative provides an acceptable level of quality and safety.

The NRC staff finds that the information submitted by the licensee related to the RV circumferential welds supports the determination that the conditional probability of failure (CPF) at the end of the period of extended operation (PEO) is bounded by the limiting CPF for a Babcock & Wilcox (B&W)-fabricated RV. This finding is based on the projected mean reference nil-ductility transition temperature (RT_{NDT}) of the limiting circumferential weld materials for BFN, Unit 1, which is a function of the chemistry and projected neutron fluence for these materials. The projected mean RT_{NDT} values are less than the mean RT_{NDT} value associated with the limiting CPF for a B&W RV from the NRC staff's final safety evaluation (SE) of the Boiling Water Reactor (BWR) Vessel and Internals Project (BWRVIP), BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations [BWRVIP-05] report, (ADAMS Legacy Accession No. 9808040037). Additionally, the licensee will continue to implement operator training and procedures to limit the frequency of cold overpressure events to the amount specified in the NRC staff's SE for the BWRVIP-05 report. Therefore, the licensee has met the two plant-specific conditions required to obtain relief from inspection of circumferential RV welds. On this basis, the NRC staff concludes that relief from inspection of RV circumferential welds is approved because the proposed alternative provides an acceptable level of quality and safety.

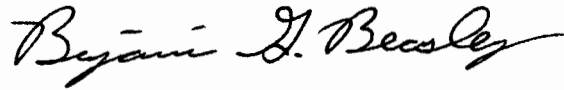
J. Shea

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Therefore, pursuant to 10 CFR 50.55a(z)(i), the request for proposed alternative, 1-ISI-27, to the requirements of the ASME Code, Section XI, Table IWB-2500-1 (Inspection Program B), Examination Category B-A, Item B1.11, pertaining to RV circumferential shell welds, is authorized for BFN, Unit 1, for the duration of the PEO as defined in Section 3.5 of the enclosed SE.

If you have any questions, please contact the Project Manager, Ms. Farideh E. Saba at 301-415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Benjamin G. Beasley". The signature is fluid and cursive, with the first name being the most prominent.

Benjamin G. Beasley, Chief
Plant Licensing Branch 2-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-259

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELIEF REQUEST NO. 1-ISI-27 FOR THE PERIOD OF EXTENDED OPERATION
REGARDING REACTOR VESSEL CIRCUMFERENTIAL WELD EXAMINATIONS FOR
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNIT 1
DOCKET NO. 50-259

1.0 INTRODUCTION

By letter dated June 26, 2015, as supplemented by letters dated October 27, 2015, and November 18, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML15181A448, ML15300A472, and ML15338A221 respectively), Tennessee Valley Authority (TVA, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI reactor vessel (RV) circumferential weld examination requirements at Browns Ferry Nuclear Plant (BFN), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested relief from reactor vessel (RV) circumferential weld examination requirements, as an alternative, on the basis that the alternative provides an acceptable level of quality and safety.

The proposed alternative would eliminate the requirement to inspect the circumferential welds except for the areas of intersection with the axial welds. This alternative is consistent with the guidance provided in Generic Letter 98-05, "Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Welds," and the NRC staff's safety evaluation (SE) for Boiling Water Reactor (BWR) Vessel and Internals Project Vessel and Internals Project (BWRVIP), BWR Reactor Pressure Vessel Shell Weld Inspection Recommendations [BWRVIP-05] report, (ADAMS Legacy Accession No. 9808040037). The proposed alternative satisfies the NRC staff's expectation identified in Section 4.2.6 of the "Safety Evaluation Report Related to the License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated January 12, 2006 (ADAMS Accession No. ML060120453).

Enclosure

2.0 REGULATORY EVALUATION

Inservice inspection (ISI) of ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g). Section 50.55a(z)(1) of 10 CFR states that alternatives to the requirements of paragraph (g) may be used when authorized by the NRC if the proposed alternatives would provide an acceptable level of quality and safety.

For RV circumferential welds, the NRC staff's final SE of topical report BWRVIP-05, dated July 28, 1998, concluded that elimination of the ISI of the RV circumferential welds for BWRs is justified, since the failure frequency for circumferential welds in BWR plants is significantly below the criterion specified in Regulatory Guide (RG) 1.154, "Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors," dated January 1987. The NRC staff notes that RG 1.154 was withdrawn on January 14, 2011, (76 FR 2726) for general application to future licensee relief requests. However, the acceptability of the use of BWRVIP-05, specifically for BFN, Unit 1, was previously affirmed by the NRC staff evaluation presented in Section 4.2.6.4 of NUREG-1843. TVA proposed a future inspection activity to seek relief from the NRC regarding the ISI of the RV circumferential welds based on the use of BWRVIP-05.

Generic Letter 98-05, "Boiling Water Reactor Licensees Use of the BWRVIP-05 Report to Request Relief from Augmented Examination Requirements on Reactor Pressure Vessel Circumferential Shell Welds," dated November 10, 1998 (ADAMS Accession No. ML082460066), provided recommendations for licensees desiring to request permanent relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of circumferential RV welds (ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item 1.11, Circumferential Shell Welds). The recommendations were based on the NRC staff's final SE of topical report BWRVIP-05 and included the need for licensees to perform their required inspections of "essentially 100 percent" of all axial welds. These recommendations were only applicable to the remaining term of operation under the initial, existing license. However, Section 4.2.6 of NUREG-1843 noted the NRC staff's expectation that relief would be requested for the extended period of operation.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirement for Which Relief is Requested

The ASME Code, Section XI, 2001 Edition Through 2003 Addenda, Table IWB-2500-1, Examination Category B-A, Item B1.11 requires a volumetric examination of all (100 percent) of the circumferential shell welds each interval.

3.2 Component(s) for which Relief is Requested

Code Class: 1

Weld Numbers: C-4-5, C-3-4, C-2-3, C-1-2, and C-BH-1

Examination Category: B-A

Exam Method: Volumetric

Item Number: B1.11

3.3 Licensee's Proposed Alternative to the ASME Code and Basis for Alternative

The proposed alternative is permanent relief from the ISI requirements of 10 CFR 50.55a(g) for the volumetric examination of circumferential RV welds (ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item B1.11, Circumferential Shell Welds) based on the probabilistic risk analysis of BWRVIP-05, combined with the continued implementation of operator procedures and training to limit the frequency of cold overpressure events in accordance with the recommendations of GL 98-05. The licensee will continue to perform its required inspections of "essentially 100 percent" of all axial welds.

3.4 Reason and Basis for Alternative

On May 12, 2004, TVA submitted a relief request to eliminate the circumferential shell welds, which was approved for the second 10-year ISI interval in the NRC letter dated May 31, 2005. In Section 4.2.6 of the license renewal application, the licensee submitted updated information that reflected the plant-specific values used in the relief request (54 effective full power years or EFPY) as part of a time-limited aging analysis (TLAA). The TLAA for RV circumferential weld examination relief was evaluated and found acceptable in Section 4.2.6.2 of NUREG-1843. The value of the mean reference nil-ductility transition temperature (RTNDT) for the limiting circumferential weld material for BFN, Unit 1, was 124 degrees Fahrenheit (°F). The licensee was still required to request relief for the circumferential weld examination for the period of extended operation (PEO) in accordance with 10 CFR 50.55a.

By letter dated December 18, 2013, TVA submitted updated pressure and temperature (P/T) limits. These revised P/T limit curves were developed based on neutron fluence analyses projected to the end of the PEO as required by 10 CFR 54.21(c)(1)(ii). On February 2, 2015, the NRC issued Amendment No. 287 for BFN, Unit 1, approving the use of the revised P/T limit curves (ADAMS Accession No. ML14325A501).

In the June 26, 2015, request for relief, the EFPY for the PEO was revised to reflect the unit's actual operational history (38 rather than 54 EFPY) and the maximum projected neutron fluence value for the PEO from the approved license amendment. The value of the mean RTNDT for the limiting circumferential weld material for BFN, Unit 1, for 38 EFPY was reduced to 92 °F. Given that the updated mean RTNDT value for BFN, Unit 1, is less than the 64 EFPY value as addressed in the NRC staff SE for a B&W vessel, the licensee concluded the BFN RV CPF is also bounded by the NRC analysis.

As previously evaluated in NUREG-1843, procedures and training to limit cold over-pressure events during the PEO have been implemented. Therefore, as discussed above, and as previously evaluated in NUREG-1843 and supplemented with the analyses performed to support the revised P/T curves, the proposed alternative provides an acceptable level of quality and safety for the PEO.

3.5 Licensee Proposed Duration of Alternative

The licensee requested use of the proposed alternative for the entire PEO for BFN, Unit 1, which ends December 20, 2033.

4.0 STAFF EVALUATION

As part of the evaluation, the staff compared the material properties for the RV materials in the December 18, 2013, submittal for the revised P/T limits with that in the July 25, 2015, submittal. The comparison confirmed the properties for the limiting circumferential weld but discovered a discrepancy. The staff noted that the fluence at the clad-to-base metal interface in Table 3 of the submittal does not match that from Table B-5 of the December 18, 2013, license amendment request. To resolve the discrepancy, the staff issued a request for additional information (RAI) asking the licensee to review the basis documents and revise the June 26, 2015, letter, as needed, to accurately assess the fluence on the beltline circumferential (girth) weld.

In its RAI response dated October 27, 2015, the licensee stated that the value of $0.0886\text{E}+19$ neutrons per square centimeter (n/cm^2) provided for the fluence at the clad/base metal interface in Table 3 of the request is actually the 38 EFPY fluence value at $\frac{1}{4}$ of the wall thickness and not the peak fluence value at the inside diameter of the RV. The discrepancy was entered into the TVA corrective action program. Table 3 of the July 25, 2015, submittal was revised by replacing the fluence value of $0.0886\text{E}+19$ n/cm^2 with $0.128\text{E}+19$ n/cm^2 from Table B-5 of Enclosure 2 of the December 18, 2013, submittal. This was the only change made to Table 3.

The staff reviewed the licensee's response to the RAI and discovered that further changes to Table 3 would be required in response to the corrected fluence value. During a followup teleconference with the NRC, the licensee determined that two additional values should have been revised based on the fluence value correction. The enclosure to the November 18, 2015, letter provides TVA's revised response to the NRC RAI, which supersedes, in its entirety, the response provided in the October 27, 2015, letter.

The staff reviewed the licensee's revised response to the RAI and notes that the neutron fluence in the revised Table 3 agrees with those used in Amendment No. 287 for BFN, Unit 1. The neutron fluence at the inside diameter will be slightly higher than the value at the clad/base metal interface, which is conservative. Furthermore, the delta RT_{NDT} without margin and the mean RT_{NDT} values in the revised Table 3 are the same as those in the staff's confirmatory calculations. Based on the information in the November 18, 2015, RAI response, the staff confirms that the plant-specific parameters for BFN, Unit 1, satisfy the limiting CPF for RV circumferential welds from B&W fabricated plants in the NRC staff's BWRVIP-05 report SE through the end of the PEO. Based on the plant-specific procedures and training to limit cold over-pressure events, as previously evaluated and approved in NUREG-1843, along with the November 18, 2015, revision to the June 25, 2015, submittal, the staff has determined that the proposed alternative provides an acceptable level of quality and safety for the PEO.

5.0 CONCLUSION

The NRC staff finds the information submitted by the licensee related to the RV circumferential welds supports the determination that the CPF at the end of the PEO is bounded by the limiting CPF for a B&W-fabricated RV. This finding is based on the projected mean RTNDT of the limiting circumferential weld materials for BFN, Unit 1, which is a function of the chemistry and projected neutron fluence for these materials. The projected mean RTNDT value for BFN, Unit 1 is less than the mean RTNDT value associated with the limiting CPF for a B&W RV from the NRC staff's final SE of BWRVIP-05. Additionally, the licensee will continue to implement operator training and procedures to limit the frequency of cold overpressure events to the amount specified in the NRC staff's SE for the BWRVIP-05 report issued on July 28, 1998. The licensee has met the two plant-specific conditions required to obtain relief from inspection of circumferential RV welds. On this basis, the NRC staff concludes that relief from inspection of RV circumferential welds and proposed alternative provides an acceptable level of quality and safety.

Therefore, pursuant to 10 CFR 50.55a(z)(i), the request for proposed alternative, 1-ISI-27, to the requirements of the ASME Code, Section XI, Table IWB-2500-1 (Inspection Program B), Examination Category B-A, Item B1.11, pertaining to RV circumferential shell welds, is authorized for BFN, Unit 1, for the duration of the PEO as defined in Section 3.5 of this SE.

All other requirements of the 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.

Principal Contributor: Patrick Purtscher

Date: February 17, 2016

J. Shea

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Therefore, pursuant to 10 CFR 50.55a(z)(i), the request for proposed alternative, 1-ISI-27, to the requirements of the ASME Code, Section XI, Table IWB-2500-1 (Inspection Program B), Examination Category B-A, Item B1.11, pertaining to RV circumferential shell welds, is authorized for BFN, Unit 1, for the duration of the PEO as defined in Section 3.5 of the enclosed SE.

If you have any questions, please contact the Project Manager, Ms. Farideh E. Saba at 301-415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

/RA/

Benjamin G. Beasley, Chief
Plant Licensing Branch 2-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-259

Enclosure:
Safety Evaluation

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