Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

November 20, 2012

10 CFR 50.4
10 CFR 50.55a

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

Sequoyah Nuclear Plant, Units 1 and 2
Facility Operating License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **American Society of Mechanical Engineers Request for Alternative 1,2-PDI-4**

In accordance with 10 CFR 50.55a, "Codes and standards," paragraph (a)(3)(i), the Tennessee Valley Authority (TVA) proposes an alternative to the requirements of Appendix I of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," as applicable to Sequoyah Nuclear Plant (SQN) Units 1 and 2. The Code of Record for the current third 10-year interval for SQN Units 1 and 2 is the ASME Section XI B&PV Code, 2001 Edition with Addenda through 2003.

TVA is submitting Request for Alternative (RFA) 1,2-PDI-4 (Enclosure) for Nuclear Regulatory Commission (NRC) approval of an alternative to paragraph IWA-2232 of ASME Code Section XI, 2001 Edition through 2003 Addenda, to allow use of Appendix VIII and the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) for performing the volumetric examination of reactor pressure vessel (RPV) circumferential shell-to-flange welds. In lieu of the requirements of Appendix I and the associated Article 4 of ASME Code Section V, TVA proposes the alternative requested in RFA 1,2-PDI-4 to allow use of the examination procedures, equipment, and personnel qualified to the requirements of ASME Code Section XI, Appendix VIII, Supplements 4 and 6 of the 2001 Edition, as administered by the EPRI PDI program. This proposed alternative has been demonstrated to have a high probability of detection and is generally considered superior to the techniques employed during earlier RPV shell-to-flange weld examinations using ASME Code Section V, Article 4, with the supplements provided by ASME Code Section XI, Table I-2000-1.

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TVA proposes to apply the alternative examination methodology of RFA 1,2-PDI-4 to the next regularly scheduled 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. Both SQN units are currently in the third period of their third ISI Program interval, which extends from June 1, 2006, to May 31, 2015.

The enclosure to this letter provides RFA 1,2-PDI-4 for SQN Units 1 and 2 for NRC review and approval. TVA requests approval of the RFA by November 1, 2013.

This RFA is similar to previous TVA submittals for Browns Ferry Units 1, 2, and 3, and Watts Bar Unit 1, and approved by the NRC in letters dated October 3, 2008, March 30, 2011, August 22, 2006, and February 29, 2008, respectively [ADAMS Accession Nos. ML082630051, ML110240474, ML062080744, and ML080630679]. In addition, the NRC has recently granted similar alternatives for NextEra Energy's Seabrook Station by letter dated March 29, 2012 [ADAMS Accession No. ML120740580], and for Energy Northwest's Columbia Generating Station by letter dated February 3, 2011 [ADAMS Accession No. ML110110172].

There are no regulatory commitments associated with this submittal. If you have any questions about this request, please contact Clyde Mackaman at (423) 751-2834.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure: Request for Alternative 1,2-PDI-4

cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant

ENCLOSURE

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT

UNITS 1 AND 2

AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE
REQUEST FOR ALTERNATIVE

REQUEST FOR ALTERNATIVE 1,2-PDI-4

Enclosure

Tennessee Valley Authority
Sequoyah Nuclear Plant
Units 1 and 2

American Society of Mechanical Engineers Code Request for Alternative

Request for Alternative 1,2-PDI-4

Executive Summary

In accordance with 10 CFR 50.55a, "Codes and standards," paragraph (a)(3)(i), the Tennessee Valley Authority (TVA) proposes an alternative to the requirements of Appendix I of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," as applicable to Sequoyah Nuclear Plant (SQN) Units 1 and 2. The Code of Record for the current third 10-year interval for SQN Units 1 and 2 is the ASME Section XI B&PV Code, 2001 Edition with Addenda through 2003.

TVA is submitting Request for Alternative (RFA) 1,2-PDI-4 for Nuclear Regulatory Commission (NRC) approval of an alternative to paragraph IWA-2232 of ASME Code Section XI, 2001 Edition through 2003 Addenda, to allow use of Appendix VIII and the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) for performing the volumetric examination of reactor pressure vessel (RPV) circumferential shell-to-flange welds. In lieu of the requirements of Appendix I and the associated Article 4 of ASME Code Section V, TVA proposes the alternative requested in RFA 1,2-PDI-4 to allow use of the examination procedures, equipment, and personnel qualified to the requirements of ASME Code Section XI, Appendix VIII, Supplements 4 and 6 of the 2001 Edition, as administered by the EPRI PDI program. This proposed alternative examination methodology uses ultrasonic testing (UT) analysis tools based upon echo dynamic motion and tip diffraction criteria, that has been validated, and is considered to be more accurate and reliable than the techniques employed during earlier RPV shell-to-flange weld examinations using ASME Code Section V, Article 4, as supplemented by ASME Code Section XI, Table I-2000-1. The enclosed figure provides a sketch of a typical RPV shell-to-flange weld configuration. The UT examinations will be performed from the vessel inside surface with the core internals removed using remotely operated inspection equipment.

TVA proposes to apply the alternative examination methodology of RFA 1,2-PDI-4 to the next regularly scheduled 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. Both SQN units are currently in the third period of their third ISI Program interval, which extends from June 1, 2006, to May 31, 2015.

ASME Code Component(s) Affected

ASME Code Class 1 Reactor Pressure Vessel (RPV) Shell-to-Flange welds, Table IWB- 2500-1 Category B-A, Item Number B1.30.

SQN Unit 1 - TVA ISI Program Weld Designation 1-W06-07
SQN Unit 2 - TVA ISI Program Weld Designation 2-W06-07

Applicable Code Edition and Addenda

The current ASME Code of Record for the ISI Programs at SQN Units 1 and 2 is ASME B&PV Code Section XI, 2001 Edition with 2003 Addenda. An update from the previous 1989 Edition (no addenda) of the ASME Code to the current later edition and addenda was approved by the NRC on May 5, 2006 [ADAMS Accession No. ML060880207].

Applicable Code Requirement

In accordance with ASME Code Section XI, Table IWB-2500-1 Category B-A, Item Number B1.30, RPV shell-to-flange welds require a volumetric examination of essentially 100 percent of the weld length. In addition, paragraph IWA-2232 of ASME Code Section XI requires that "Ultrasonic examinations shall be conducted in accordance with Appendix I," and paragraph I-2110(b) of Appendix I requires that "Ultrasonic examination of reactor vessel-to-flange welds, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with Article 4 of Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table I-2000-1."

The volumetric examination of "essentially 100 percent" of the RPV shell-to-flange weld length is clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," to allow a reduction in examination coverage on any Class 1 or Class 2 weld provided the reduction in coverage for that weld is less than 10 percent (i.e., "essentially 100 percent" is defined as more than 90 percent of the specified volume (NRC Information Notice 98-42)). ASME Code Case N-460 has been approved for use by the NRC in Regulatory Guide 1.147, Revision 16, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1."

Reason for Request

ASME Code Section XI, Appendix I, paragraph I-2110(b), requires that the UT techniques of ASME Code Section V, Article 4, as supplemented by ASME Code Section XI, Table I-2000-1, shall be used for the RPV shell-to-flange weld. Article 4 of ASME Code Section V describes the required techniques to be used for UT examination of welds in ferritic pressure vessels with wall thicknesses greater than 2 inches. The UT examination techniques were added to ASME Code Section V in the 1974 Edition, Winter 1975 Addenda. The UT calibration techniques, recording criteria, and flaw sizing methods are based upon the use of a distance-amplitude-correction (DAC) curve derived from machined reflectors in a basic calibration block. UT evaluations performed in accordance with ASME Code Section V, Article 4 used recording thresholds in percent DAC for the reporting of indications within the examination volume. These recording thresholds are generic and do not take into consideration such factors as flaw orientation, which can influence the amplitude of UT responses.

The most practical method for access to the RPV shell-to-flange circumferential weld for UT examination is from the inside surface of the vessel with the core internals removed. As indicated in the enclosed figure, the flange forging contains both outside and inside surface tapers. While both the outside and inside tapers interfere with examination of the circumferential weld to some degree, the inside taper provides the least amount of interference. UT examinations performed on the RPV shell-to-flange circumferential weld in accordance with the ASME Code Section V, Article 4 generally require the use of beam angles of 0 degrees, 45 degrees, 60 degrees, and 70 degrees, with recording criteria and equipment changes that are time consuming and costly with no compensating increase in quality or safety.

The RPV shell-to-flange weld is the only circumferential shell weld in the vessel that is not examined with the UT examination techniques of ASME Code Section XI, Appendix VIII, Supplements 4 and 6. The procedures, equipment, and personnel qualified via ASME Code Section XI, Appendix VIII, Supplements 4 and 6, as administered by the EPRI PDI (ASME Code Section XI, Appendix VIII/EPRI-PDI) program, have been demonstrated to have a high probability of detection and increased accuracy and reliability when compared to the techniques employed during earlier ASME Code Section V, Article 4 RPV examinations. Use of the ASME Code Section XI, Appendix VIII/EPRI-PDI methodology would enhance the quality of the examination results since the detection criteria are more conservative and the procedures require the examiner to evaluate all indications determined to be flaws regardless of their associated amplitude. TVA concludes that performing the RPV shell-to-flange circumferential weld examination using the UT techniques of ASME Code Section XI, Appendix VIII/EPRI-PDI qualified processes provides an acceptable level of quality and safety, and is an acceptable alternative to the earlier UT techniques as prescribed by ASME Code Section V, Article 4, as supplemented by ASME Code Section XI, Table I-2000-1.

Proposed Alternative and Basis for Use

In accordance with 10 CFR 50.55a(a)(3)(i), TVA is submitting RFA 1,2-PDI-4 for NRC approval of the proposed alternative to the requirements of ASME Code Section XI, paragraph IWA-2232 and the associated methodology of ASME Code Section V, Article 4, as required by ASME Code Section XI, Appendix I, paragraph I-2110(b), for performing the designated RPV shell-to-flange weld examinations. In lieu of employing the earlier RPV shell-to-flange weld examination techniques of ASME Code Section V, Article 4, it is proposed to use evaluation procedures, equipment, and personnel qualified to the requirements of ASME Code Section XI, Appendix VIII, Supplements 4 and 6 of the 2001 Edition, in compliance with 10 CFR 50.55a(b)(2)(xxiv), as amended by Sections 10 CFR 50.55a(b)(2)(xv)(B) through 10 CFR 50.55a(b)(2)(xv)(G), and 10 CFR 50.55a(b)(2)(xvi)(A), as administered by the EPRI PDI program, to conduct the required RPV shell-to-flange weld examinations.

EPRI Report NP-6273, "Accuracy of Ultrasonic Flaw Sizing Techniques for Reactor Pressure Vessels," dated March 1989, contains a comparative analysis of flaw sizing accuracy for several different UT evaluation techniques. The analysis established that UT evaluation flaw sizing techniques based on tip diffraction are the most accurate. The qualified prescriptive-based UT evaluation procedures of ASME Code Section V, Article 4 were applied in a controlled process with mockups of RPVs which contained real flaws, and the results were statistically analyzed according to the screening criteria in Appendix VIII of ASME Code Section XI. The results show that the procedures in ASME Code Section V, Article 4 are less effective in detecting flaws than procedures qualified in accordance with ASME Code Section XI, Appendix VIII, as administered by the EPRI PDI program. The ASME Code Section XI, Appendix VIII/EPRI-PDI qualified programmatic processes use analysis tools based upon echo dynamic motion and tip diffraction criteria. This methodology has been validated and is considered more accurate than the ASME Code Section V, Article 4 processes. Given these results, TVA proposes to use the ASME Code Section XI, Appendix VIII/EPRI-PDI qualified UT flaw detection and sizing methodology as an alternative to those of ASME Code Section V, Article 4, as supplemented by ASME Code Section XI, Table I-2000-1.

ASME Code Section V, Article 4 describes the UT examination techniques to be used for the RPV shell-to-flange weld. UT examinations performed in accordance with ASME Code Section V, Article 4 used recording thresholds that are based on a percentage of a DAC curve. Indications detected in the designated examination volume with amplitudes below the specified

thresholds were not required to be recorded, regardless of other signal characteristics. The ASME Code Section XI, Appendix VIII/EPRI-PDI qualified processes use fewer transducers than the ASME Code Section V, Article 4 methods, and the UT examinations are performed with higher sensitivity, which increases the probability of detecting flaws when compared to the prescriptive-based requirements of ASME Code Section V, Article 4. As such, the proposed alternative to use the ASME Code Section XI, Appendix VIII/EPRI-PDI qualified processes is expected to enhance the quality of the reported results of the examination.

In summary, the proposed alternative to use the procedures, equipment, and personnel qualified through the ASME Code Section XI, Appendix VIII/EPRI-PDI programmatic processes has been demonstrated to have a high probability of detection of flaws and is generally considered superior to the techniques employed earlier by ASME Code Section V, Article 4 for RPV shell-to-flange weld examinations. The ASME Code Section XI, Appendix VIII/EPRI-PDI examinations are more sensitive for detecting flaws than the ASME Code Section V, Article 4 methods because the examination sensitivity levels, detailed procedure criteria, and blind demonstrations enhance and verify their effectiveness. This results in increased reliability of the examinations and provides assurance that an acceptable level of quality and safety is maintained using the proposed alternative methodology. In addition, the proposed alternative to use the ASME Code Section XI, Appendix VIII/EPRI-PDI methodology would facilitate and enhance the efficiency of the transition to the UT examinations of the adjacent RPV circumferential welds (the four B1.11 welds) which currently require UT examinations in accordance with ASME Code Section XI, Appendix VIII, Supplements 4 and 6. Accordingly, TVA requests NRC approval of the proposed alternative methodology for examination of the RPV shell-to-flange welds for SQN Units 1 and 2 as described in this RFA pursuant to the provisions of 10 CFR 50.55a(a)(3)(i).

TVA does not anticipate any less coverage than the required minimum of more than 90 percent coverage for the required RPV shell-to-flange weld examinations. However, if any such limitations are encountered during the conduct of the examinations, separate individual Requests for Relief (RFRs) or RFAs will be submitted, as appropriate.

Duration of Proposed Alternative

TVA proposes to apply the alternative examination methodology of RFA 1,2-PDI-4 for SQN Units 1 and 2 during the current third 10-year ISI Program interval. As such, the methodology will be applied to the next regularly scheduled RPV examinations to be performed on SQN Units 1 and 2 at or near the end of the third 10-year ISI Program interval. Both SQN units are currently in the third period of their third ISI Program interval, which extends from June 1, 2006 through May 31, 2015.

Precedents

This RFA is similar to previous TVA submittals for Browns Ferry Units 1, 2, and 3, and Watts Bar Unit 1, and approved by the NRC in letters dated October 3, 2008, March 30, 2011, August 22, 2006, and February 29, 2008, respectively [ADAMS Accession Nos. ML082630051, ML110240474, ML062080744, and ML080630679]. In addition, the NRC has recently granted similar alternatives for NextEra Energy's Seabrook Station by letter dated March 29, 2012 [ADAMS Accession No. ML120740580], and for Energy Northwest's Columbia Generating Station by letter dated February 3, 2011 [ADAMS Accession No. ML110110172].

FIGURE

Typical Reactor Vessel-To-Flange Weld Joint