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

October 3, 2008

Mr. William R. Campbell, Jr.
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT UNIT 1 - INSERVICE INSPECTION PROGRAM RELIEF REQUEST PDI-4 (TAC NO. MD8798)

Dear Mr. Campbell:

By a letter dated May 27, 2008, the Tennessee Valley Authority (TVA, the licensee) submitted Relief Request (RR) 1-PDI-4 requesting relief from the requirements specified in Appendix I to the American Society of Mechanical Engineers Code (ASME), Section XI for the Reactor Pressure Vessel (RPV) circumferential shell-to-flange and RPV closure head-to-flange welds under Title 10, *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i) for the Browns Ferry Nuclear Plant, Unit 1. The request proposed that in lieu of the requirements of the ASME Code, Section XI, Subarticle IWA-2232 and its referenced Section V, Article 4 requirements, the procedures, personnel, and equipment qualified to meet the requirements of ASME Section XI, Appendix VIII, Supplements 4 and 6 of the 2001 Edition, as administered by the Electric Power Research Institute's Performance Demonstration Initiative (PDI) processes be used to conduct the required examinations for the RPV circumferential shell-to-flange flange and RPV closure head-to-flange welds.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the information provided in TVA's May 27, 2008, letter. The NRC staff concluded that the proposed alternative to the requirements of Section XI, paragraph IWA-2232 of the ASME Code described in the licensee's letter provides an acceptable level of quality and safety. Therefore, RR-1-PDI-4 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for Browns Ferry Nuclear Plant, Unit 1. All other requirements of the ASME Code, Section XI 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.

This relief is authorized for the remainder of the second 10-year inservice inspection interval at Browns Ferry Unit 1, which began June 2, 2008, and is scheduled to end June 1, 2018.

Sincerely,

Thomas H. Boyce, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-259

Enclosure: Safety Evaluation

cc w/encl: See next page

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Letter to William R. Campbell, Jr. from Eva A. Brown dated: October 3, 2008

SUBJECT: BROWNS FERRY NUCLEAR PLANT UNIT 1 - INSERVICE INSPECTION PROGRAM RELIEF REQUEST PDI-4 (TAC NO. MD8798)

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Tennessee Valley Authority

BROWNS FERRY NUCLEAR PLANT

cc:
Mr. Ashok S. Bhatnagar
Senior Vice President
Nuclear Generation Development
and Construction
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Vice President
Nuclear Support
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Michael J. Lorek
Vice President
Nuclear Engineering & Projects
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. D. Tony Langley, Manager
Licensing and Industry Affairs
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

General Counsel
Tennessee Valley Authority
6A West Tower
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. John C. Fornicola, General Manager
Nuclear Assurance
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. R. G. (Rusty) West
Site Vice President
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Ms. Beth A. Wetzel, Manager
Corporate Nuclear Licensing
and Industry Affairs
Tennessee Valley Authority
4K Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. James E. Emens, Jr.
Supervisor, Nuclear Site Licensing
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

James B. Baptist
Browns Ferry Senior Project Engineer
Division of Reactor Projects, Branch 6
U.S. Nuclear Regulatory Commission
61 Forsyth Street, SW.
Suite 24T85
Atlanta, GA 30303-8931

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, AL 35611-6970

State Health Officer
Alabama Dept. of Public Health
RSA Tower - Administration
Suite 1552
P.O. Box 303017
Montgomery, AL 36130-3017

cc:
Chairman
Limestone County Commission
310 West Washington Street
Athens, AL 35611

Mr. Larry E. Nicholson, General Manager
Performance Improvement
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Michael A. Purcell
Senior Licensing Manager
Nuclear Power Group
Tennessee Valley Authority
4K Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-259

1.0 INTRODUCTION

By letter dated May 27, 2008, the Tennessee Valley Authority (TVA, the licensee) submitted a relief request from certain qualification requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code at the Browns Ferry Nuclear Plant, Unit 1. Specifically, the licensee proposed (Relief Request 1-PDI-4) examining the reactor pressure vessel (RPV) closure head-to-flange weld and circumferential RPV shell-to-flange weld with procedure and personnel qualified to ASME Code, Section XI, Appendix VIII, Supplements 4 and 6 requirements.

The request is for the remainder of the second 10-year inservice inspection (ISI) interval that began June 2, 2008, and is scheduled to end June 1, 2018.

2.0 REGULATORY REQUIREMENTS

The ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 Code of Federal Regulations (10 CFR) Section 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). In 10 CFR 50.55a(a)(3), it states, in part, that alternatives to the requirements of paragraph (g) may be used when authorized by the Nuclear Regulatory Commission (NRC), if the applicant demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The 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 10 CFR 50.55a(b) 12 months prior to

the start of the 120-month interval, subject to the limitations and modifications listed therein. As stated in 10 CFR 50.55a(g)(4)(iv), inservice examination of components and system pressure tests may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in paragraph 10 CFR 50.55a(b), subject to the limitations and modification listed in 10 CFR 50.55a(b) and subject to Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions or addenda are met.

The code of record for the second 10-year ISI interval at the Browns Ferry Nuclear Plant, Unit 1, is the 2001 Edition through 2003 Addenda of the ASME Code.

3.0 RELIEF REQUEST NO. 1-PDI-4

3.1 Component Function/Description

ASME Code Class 1, RPV upper vessel shell-to-flange weld and RPV closure head-to-flange weld, Table IWB-2500-1, Category B-A, Item Numbers B1.30 and B1.40, TVA ISI program weld designations 1-C-5-FLG and RCH-1-2C.

3.2 Code Requirements for Which Relief is Requested

ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 2001 Edition through 2003 Addenda, Subsection IWA-2232 "Ultrasonic examinations shall be conducted in accordance with Appendix I." Appendix I, paragraph I-2110(b) states that,

> Ultrasonic examinations of the RPV-to-flange weld, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with ASME Section V, Article 4, except that alternative examination beam angles may be used.

Regulatory Guide (RG) 1.150, Revision 1, *Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations*, provides guidance for UT examinations of RPV welds.

3.3 Licensee's Proposed Alternative

The licensee proposes using the techniques (procedures), personnel, and equipment qualified to meet the requirements of the 2001 Edition of the ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, in accordance with 10 CFR 50.55a(b)(2)(xxiv) and, 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 Electric Power Research Institute's (EPRI) Performance Demonstration Initiative (PDI) program.

3.4 Licensee's Bases for Alternative

Section V, Article 4 of the ASME Code, describes the required techniques to be used for the ultrasonic testing (UT) of welds in ferritic pressure vessels with wall thicknesses greater than 2-inches. UT performed in accordance with Section V, Article 4, uses recording thresholds of 50 percent distance-amplitude-correction (DAC) for the outer 80 percent of the required examination volume and 20 percent DAC from the clad/base metal interface to the inner 20 percent margin of the examination volume. Indications detected in the designated exam volume portions, with amplitudes below these thresholds, are not required to be recorded. Use of

the Appendix VIII/PDI processes would enhance the quality of the examination results reported because the detection sensitivity is more conservative and the procedure requires the examiner to evaluate all indications determined to be flaws, regardless of their associated amplitude. The recording thresholds in Section V, Article 4, and the guidelines of RG 1.150, Revision 1, are generic and somewhat arbitrary and do not take into consideration such factors as flaw orientation, which can influence the amplitude of UT responses.

> The EPRI Report NP-6273, *Accuracy of Ultrasonic Flaw sizing Techniques for Reactor Pressure Vessels*, dated March 1989, established that UT flaw sizing techniques based on tip diffraction are the most accurate. The qualified prescriptive-based UT procedures of ASME Section V, Article 4 have been applied in a controlled process with mockups of RPVs that contained real flaws and the results statistically analyzed according to the screening criteria in ASME Section XI, Appendix VIII. The results show that the procedures in Section V, Article 4 are less effective in detecting flaws than procedures qualified in accordance with Appendix VIII as administered by the PDI program. Appendix VIII/PDI qualification procedures use the tip diffraction techniques for flaw sizing. The proposed alternative Appendix VIII/PDI UT methodology uses analysis tools based upon echo dynamic motion and tip diffraction criteria, which has been validated, and is considered more accurate than the Section V, Article 4 processes.

3.5 Evaluation

The 2001 Edition of the ASME Code, Section V, Article 4, as supplemented by Appendix I provides a prescriptive process for qualifying UT procedures. In lieu of I-2100(b) requirements, the licensee proposed using procedures, equipment, and personnel qualified in accordance with performance-based criteria as administered by the PDI program for the examination of RPV welds. The PDI program implements the requirements of Section XI, Appendix VIII, Supplements 4 and 6 as modified by 10 CFR 50.55a(b)(2)(xv).

When prescriptive Section V, Article 4 UT procedures are applied in a controlled setting containing real flaws in mockups and the sizing results are statistically analyzed according to the performance-based screening criteria in Section XI, Appendix VIII, the prescriptive-based sizing results were determined to be equal to or less effective than the sizing results from performance-based Section XI, Appendix VIII procedures. The improvement in sizing is attributed to the echo-dynamic motion and tip diffraction criteria used by performance-based UT as opposed to the less accurate amplitude drop criteria of prescriptive Section V, Article 4 requirements.

Recently, the ASME Code approved a change that permitted licensees to use Appendix VIII qualified procedures, personnel, and equipment for examinations of components to which Appendix VIII is not applicable provided the component materials, sizes, and shapes are with the scope of the qualified examination procedures. The ASME Code Appendix VIII UT qualifications are more rigorous than ASME Section V, Article 4 qualifications. Appendix VIII qualifications are based on passing a blind test performed on representative mockups containing representative flaws, while an ASME Section V, Article 4 qualification process relies on non-blind detection of machined marks in a calibration block.

For detection of flaws, Section V, Article 4 and RG 1.150 require indications of 20 percent DAC displayed on a cathode ray tube (CRT) screen and greater to be evaluated. Performance-based UT requires that the essential variable settings used during the performance demonstration be

used for the examinations, which usually is DAC above the background noise displayed on the CRT. The performance-based UT is performed with higher sensitivity, which increases the chances of detecting a flaw when compared to prescriptive Section V, Article 4 requirements. Procedures, equipment, and personnel qualified through the PDI program have shown high probability of detection levels. Based on this, the NRC staff concludes that this will result in an acceptable level of quality and safety per 50.55a(3)(i) of inspections for weld configurations within the scope of the PDI program.

4.0 CONCLUSION

Based on the increased reliability of inspections within the scope of the PDI program, as discussed above, the staff concludes that the licensee's proposed alternative in RR-PDI-4 to use UT procedures, equipment, and personnel qualified to the 2001 Edition of the ASME Section XI, Appendix VIII, Supplements 4 and 6 as modified by 10 CFR 50.55a for the RPV shell-to-flange weld and RPV head-to-flange weld, is acceptable. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative in RR-1-PDI-4 is authorized for the subject welds for the remainder of the second 10-year ISI interval at Browns Ferry Nuclear Plant, Unit 1, that began June 2, 2008, and is scheduled to end June 1, 2018. This authorization is limited to those components described in Section 3.1 above.

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.

Principal Contributor: Donald Naujock

Date: October 3, 2008