

December 19, 2003

Mr. J. A. Scalice
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SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 2 AND 3 — RELIEF REQUESTS
NOS. 2-ISI-21 AND 3-ISI-17 RELATED TO INSERVICE INSPECTION
PROGRAM (TAC NOS. MB9759 AND MB9764)

Dear Mr. Scalice:

By letter dated June 30, 2003, the Tennessee Valley Authority submitted two relief requests (RRs), Nos. 2-ISI-21 and 3-ISI-17, for Browns Ferry Nuclear Plant (BFN), Units 2 and 3, respectively.

The U.S. Nuclear Regulatory Commission staff has reviewed and evaluated the information provided in support of these RR's. Based on the conclusions contained in the enclosed safety evaluation, the staff finds that for RR's 2-ISI-21 and 3-ISI-17, relief is authorized pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i), on the basis that the licensee's proposed alternative to use the Performance Demonstration Initiative program for weld overlay qualifications as described in the submittal, in lieu of Supplement 11 to Appendix VIII of Section XI of the American Society of Mechanical Engineers Code, will provide an acceptable level of quality and safety.

Granting relief pursuant to 10 CFR 50.55a(a)(3)(i) is authorized by law and will not endanger the life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Relief is authorized for the above requests for the duration of the third 10-year inservice inspection interval for BFN Unit 2 and the duration of the second 10-year inservice inspection interval for BFN Unit 3.

Sincerely,

/RA by M. L. Marshall Jr. for/

Allen G. Howe, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-260 and 50-296

Enclosure: Safety Evaluation

cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

RELIEF REQUESTS 2-ISI-21 AND 3-ISI-17

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 2 AND 3

DOCKET NOS. 50 260 AND 50-296

1.0 INTRODUCTION

By letter dated June 30, 2003, the Tennessee Valley Authority the licensee) submitted two relief requests (RRs), Nos. 2-ISI-21 and 3-ISI-17, for the Third and Second 10-Year Interval Inservice Inspection (ISI) Programs for Browns Ferry Nuclear Plant, Units 2 and 3 (BFN Units 2 and 3), respectively.

2.0 REGULATORY REQUIREMENTS

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, requires that ISI of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2 and 3 components be performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (Code) applicable Edition and Addenda, except where specific relief has been requested by the licensee and authorized by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(6)(g)(i). The regulation at 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that (i) the proposed alternative provides 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 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.

ENCLOSURE

The Code of record for the BFN Unit 2 third 10-year ISI interval is the 1995 Edition of the ASME Code, Section XI with 1996 Addenda. The Code of record for the BFN Unit 3, second 10-year ISI interval is the 1989 Edition of the ASME Code, Section XI without Addenda.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements

ASME Code Section XI, 1995 Edition with 1996 Addenda, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds."

3.2 Licensee's Request for Relief

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requests relief from the ASME Code, Section XI, Appendix XIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds," requirements at Browns Ferry Nuclear Plant Units 2 and 3. In lieu of the Code qualification requirements, the licensee proposes to use the qualification process as administered by the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) for weld overlay qualifications.

3.3 Identification of Affected Components

The items affected by the proposal involve the following Unit 2 Recirculation, Core Spray and Reactor Water Cleanup (RWCU) System piping welds with a structural weld overlay:

| Weld Number | System | Pipe Size (inches) | Category |
|-------------|---------------|--------------------|----------|
| GR-2-15 | Recirculation | 12.0 | E |
| DSRWC-2-03 | RWCU | 6.0 | E |
| DSRWC-2-04 | RWCU | 6.0 | E |
| DSRWC-2-05 | RWCU | 6.0 | E |
| TCS-2-421 | Core Spray | 12.0 | E |
| GR-2-45 | Recirculation | 12.0 | E |
| GR-2-59 | Recirculation | 28.0 | E |
| GR-2-64 | Recirculation | 28.0 | E |
| GR-2-61 | Recirculation | 28.0 | E |

The items affected by the proposal involve the following Unit 3 Recirculation and Residual Heat Removal (RHR) System piping welds with a structural weld overlay:

| Weld Number | System | Pipe Size (inches) | Category |
|-------------|---------------|--------------------|----------|
| GR-3-53 | Recirculation | 28.0 | E |
| DSRHR-3-11 | RHR | 20.0 | E |
| GR-3-03 | Recirculation | 28.0 | E |
| GR-3-27 | Recirculation | 28.0 | E |
| GR-3-54 | Recirculation | 28.0 | E |
| GR-3-57 | Recirculation | 28.0 | E |
| GR-3-59 | Recirculation | 28.0 | E |
| GR-3-60 | Recirculation | 28.0 | E |
| GR-3-64 | Recirculation | 28.0 | E |

3.4 NRC Staff Evaluation

The U.S. nuclear utilities created the PDI to implement performance demonstration requirements contained in Appendix VIII of Section XI of the Code. To this end, PDI has developed a program for qualifying equipment, procedures, equipment, and personnel in accordance with the ultrasonic testing criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, EPRI was maintaining a performance demonstration program for weld overlay qualification under the Tri-party Agreement (Reference 1). Instead of having two programs with similar objectives, the NRC staff recognized the PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement (Reference 2). The PDI program does not fully comport with the existing requirements of Supplement 11. The differences are discussed below.

Paragraph 1.1(b) of Supplement 11 states limitations to the maximum thickness for which a procedure may be qualified. The Code states that "The specimen set must include at least one specimen with overlay thickness within minus 0.10 inch to plus 0.25 inch of the maximum nominal overlay thickness for which the procedure is applicable." The Code requirement addresses the specimen thickness tolerance for a single specimen set, but is confusing when multiple specimen sets are used. The PDI proposed alternative states that "the specimen set shall include specimens with overlay not thicker than 0.10-inch more than the minimum thickness, nor thinner than 0.25 inch of the maximum nominal overlay thickness for which the examination procedure is applicable." The proposed alternative provides clarification on the application of the tolerance. The tolerance is unchanged for a single specimen set, however, it clarifies the tolerance for multiple specimen sets by providing tolerances for both the minimum and maximum thicknesses. The proposed wording eliminates confusion while maintaining the intent of the overlay thickness tolerance. Therefore, the staff finds this PDI Program revision acceptable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. For example, flaw implantation requires excavating a volume of base material to allow a pre-cracked coupon to be welded into this area. This process would add weld material to an area of the specimens that typically consists of only base material, and could potentially make ultrasonic examination more difficult and not representative of actual field conditions. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibit crack-like reflective characteristics. Instead of all flaws being cracks as required by Paragraph 1.1(d)(1), the PDI weld overlay performance demonstrations contain at least 70 percent cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The fabricated flaws are semi-elliptical with tip widths of less than 0.002 inch. The licensee provided further information describing a revision to the PDI Program alternative to clarify when real cracks, as opposed to fabricated flaws, will be used; "Flaws shall be limited to the cases where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws." The NRC has reviewed the flaw fabrication process, compared the reflective characteristics between actual cracks and PDI-fabricated flaws, and found the fabricated flaws acceptable for this application (References 3 and 4).

Paragraph 1.1(e)(1) requires that at least 20 percent but not less than 40 percent of the flaws shall be oriented within plus or minus 20 degrees of the axial direction [of the piping test specimen]. Flaws contained in the original base metal heat-affected zone satisfy this requirement, however, PDI excludes axial fabrication flaws in the weld overlay material. PDI has concluded that axial flaws in the overlay material are improbable because the overlay filler material is applied in the circumferential direction (parallel to the girth weld), therefore fabrication anomalies would also be expected to have major dimensions in the circumferential direction. The NRC finds this approach to implantation of fabrication flaws to be reasonable. Therefore, PDI's application of flaws oriented in the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases, this permits flaws to be spaced closer than what is allowed for classification as a multiple set of flaws by IWA-3300, thus potentially making the performance demonstration more challenging. Hence, PDI's application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld, and the base grading unit includes the outer 25 percent of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to 1 inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The proposed change permits the PDI program to continue using test specimens from the existing weld overlay program which have flaws on both sides of the welds. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. The weld overlay qualification is designed to be a near-side [relative to the weld] examination, and it is improbable that a candidate would detect a flaw on the opposite side of the weld due to the sound attenuation and re-direction caused by the weld microstructure. However, the presence of flaws on both sides of the original weld (outside the PDI grading unit)

may actually provide a more challenging examination, as candidates must determine the relevancy of these flaws, if detected. Therefore, PDI's use of the 1-inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld, as described in the revised PDI Program alternative, is acceptable.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exists on all sides of the grading unit and that flawed grading units must be free of interfering reflections from adjacent flaws which addresses the same concerns as Code. Hence, PDI's application of the variable flaw-free area adjacent to the grading unit is acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and a base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches. The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01 (Tri-party Agreement, July 1984). This criterion may be more challenging than Code because of the variability associated with the shape of the grading unit. Hence, PDI's application of the grading unit is acceptable.

Paragraph 2.3 states that, for depth sizing tests, 80 percent of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. This requires detection and sizing tests to be separate. PDI revised the weld overlay program to allow sizing to be conducted either in conjunction with, or separately from, the flaw detection test. If performed in conjunction with detection, and the detected flaws do not meet the Supplement 11 range criteria, additional specimens will be presented to the candidate with the regions containing flaws identified. Each candidate will be required to determine the maximum depth of flaw in each region. For separate sizing tests, the regions of interest will also be identified and the maximum depth and length of each flaw in five the region will similarly be determined. In addition, PDI stated that grading units are not applicable to sizing tests, and that each sizing region will be large enough to contain the target flaw, but small enough that candidates will not attempt to size a different flaw. The above clarification provides a basis for implementing sizing tests in a systematic, consistent manner that meets the intent of Supplement 11. As such, this method is acceptable to the staff.

Paragraphs 3.1 and 3.2 of Supplement 11 state that procedures, equipment and personnel [as a complete ultrasonic system] are qualified for detection or sizing of flaws, as applicable, when certain criteria are met. The PDI program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase this passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The

personnel and equipment are still required to meet Supplement 11, therefore, the PDI program exceeds ASME requirements for personnel, procedures, and equipment qualification.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.10 inch are reported as being intrusions into the overlay material. The PDI program omits this criterion because of the difficulty in actually fabricating a flaw with a 0.10-inch minimum extension into the overlay, while still knowing the true state of the flaw dimensions. However, the PDI program requires that cracks be depth-sized to the tolerance of 0.125 inch as specified in Code. Since the Code tolerance is close to the 0.10-inch value of Paragraph 3.2(b), any crack extending beyond 0.10 inch into the overlay material would be identified as such from the characterized dimensions. The reporting of an extension in the overlay material is redundant for performance demonstration testing because of the flaw sizing tolerance. Therefore, PDI's omission of highlighting a crack extending beyond 0.10 inch into the overlay material is acceptable.

On the basis of the above discussion, the NRC staff has determined that the licensee's proposed alternative to use the PDI program for weld overlay qualifications as described in the submittal, in lieu of Supplement 11 to Appendix VIII of Section XI of the Code, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative under RRs 2-ISI-21 and 3-ISI-17 is authorized for the third 10-year inservice inspection interval at Browns Ferry Units 2 and 3.

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

4.0 CONCLUSION

The NRC staff concludes that for RR Nos. 2-ISI-21 and 3-ISI-17, relief is authorized pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the proposed alternatives provide an acceptable level of quality and safety.

Granting relief pursuant to 10 CFR 50.55a(a)(3)(i) is authorized by law and will not endanger the life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. For BFN Unit 2, relief is authorized for the above requests for the duration of the third 10-year ISI interval. For BFN Unit 3, relief is authorized for the above requests for the duration of the second 10-year ISI interval.

5.0 REFERENCES

1. Tri-party Agreement is between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), "Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel," July 3, 1984.
2. Letter from William H. Bateman to Michael Bratton, "Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations," January 15, 2002. ADAMS Accession No. **ML020160532**

3. NRC memorandum, "Summary of Public Meeting Held January 31 through February 2, 2001," with PDI Representatives, March 22, 2001. **ML010940402**
4. NRC memorandum, "Summary of Public Meeting Held June 12 through June 14, 2001," with PDI Representatives, November 29, 2001. **ML013330156**

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Date: December 19, 2003

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