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

CNL-15-125

June 26, 2015

10 CFR 50.55a

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

Browns Ferry Nuclear Plant, Unit 1
Renewed Facility Operating License No. DPR-33
NRC Docket No. 50-259

Subject: **Browns Ferry Nuclear Plant (BFN) Unit 1, American Society of Mechanical Engineers (ASME) Section XI, Inservice Inspection (ISI) and Augmented Program, Second Ten Year Interval Request For Relief 1-ISI-27**

Reference: Letter from NRC to BFN, "Browns Ferry Nuclear Plant Unit 1 - Safety Evaluation for Relief Request 1-ISI-19 Associated with Reactor Pressure Vessel Circumferential Shell Welds," dated May 31, 2005 (ML051110626)

Tennessee Valley Authority (TVA) is requesting a proposed alternative in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1) on the basis that the proposed alternative provides an acceptable level of quality and safety. Based on a start date of June 2, 2008, BFN Unit, 1 ISI Program complies with the requirements of the 2001 Edition through 2003 Addenda of the ASME, Section XI Code. The second Ten-Year Interval began on June 2, 2008, and concludes on June 1, 2017. The proposed alternative would provide relief from reactor vessel circumferential weld examinations currently required by ASME Code for the period of extended operation ending December 20, 2033.

Permanent relief from reactor vessel circumferential weld examinations was approved for the Second Ten-Year ISI Inspection Interval for BFN Unit 1 by the NRC letter dated May 31, 2005, (Reference 1) for the remaining term of operation under the original operating license that expired on December 20, 2013.

The enclosure to this letter contains the BFN Unit 1, Request for Relief 1-ISI−27 for NRC review and approval. Table 1 of the enclosure contains specific information associated with each weld for which TVA is requesting relief from reactor vessel circumferential weld examinations.

TVA requests approval of this request for relief within one year from the date of this letter.

There are no new regulatory commitments contained in this letter. If you have any questions, please contact Jamie L. Paul at (256) 729-2636.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure:
Tennessee Valley Authority Browns Ferry Nuclear Plant (BFN) Unit 1 American Society of Mechanical Engineers (ASME) Section XI, Inservice Inspection (ISI) and Augmented Program Second Ten Year Interval Request for Relief 1-ISI-27

cc (w/Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

Enclosure

Tennessee Valley Authority
Browns Ferry Nuclear Plant
Unit 1

American Society of Mechanical Engineers (ASME) Section XI, Inservice Inspection (ISI) and Augmented Program Second Ten Year Interval

Request for Relief 1-ISI-27

Enclosure

TENNESSEE VALLEY AUTHORITY
Browns Ferry Nuclear Plant, Unit 1
Request for Relief 1-ISI-27

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN) UNIT 1
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI, INSERVICE INSPECTION (ISI) AND AUGMENTED PROGRAM SECOND TEN YEAR INTERVAL REQUEST FOR RELIEF 1-ISI-27

I. ASME Code Components Affected

Permanent relief from Reactor Vessel (RV) Circumferential Shell Weld Examinations is requested for the five welds listed in Table 1.

TABLE 1

Weld Number and Description	Category and Exam Method	Item Number	ASME Code Class
No. C-4-5, Vessel Shell to Shell Weld	B-A, Volumetric	B1.11	1
No. C-3-4, Vessel Shell to Shell Weld	B-A, Volumetric	B1.11	1
No. C-2-3, Vessel Shell to Shell Weld	B-A, Volumetric	B1.11	1
No. C-1-2, Vessel Shell to Shell Weld (Located in Belt-line Region)	B-A, Volumetric	B1.11	1
No. C-BH-1, Vessel Shell to Bottom Head Weld	B-A, Volumetric	B1.11	1

II. ASME Code Edition and Addenda

ASME Section XI, 2001 Edition through 2003 Addenda.

III. Applicable Code Requirement

ASME Section XI, 2001 Edition through 2003 Addenda, Table IWB-2500-1, Examination Category B-A, Item B1.11, requires a volumetric examination of the RV circumferential shell welds each interval.

TENNESSEE VALLEY AUTHORITY
Browns Ferry Nuclear Plant, Unit 1
Request for Relief 1-ISI-27

IV. Reason for Request

The Tennessee Valley Authority (TVA) is requesting a proposed alternative in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.55a(z)(1) on the basis that the proposed alternative provides an acceptable level of quality and safety. The proposed alternative would provide relief from RV circumferential weld examinations currently required by ASME Code for the period of extended operation.

Permanent relief from RV circumferential weld examinations was approved for the Second Ten-Year ISI Inspection Interval for BFN Unit 1 in the NRC letter dated May 31, 2005, for the remaining term of operation under the original operating license that expired on December 20, 2013.

Relief from RV circumferential weld examinations for the period of extended operation was discussed in NUREG-1843, "Safety Evaluation Report Related to the License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated April 2006, Section 4.2.6. The NRC staff reviewed the TVA Time-Limited Aging Analysis (TLAA) on RV circumferential weld examination relief, as summarized in License Renewal Application (LRA) Section 4.2.6, and determined that TVA appropriately explained that the conditional failure probabilities for the RV circumferential welds are bounded by the staff analysis in the Safety Evaluation Report (SER) for the Boiling Water Reactor Vessel and Internals Project (BWRVIP) BWRVIP-05 report, dated July 28, 1998, and that BFN will be using procedures and training to limit cold over-pressure events during the period of extended operation for BFN. The NRC concluded that the TVA LRA Section 4.2.6 on TLAA, and LRA Section A.3.1.6 for the BFN RV circumferential weld examination relief will meet the requirements of 10 CFR 54.21(c)(1)(ii) with one exception that was addressed by letter dated May 25, 2005, in which TVA provided the RV circumferential weld examination analysis for BFN Unit 1 in a revised version of Updated Final Safety Analysis Report (UFSAR) Supplement A.3.1.6.

V. Proposed Alternative and Basis for Use

The following information from NUREG-1843 (Section 4.2.6.2) is provided as the basis for use of the proposed alternative to perform only RV longitudinal shell weld examinations for the period of extended operation.

The technical basis for relief is discussed in the NRC staff's final SER concerning the BWRVIP-05 report, which is enclosed in a July 28, 1998, letter from Mr. G. C. Laines (NRC) to Mr. C. Terry (BWRVIP Chairman). In this letter, the staff concluded that since the failure frequency for RV circumferential welds in Boiling Water Reactor (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," and below the core damage frequency of any BWR plant, the continued inspection would result in a negligible decrease in an already acceptably low value of RV failure. Therefore, elimination of the inservice inspection for RV circumferential welds is justified. The NRC staff's letter indicated that BWR applicants may request relief from ISI requirements of 10 CFR 50.55a(g) for volumetric examination of circumferential RV welds by demonstrating that (1) at the expiration of the license, the circumferential welds satisfy the limiting conditional failure probability for RV circumferential welds in the NRC staff's July 28,1998 evaluation, and (2) the applicants have implemented operator training and established procedures that limit the

frequency of cold over-pressure events to the frequency specified in the NRC staff's SER. The letter indicated that the requirements for inspection of circumferential RV welds during an additional 20-year license renewal period would be reassessed, on a plant-specific basis, as part of any BWR LRA. Therefore, TVA must request relief from inspection of RV circumferential welds during the license renewal period per 10 CFR 50.55a, Codes and Standards.

Section A.4.5 of the BWRVIP-74 report indicates that the NRC staff's SER of the BWRVIP-05 report conservatively evaluated the BWR RVs to 64 Effective Full Power Years (EFPY), which is 10 EFPY greater than what is realistically expected for the end of the BFN Unit 1 license renewal period. The NRC staff used the mean Nil-Ductility Transition Reference Temperature (RT_{NDT}) value for materials to evaluate failure probability of BWR RV circumferential welds at 32 and 64 EFPY in the SER of the BWRVIP-05 report. The neutron fluence used in this evaluation was the neutron fluence at the clad-weld (inner) interface.

Because the NRC staff analysis discussed in the BWRVIP-74 report is a generic analysis, TVA is required to submit plant-specific information to demonstrate that the beltline materials meet the criteria specified in the report.

On May 12, 2004, TVA submitted a relief request concerning the examination of the BFN Unit 1 RV circumferential welds for the original license period.

In Request for Additional Information (RAI) 4.2.6-1, dated December 1, 2004, the NRC requested the RV circumferential weld examination relief analyses for BFN Unit 1. On January 31, 2005, TVA submitted the following relief analyses related to the BFN Unit 1 RV circumferential weld examination.

The following table provides a comparison of the BFN Unit 1 RV limiting circumferential weld parameters to those used in the NRC evaluation of BWRVIP-05 for the first two key assumptions. Data provided in this table was supplied from Tables 2.6.4 and 2.6.5 of the Final Safety Evaluation of the BWRVIP-05 Report (NRC letter from Gus C. Lainas to Carl Terry, Niagara Mohawk Power Company, BWRVIP Chairman), "Final Safety Evaluation of the BWRVIP Vessel and Internals Project BWRVIP-05 Report," (TAC No. M93925), July 28, 1998.

TABLE 2
Effects of Irradiation on RPV Circumferential Weld Properties for BFN Unit 1

Group	Babcock and Wilcox (B&W) 64 EFPY	BFN Unit 1 54 EFPY
Cu %	0.31	0.27
Ni %	0.59	0.6
Weld Chemistry Factor (CF)	196.7	184
Fluence at Clad/Weld Interface 10^{19} neutrons (n)/centimeter^2 (cm^2)	0.19	0.2
Delta RT_{NDT} Without Margin (°F)	109.4	104
Initial RT_{NDT} (°F)	20	20

Group	Babcock and Wilcox (B&W) 64 EFPY	BFN Unit 1 54 EFPY
Mean RT_{NDT} (°F)	129.4	124
P (F/E)* NRC	4.83×10^{4}	_____
P (F/E) BWRVIP	_____	_____

*P (F/E) is the conditional probability of vessel failure.

The fluence assumed for Unit 1 is very conservative based on an extended shutdown period from 1985 to a scheduled restart in 2007, which will result in less than 32 EFPY of vessel exposure through the end of the extended period of operation. However, TVA conservatively chose to use the higher exposure of 54 EFPY to simplify the basis for the Unit 1 vessel evaluations. As shown in the table, the Unit 1 unirradiated weld RT_{NDT} is identical to the reference B&W plant unirradiated weld RT_{NDT} used in the NRC analysis, and the Unit 1 fluence value is approximately equivalent to that used in the NRC analysis. However, because the Unit 1 chemistry factor is less than the reference B&W plant, the mean RT_{NDT} values for Unit 1 at 54 EFPY are bounded by the 64 EFPY Mean RT_{NDT} assumed by the NRC in its analysis. Accordingly, Unit 1 is bounded by the conditional failure probability calculated by the Staff for the limiting B&W vessel.

The NRC staff verified the accuracy of the mean RT_{NDT} for the limiting beltline circumferential weld on BFN Unit 1 and found it acceptable. In the NRC staff's evaluation of the BWRVIP-05 report, a fluence of 0.19×10^{19} n/cm^2 for B&W RVs was used for 64 EFPY and the corresponding delta RT_{NDT} value is 109.4 °F. The delta RT_{NDT} value for the limiting beltline weld metal of BFN Unit 1 is less than the limiting delta RT_{NDT} value in the NRC staff's evaluation of BWRVIP-05 report, which is conservative. Therefore, BFN's calculated mean RT_{NDT} value for the limiting beltline weld metal is acceptable and meets the requirements specified in the NRC approved SER for the BWRVIP-05 report.

The SER for the BWRVIP-05 report provides a limiting conditional failure probability of 4.83×10^{-4} per reactor-year for a limiting plant-specific mean RT_{NDT} of 129.4 °F for B&W fabricated RVs. The Low Temperature Over-Pressure (LTOP) transient frequency is the frequency of the transient occurring, determined as 10^{-3} per reactor-year in the evaluation of BWRVIP-05 report. The conditional failure probability is the probability of failure, if the event were to occur. The vessel failure frequency is the product of conditional failure probability and LTOP frequency. Comparing the information in the Reactor Vessel Internal Database (RVID) with that submitted in the analysis, the NRC staff confirmed that the mean RT_{NDT} of the RV circumferential welds at BFN Unit 1 is projected to be 124°F at the end of the period of extended operation (54 EFPY). In this evaluation, the chemistry factor, delta RT_{NDT}, and mean RT_{NDT} were calculated consistent with the guidelines of RG 1.99, Revision 2. Because the calculated value of mean RT_{NDT} for the RV circumferential welds at BFN Unit 1 is lower than that for the limiting plant-specific case for B&W fabricated RVs, the vessel failure frequencies of the BFN Unit 1 RV circumferential welds is less than 4.83×10^{-7} per reactor-year.

The NRC staff found that BFN's evaluation for this TLAA is acceptable because the BFN Unit 1 54 EFPY conditional failure probabilities for the RV circumferential welds are bounded by the NRC staff analysis in the SER for the BWRVIP-05 report and because BFN will be using procedures and training to limit cold over-pressure events during the period of extended

operation. This analysis satisfied the evaluation requirements of the NRC SER for the BWRVIP-05 report; however, TVA is still required to request relief for the BFN Unit 1 RV circumferential weld examination for the period of extended operation in accordance with 10 CFR 50.55a.

By letter dated December 18, 2013, TVA submitted a license amendment request to revise Browns Ferry Nuclear Plant, Unit 1, Technical Specifications (TS) for Limiting Condition for Operation (LCO) 3.4.9, "RCS Pressure and Temperature (P/T) Limits." This submittal satisfied the requirements of NUREG-1843, "Safety Evaluation Report Related to the License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated April 2006 (ADAMs Accession No. ML061030032), commitment 39 that required the development and submittal of revised P/T limit curves for NRC approval prior to the period of extended operation. These revised P/T limit curves were developed based on analyses projected to the end of the period of extended operation as required by 10 CFR 54.21(c)(1)(ii). On February 2, 2015, the NRC issued License Amendment Number 287 for BFN Unit 1 approving the use of the revise P/T limit curves (ADAMs Accession No. ML14325A501).

The following table provides a comparison of the BFN Unit 1 RV limiting circumferential weld parameters to those used in the NRC evaluation of BWRVIP-05 for the first two key assumptions. The data in this table is taken from Tables 2.6.4 and 2.6.5 of the SER for the BWRVIP-05 Report, dated July 28, 1998, and the analyses performed to support the revised P/T curves. Fluence values associated with the revised P/T curves for BFN Unit 1 38 EFPY were calculated using the General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluation, NEDC-32983P-A, Revision 2.

TABLE 3

Group	B&W 64 EFPY	BFN Unit 1 38 EFPY
Cu %	0.31	0.27
Ni %	0.59	0.6
CF	196.7	184
Fluence at Clad/Weld Interface 10^{19} n/cm^2	0.19	0.0886
Delta RT_{NDT} Without Margin (°F)	109.4	72
Initial RT_{NDT} (°F)	20	20
Mean RT_{NDT} (°F)	129.4	92
P (F/E) NRC	4.83×10^4	_____
P (F/E) BWRVIP	_____	_____

Based on comparison with the limiting values for BFN Unit 1 presented above and the SER for the BWRVIP-05 Report, at the expiration of the renewed operating license, the RV circumferential welds satisfy the limiting conditional failure probability for RV circumferential welds in the NRC staff's BWRVIP-05 report safety evaluation. As previously evaluated in NUREG-1843, procedures and training to limit cold over-pressure events during the period of extended operation been have implemented. Therefore, the proposed alternative as discussed above and as previously evaluated in NUREG-1843 and supplemented with the analyses performed to support the revised P/T curves provides an acceptable level of quality and safety for the period of extended operation.

VI. Duration of Proposed Alternative

Relief is requested for examinations of RV circumferential welds for the period of the renewed license for BFN Unit 1 that expires December 20, 2033.

VII. Precedents

Similar relief was approved for Oyster Creek Nuclear Generating Station (ADAMs Accession No. ML092520039) and Peach Bottom Atomic Power Station Units 2 and 3 (ADAMs Accession No. ML112770217).

VIII. Attachment

Brown Ferry Unit 1 RPV shell weld location schematic drawing.

Enclosure

TENNESSEE VALLEY AUTHORITY
Browns Ferry Nuclear Plant, Unit 1
Request for Relief 1-ISI-27

Attachment 1