



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

November 5, 2013

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

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – REQUEST FOR
ALTERNATIVE 1,2-PDI-4 REGARDING VOLUMETRIC EXAMINATION OF
REACTOR PRESSURE VESSEL CIRCUMFERENTIAL SHELL-TO-FLANGE
WELDS (TAC NOS. MF0076 AND MF0077)

Dear Mr. Shea:

By letter dated November 20, 2012, Tennessee Valley Authority (TVA or the licensee) submitted Request for Alternative (RFA) 1,2-PDI-4 to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to the requirements of Appendix I of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI at Sequoyah Nuclear Plant (SQN), Units 1 and 2. TVA proposes to apply the alternative examination methodology of RFA 1,2-PDI-4 to the next regularly scheduled reactor pressure vessel (RPV) examinations to be performed on SQN, Units 1 and 2 at or near the end of the third 10-year inservice inspection (ISI) Program interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The licensee proposed examining the RPV upper shell-to-flange weld with procedures and personnel qualified to ASME Code, Section XI, performance demonstration initiative (PDI) Appendix VIII, Supplements 4 and 6 requirements in lieu of the requirements of Article 4 of ASME Code Section V. The request is for the remainder of the third 10-year ISI interval. The SQN third 10-year ISI interval is projected to end May 31, 2015.

The NRC staff has reviewed TVA's submittal and has determined that using inspection procedures qualified under ASME Code Section XI Appendix VIII Supplements 4 and 6 in lieu of ASME Code Section V Article 4 inspections provides an acceptable level of quality and safety for RFA 1,2-PDI-4. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(i). Therefore, the NRC staff authorizes the use of RFA 1,2-PDI-4 at SQN, Units 1 and 2, for the remainder of the third 10-year ISI interval that will end on May 31, 2015.


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.

J. Shea

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If you have any questions, please contact the Project Manager, Mr. Siva P. Lingam by phone at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,



Jessie F. Quichocho, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE 1,2-PDI-4 REGARDING

VOLUMETRIC EXAMINATION OF REACTOR PRESSURE VESSEL

CIRCUMFERENTIAL SHELL-TO-FLANGE WELDS

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

1.0 INTRODUCTION

By letter dated November 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12333A238), Tennessee Valley Authority (the licensee) submitted a relief request from proscriptive inspection requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code) Section XI at the Sequoyah Nuclear Plant (SQN), Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The licensee proposed examining the reactor pressure vessel (RPV) upper shell-to-flange weld with procedures and personnel qualified to ASME Code, Section XI, performance demonstration initiative (PDI) Appendix VIII, Supplements 4 and 6 requirements in lieu of the requirements of Article 4 of ASME Code Section V. The request is for the remainder of the third 10-year inservice inspection (ISI) interval. The SQN third 10-year ISI Interval is projected to end May 31, 2015.

2.0 REGULATORY EVALUATION

Section 50.55a(g) of 10 CFR Part 50, "Inservice inspection requirements," requires, in part, that ASME Class 1, 2, and 3 components must meet the inspection examination requirements set forth in the applicable editions and addenda of the ASME Code, except where alternatives have been authorized by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(a)(3)(i) or (a)(3)(ii).

Section 50.55a(a)(3) of 10 CFR Part 50 states in part that alternatives to the requirements of paragraph (g) may be authorized by the NRC, if the applicant demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance

Enclosure

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

The Code of record for the third 10-year ISI interval at SQN is the 2001 edition with 2003 addenda of the ASME Code, Section XI.

3.0 TECHNICAL EVALUATION

3.1 Affected Component

ASME Code Class 1, RPV upper vessel shell-to-flange weld, Table IWB-2500-1, Category B-A, Item Number B1.30, SQN, Units 1 and 2 ISI component identification 1-W06-7 and 2-W06-7.

3.2 Applicable Code

ASME Code, Section XI, 2001 edition with 2003 addenda, Appendix I, Article 1-2100, paragraph (b) requires "Ultrasonic examination of reactor vessel-to-flange welds shall be conducted in accordance with Article 4 of ASME Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table 1-2000-1."

3.3 Proposed Alternative

The licensee proposes using the procedures, personnel, and equipment qualified to the requirements of ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, of the 2001 edition as administered by the Electric Power Research Institute's (EPRI) PDI program to conduct the vessel-to-flange weld examination.

3.4 Licensee Basis for the Alternative

ASME Code, Section XI, Appendix I, paragraph 1-2000-1 requires that ASME Section V, Article 4 ultrasonic testing (UT) techniques shall be used for the RPV-to-flange weld. ASME Code Section V, Article 4 describes the required techniques to be used for UT examination of the welds in ferritic pressure vessels with wall thicknesses greater than 2 inches. The ASME Section V, Article 4 UT technique calibrations, recording criteria and flaw sizing capabilities are based upon the use of a distance-amplitude-correction curve (DAC) derived from machined reflectors in a basic calibration block. UT performed in accordance with Section V, Article 4, uses recording thresholds known as percent of DAC for recording and reporting of indications within the examination volume. Indications detected in the exam volume, with amplitudes below these thresholds, are not required to be recorded and/or evaluated. The recording thresholds in Section V, Article 4 are generic and do not take into consideration such factors as flaw orientation, which can influence the amplitude of UT responses.

The RPV-to-flange weld is the only circumferential shell weld in the RPV that is not examined with ASME Code Section XI, Appendix VIII, Supplements 4 and 6 UT techniques. Procedures, equipment and personnel qualified via the PDI Appendix VIII Supplements 4 and 6 programs have been demonstrated to have a high probability of detection and are generally considered superior to the techniques employed during earlier Section V, Article 4

RPV examinations. Use of the detection criterion is more conservative and the procedure requires the examiner to evaluate all indications determined to be flaws regardless of their amplitude.

EPRI Report NP-6273, "Accuracy of Ultrasonic Flaw Sizing Techniques for Reactor Pressure Vessels," dated March 1989, contains a comparative analysis of sizing accuracy for several different techniques. The results show that UT flaw sizing techniques based on tip diffraction are the most accurate. The proposed alternative Appendix VIII UT qualified detection and sizing methodologies use analysis tools based upon echo dynamics and tip diffraction. This methodology is considered more sensitive and accurate than the Section V, Article 4 processes. Accordingly, approval of this alternative examination and evaluation process is requested pursuant to 10 CFR 50.55a(a)(3)(i).

In addition, this alternative to the ASME Code requirements is similar to previous industry submittals for other units that were approved by the NRC (ADAMS Accession Nos. ML082630051, ML110240474, ML062080744, ML080630679, ML1 20740580, and ML110110172).

3.5 NRC Staff Evaluation

The 2001 edition with 2003 addenda of the ASME Code, Section XI, IWA-2232 states, "Ultrasonic examination shall be conducted in accordance with Appendix I." ASME Code, Section V, Article 4 provides a prescriptive process for qualifying UT of procedures and the scanning requirements for examinations. The UT performed to ASME Code, Section V, Article 4 uses detailed criteria for setting up and calibrating equipment, calculating coverage, and detecting indications. The capability of an ASME Code, Section V, Article 4 UT examination is demonstrated with calibration blocks made from representative material containing holes and notches.

In lieu of the ASME Code, Section V, Article 4 angle beam examination, the licensee proposes to use an examination that will be performed using examination procedures, personnel, and equipment qualified in accordance with a performance-based UT method, ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, as modified by 10 CFR 50.55a. Performance-based UT requires that detailed criteria be used for performance demonstration tests. The results for the tests are compared against statistically developed screening criteria. The tests are performed on representative mockups containing flaws similar to those found in operating plants. The performance-based tests demonstrate the effectiveness of UT personnel and procedures.

The use of the rules in ASME Code Section XI Appendix VIII to qualify ultrasonic procedures and personnel in the nuclear industry has resulted in an improvement in the effectiveness of inservice inspections of nuclear power plant components. Increasing the number of ASME Code Section XI Appendix VIII-qualified examinations, as is the intent of the proposed request, would, in general, increase the effectiveness of the ISI inspections. The NRC staff has supported the use of performance-based nondestructive examination and continues to monitor, review, and evaluate the adequacy of the transition to performance-based examinations and the appropriateness of selected performance-based criteria.

One issue that could occur when switching to Appendix VIII-qualified examinations is a possible reduction of inspection coverage if the ASME Code Section XI Appendix VIII-qualified procedure is more complex than the procedure meeting ASME Code Section V Article 4 requirements. The licensee has expressed that they expect to achieve greater than 90 percent coverage with the ASME Code Section XI Appendix VIII-qualified procedure.

In summary, the procedures, equipment, and personnel qualified to ASME Code, Section XI, Appendix VIII and scanning requirements in 10 CFR 50.55a(b)(2)(xv)(G) have shown a high probability of flaw detection, and have increased the reliability of examinations of weld configurations within the scope of the PDI program. Therefore, the NRC staff has determined that using inspection procedures qualified under ASME Code Section XI Appendix VIII Supplements 4 and 6 in lieu of ASME Code Section V Article 4 inspections provides an acceptable level of quality and safety.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's proposed alternative to apply ASME Code, Section XI, Appendix VIII examination requirements when volumetrically examining the SQN, Units 1 and 2 RPV Shell-to-Flange Welds No. 1-W06-7 and 2-W06-7 by UT, and concludes that the procedures, equipment, and personnel qualified to ASME Code, Section XI, Appendix VIII have shown a high probability of flaw detection, and have increased the reliability of examinations of weld configurations within the scope of the PDI program. Therefore, the licensee's proposed alternative provides an acceptable level of quality and safety and is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the SQN third 10-year ISI interval.

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

Principal Contributor: Patrick T. Purtscher

Date: November 5, 2013

J. Shea

- 2 -

If you have any questions, please contact the Project Manager, Mr. Siva P. Lingam by phone at 301-415-1564 or via e-mail at Siva.Lingam@nrc.gov.

Sincerely,

/RA/

Jessie F. Quichocho, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure:
Safety Evaluation

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