April 12, 2004

Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
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SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 2 - REQUESTS FOR RELIEF NOS. 2-ISI-18 AND 2-ISI-19 FOR THIRD 10-YEAR INTERVAL INSERVICE INSPECTION (TAC NOS. MB9749 AND MB9750)

Dear Mr. Scalice:

By letter to the Nuclear Regulatory Commission (NRC) dated June 2, 2003, as supplemented December 16, 2003, the Tennessee Valley Authority submitted Requests for Relief 2-ISI-18 and 2-ISI-19 for Browns Ferry Nuclear Plant, Unit 2, third 10-year inservice inspection (ISI) interval. The submittal proposed an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Table IWB-2500-1, Examination Categories.

The NRC staff has reviewed and evaluated the information provided in support of the above relief requests. Based on the conclusions contained in the enclosed safety evaluation, the NRC staff finds that the alternatives proposed in Relief Requests 2-ISI-18 and 2-ISI-19 provide an acceptable level of quality and safety. Therefore, relief is authorized pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.55a(a)(3)(i). These reliefs are authorized for the remainder of the current 10-year ISI interval.

Sincerely,

/RA/

William F. Burton, Acting Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-260

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

RELIEF REQUESTS 2-ISI-18 AND 2-ISI-19

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 2

DOCKET NO. 50-260

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC, Commission) dated June 2, 2003, as supplemented December 16, 2003, the Tennessee Valley Authority (the licensee) submitted requests for relief for the Browns Ferry Nuclear Plant (BFN), Unit 2, for the third 10-year inservice inspection (ISI) interval. Specifically, the licensee requested relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code(Code), Section XI, Table IWB-2500-1, Examination Categories. The Code requires volumetric and surface examination of essentially 100 percent of the weld length.

2.0 REGULATORY REQUIREMENTS

The ISI of the ASME Code Class 1, Class 2, and Class 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 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). As stated, in part, in 10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee 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) shall 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 (ISI) 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. The ISI Code of record for ASME, Section XI,

nondestructive examination (NDE) for BFN, Unit 2, third 10-year ISI interval, which began May 25, 2001, and is scheduled to end on May 24, 2011.

3.0 TECHNICAL EVALUATION

3.1 Relief Request 2-ISI-18

3.1.1 Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-J, Pressure Retaining Welds in Piping, Item No. B9.11, requires volumetric and surface examination of essentially 100 percent of the weld length as depicted in Figure IWB-2500-8.

3.1.2 System/Component(s) for Which Relief is Requested

Class 1 Reactor Recirculation System Weld No. KR-2-25, and Reactor Water Cleanup (RWCU) System Weld No. RWCU-2-003-G-003 as identified in Table 1[1] below:

Weld Numbers	NPS	ISI Drawing[2]	Percent Examined	Remarks
K-2-25	28"	ISI-0270-C	50%	Limitations due to component configuration and the requirement in 10 CFR 50.55a(b)(2)(xv)(A)(2), which requires UT [ultrasonic examination] of one side of austenitic welds to be qualified to Appendix VIII Program to claim full code coverage. At this time, there are no Appendix VIII Program for single sided austenitic welds nor is one planned for the future; therefore, only 50 percent coverage can be claimed.
RWCU-2-003-G003	6"	ISI-0272-C	75%	Limitations due to component configuration and the requirement in 10 CFR 50.55a(b)(2)(xv)(A)(2), which requires UT of one side of austenitic welds to be qualified to Appendix VIII Program to claim full code coverage. At this time, there are no Appendix VIII Program for single sided austenitic welds nor is one planned for the future; therefore, only 75 percent coverage can be claimed.

[1] Table 1 is contained in the licensee's letter dated June 2, 2003, and reproduced in this safety evaluation.

[2] ISI drawings are contained in the licensee's letter dated June 2, 2003, and are not included in this safety evaluation.

3.1.3 Code Requirement from Which Relief is Requested

Relief is requested from performing a full Code coverage volumetric examination of essentially 100 percent of the weld length as depicted in Figure IWB-2500-8 because of component configuration of the welds identified in Table 1 to this request for relief.

3.1.4 Licensee's Proposed Alternative Examination (as stated)

> In lieu of the Code required essentially 100 percent volumetric ultrasonic examination, TVA proposes an ultrasonic examination of accessible areas to the maximum extent practical given the component design configuration of the aforementioned piping welds.

3.1.5 Licensee's Basis for Relief Request (as stated)

> It is not possible to perform the volumetric ultrasonic examination from both sides of the welds due to the configuration of these components. Also, because of the requirement mandated in 10 CFR 50.55a(b)(2)(xv)(A)(2), which states in part, 'Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.' At this time, there are no Appendix VIII Program for single-sided austenitic welds nor is one planned in the future, therefore, only 50 percent coverage for weld KR-2-25 and 75 percent coverage for weld RWCU-2-003-G003 can be claimed. Under the original ASME Section XI Code requirements UT coverage attained was 100 percent.
>
> Weld KR-2-25 limitations were due to the configuration of the component, Pipe to Tee.
>
> Weld RWCU-2-003-G003 limitations were due to the configuration of the component, Pipe to Flued Head.
>
> The performance of the ultrasonic examination of the subject areas to the maximum extent practical provides an acceptable level of quality and safety because the information and data obtained from the volume examined provides sufficient information to judge the overall integrity of the piping welds.

3.1.6 NRC Staff's Evaluation

ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1995 Edition through the 1996 Addenda, Table IWB-2500-1, Category B-J, "Pressure Retaining Welds in Piping," Item No. B9.11, "Circumferential Welds," requires volumetric examination of essentially 100 percent of the weld and adjacent material as depicted in Figure IWB-2500-8.

TVA has determined that certain BFN Unit 2 welds had NDE coverage limitations, less than 100 percent coverage of the weld and adjacent material. The limitations encountered during the performance of the UT examinations on welds KR-2-25 and RWCU-2-003-G003 were

caused by component configuration and a rule change in 10 CFR 50.55a(b)(2)(xv)(A)(2) that restricts taking credit for “single-sided” examinations without completing a “single-sided” ASME, Section XI, Appendix VIII demonstration using flaws on the opposite side of the weld. Because of these limitations, the percent examination coverages achieved for the subject welds were 50 and 75 percent for welds KR-2-25 and RWCU-2-003-G003, respectively. The examination coverages attained for the subject welds found no recordable indications or degradation on the examined areas.

Previous ISI interval UT examinations on the subject welds were conducted using the prescriptive requirements of the ASME Section XI, Appendix III. Under these requirements the examination coverage attained for each weld was 100 percent, with no recordable indications or degradation found on the examined areas.

Though previous and current UT examination scan paths and angles are equivalent, the current coverage requirements are based on utilizing a procedure qualified to ASME, Section XI, Appendix VIII, Performance Demonstration Initiative (PDI). At the time of the examinations, no PDI program existed for single-side austenitic welds. The regulation at 10 CFR 50.55a(b)(2)(xv) requires that if access is available, the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld on each side of the weld centerline). Coverage credit may be taken for single side exams on austenitic piping if a procedure is qualified with flaws on the inaccessible side of the weld. This procedure must demonstrate single-side access examinations equivalency to “two-sided” examinations. Current technology is not capable of reliably detecting or sizing flaws on the inaccessible side of an austenitic weld for configurations common to U.S. nuclear applications. Instead of a full single-side qualification, PDI offers a best-effort approach, which demonstrates that the best available technology is applied. PDI Performance Demonstration Qualification Summary austenitic piping certificates list the limitation that single side examination is performed on a best-effort basis. This requires the inaccessible side of the weld to be listed as an area of no coverage. This examination provides, to the maximum extent practical, an acceptable level of quality and safety based upon the demonstrated and qualified techniques offered.

The NRC staff determined, based on the information provided by the licensee, that the subject welds were examined using the best available techniques, equipment and personnel as qualified through the PDI for ASME, Section XI, Appendix VIII, with demonstrated best effort for single-side examination. Current and previous examinations on the subject welds found no recordable indication or degradation on the examined areas. Also, the NRC staff agrees with the licensee’s conclusion that if significant degradation is present, it would be detected during a UT examination, to the maximum extent practical, from one side of the weld.

Based on the information contained in the licensee’s submittal dated June 2, 2003, as supplemented by letter dated December 16, 2003, the NRC staff has determined that the proposed alternative in RR 2-ISI-18 provides an acceptable level of quality and safety. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i), for the third 10-year ISI interval at BFN, Unit 2. This authorization is limited to those components described in Section 3.1 above.

3.2 Relief Request 2-ISI-19

3.2.1 Code Requirements

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels, Item No. B3.90, requires volumetric examination of essentially 100 percent of the weld and adjacent material as depicted in Figure IWB-2500-7.

3.2.2 System/Component(s) for Which Relief is Requested

Class 1 Reactor Pressure Vessel (RPV) Nozzles Welds as identified in Table 2[3] below:

Weld Number	NPS	ISI Drawing[4]	Percent Examined	Remarks
N1A (Recirc. Outlet)	28"	2-ISI-0270-C	48.8%	Nozzle to Vessel Weld 43 and 60 degree shear and 43 and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2B (Recirc. Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 43, 63 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2F (Recirc. Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 60 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N2J (Recirc. Inlet)	12"	2-ISI-0270-C	51.5%	Nozzle to Vessel Weld 40, 58 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.

[3] Table 1 is contained in the licensee's letter dated June 2, 2003, and reproduced in this safety evaluation.

[4] ISI drawings are contained in the licensee's letter dated June 2, 2003, and are not included in this safety evaluation.

Weld Number	NPS	ISI Drawing[4]	Percent Examined	Remarks
N3D (Main Steam)	26"	2-ISI-0222-C	47.3%	Nozzle to Vessel Weld 41, 58 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration. Exams performed from the shell side and outer nozzle blend radius.
N4A (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 41, 58, degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL [refracted longitudinal] radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4B (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4C (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 60 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.

Weld Number	NPS	ISI Drawing[4]	Percent Examined	Remarks
N4D (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 59, degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4E (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N4F (Feedwater)	12"	2-ISI-0269-C	45.4%	Nozzle to Vessel Weld 40, 42, 59 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and RPV Circumferential weld No. C-3-4. The 60 degree RL radial scan was limited by approximately 4.7 percent due to lift off on lower toe of nozzle to vessel weld. Exams performed from the shell side and outer nozzle blend radius.
N8A (Recirc. Instr. Nozzle)	4"	2-ISI-0410-C	89.5%	Nozzle to Vessel Weld 50 degree shear and 60 degree longitudinal scanning was restricted due to nozzle configuration and Circumferential RPV weld C-BH-1. The 60 degree radial scan was limited by approximately 4.8 percent due to lift off on upper toe of nozzle to vessel weld. Exams performed from the shell side.

3.2.3 Code Requirement from Which Relief is Requested

Relief is requested from performing a full Code coverage volumetric examination of essentially 100 percent of the weld length as depicted in Figure IWB-2500-7 because of component configuration of the welds identified in Table 2 to this request for relief.

3.2.4 Licensee's Proposed Alternative Examination

In lieu of the Code requirements of 100 percent volume UT examination, TVA proposes a UT examination of accessible areas to the maximum extent practical given the component design configuration of the RPV nozzle-to-vessel welds.

3.2.5 Licensee's Basis for Relief Request

The design configuration of the RPV nozzle-to-vessel welds precludes a UT examination of essentially 100 percent of the required volume. The component design configuration limits UT examination coverage of the welds to the percentages listed in Table 2 to this request for relief.

3.2.6 NRC Staff's Evaluation

ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1995 Edition through the 1996 Addenda, Table IWB-2500-1, Category B-D, "Full Penetration Welds of Nozzles in Vessels," Item No. B3.90, "Nozzle-to-Vessel Welds," requires volumetric examination of 100 percent of the weld and adjacent material as depicted in Figure IWB-2500-7.

The design configuration of the RPV nozzle-to-vessel welds, identified in Table 2, precludes a UT examination of essentially 100 percent of the volume as required by ASME, Section XI. The component design configuration limits UT examination coverage of the welds to the percentages listed in Table 2. In order to examine the welds in accordance with the ASME Code requirements, the RPV would require extensive design modifications. The physical arrangements of the nozzle-to-vessel welds preclude UT examination from the nozzle side. The limitations are inherent to the barrel-type nozzle-to-vessel weld design and are compounded by the close proximity of the biological shield wall. Scanning from the nozzle surface is ineffective due to the weld location and the asymmetrical inside surface where the nozzle and vessel converge. Coverage was increased by scanning from the outside blend radius of the weld where practical. Experience from the automated UT examination performed from the inside surface has shown that the nozzle-to-vessel weld coverage will not be greatly improved even if performed from the inside surface utilizing the current state-of-the-art techniques.

The extent of examination coverage from the vessel side provides reasonable assurance that no flaws oriented parallel to the weld are present. The areas receiving little or no examination coverage are located toward the outside surface of the RPV in the general area of the nozzle outside blend radius (the blend radius restricts the scanning movement and/or transducer contact). The reactor vessel inner-half of the thickness and inside surface are interrogated with the UT beam. Any degradation located at the inside surface or inner-half of the vessel would be located. It should be noted that the nozzle inside radius section received essentially 100 percent examination coverage on the subject nozzles, with no recordable indications or degradation identified.

Radiographic examination as an alternate volumetric examination method was determined to be impractical due the radiological concerns. Gaining access to the inside surface of the RPV to place radiographic film would require extensive personnel protection due to high radiation and contamination levels. Also, due to the varying thickness at the outside blend radius of the weld, several radiographs may be required of one area to obtain the required coverage and/or film density. The additional Code coverage gained by radiography is impractical when weighed against the radiological concerns.

Based on the information contained in the licensee's submittal dated June 2, 2003, as supplemented by letter dated December 16, 2003, the NRC staff has determined that the proposed alternative in Relief Request 2-ISI-19 provides an acceptable level of quality and safety. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i), for the third 10-year ISI interval at BFN, Unit 2. This authorization is limited to those components described in Section 3.1 above.

4.0 CONCLUSION

The NRC staff concludes that, for Relief Requests 2-ISI-18 and 2-ISI-19, the proposed alternatives are authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that they provide an acceptable level of quality and safety.

The relief for the above requests is for the duration of the third 10-year ISI interval. All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this safety evaluation remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Arroyo

Date: April 12, 2004

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