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SALAS,P. Tennessee Valley Authority
RECIP.NAME RECIPIENT AFFILIATION
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SUBJECT: Forwards Request for Relief R&R-001 from ASME Section XI, repair requirements for NRC review & approval prior to sys pressure test currently scheduled for 941107 & requests to use ASME Code Case N-504-1 for plant ASME repair program.

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MAY

Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609

10 CFR 50.55a(a)(3)(i)

October 28, 1994

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

Gentlemen:

In the Matter of	)	Docket No. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI REPAIR AND REPLACEMENT PROGRAM - REQUEST FOR RELIEF - CLASS 1, 2, AND 3 AUSTENITIC STAINLESS STEEL PIPING

In accordance with 10 CFR 50.4 and 10 CFR 50.55a(a)(3)(i), TVA is submitting a Request for Relief from ASME Section XI, repair requirements for NRC review and approval. The relief request will permit BFN to repair austenitic stainless steel piping using weld reinforcement material (overlays) on the outside surface of the pipe. TVA is requesting to use ASME Code Case N-504-1 for the BFN Units 1, 2, and 3 ASME Section XI repair program. In addition, TVA's reply to NRC's October 20, 1994, telephone information request is included (Enclosure 2).

The ASME Code Committee approved Code Case N-504-1, "Alternative Rules for Repairs of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1," on August 9, 1993. Code Case N-504-1 has not been approved for use by the NRC in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1." However, provisions stated in footnote six to 10 CFR 50.55a provide for use of other Code Cases upon request, if approved by the Director of the Office of Nuclear Reactor Regulation pursuant to 10 CFR 50.55a(a)(3).

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On October 10, 1994, TVA found three intergranular stress corrosion cracking circumferential indications in reactor recirculation piping weld GR-2-64. These indications were identified while performing augmented examinations. Weld GR-2-64 joins a 28 inch loop B recirculation pump inlet to a stainless steel elbow.

The indications were evaluated to ASME Section XI, Table IWB-3514-2 criteria, and determined to exceed the allowable ASME Code limits. TVA performed an engineering evaluation which determined that BFN could operate approximately twenty months without repair to weld GR-2-64. However, TVA decided to repair weld GR-2-64 during the Unit 2 Cycle 7 refueling outage by performing a full structural weld overlay in accordance with Code Case N-504-1.

Weld overlays performed in accordance with Code Case N-504-1 provide an acceptable level of quality and safety.

TVA is requesting NRC review of the enclosed relief request as a Priority 2 - High Priority Near-term item as described in a memorandum from Dr. T. E. Murley to the NRR staff, dated June 6, 1993. As discussed in the telephone conversation between TVA and NRC personnel on October 20, 1994, this short review period is necessary in order to support BFN's Unit 2, November 13, 1994 restart. TVA requests approved of this relief request (Enclosure 1) prior to the system pressure test currently scheduled for November 7, 1994. TVA will keep you informed of changes to the test schedule.

The commitment in this letter is contained in Enclosure 3. If you have any questions, please contact me at (205) 729-2636.

Sincerely,

Pedro Salas
Manager of Site Licensing

cc: see page 3

Enclosures
cc (Enclosure):
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI
REPAIR PROGRAM REQUEST FOR RELIEF

Request For Relief R&R-001 (UNITS 1, 2, AND 3)

Components:	Austenitic Stainless Steel Piping
Classification:	Code Class 1, 2, and 3
Code Categories:	N/A
Item Numbers:	Weld GR-2-64 and Future weld overlays
Code Requirements:	ASME Section XI, 1986 Edition, IWB 4120 states: Defects shall be removed in accordance with IWB-4200. If the cavity created by removal of this defect exceeds the acceptance standards of IWA-3000 and repair by welding is necessary, the repair welds shall be made in accordance with IWA-4000 and this Article. If repair welding is impractical, the defect may be removed or reduced in size without welding, provided the requirements of IWA-3000 are met. ASME Section XI, 1986 Edition, IWC-4120 states: Defects shall be removed in accordance with IWC-4200. If the cavity created by removal of this defect exceeds the acceptance standards of IWA-3000 and repair by welding is necessary, the repair welds shall be made in accordance with IWA-4000 and this Article. If repair welding is impractical, the defect may be removed or reduced in size without welding, provided the requirements of IWA-3000 are met.

ASME Section XI, 1986 Edition, IWD-4120 states: Defects shall be removed in accordance with IWD-4200. If the cavity created by removal of this defect exceeds the acceptance standards of IWA-3000 and repair by welding is necessary, the repair welds shall be made in accordance with IWA-4000 and this Article. If repair welding is impractical, the defect may be removed or reduced in size without welding, provided the requirements of IWA-3000 are met.

Basis For Relief:

TVA proposes to apply Code Case N-504-1 as an alternate repair method for Code Class 1, 2, and 3 austenitic stainless steel piping. Code Case N-504-1 was approved by the ASME Boiler and Pressure Vessel Committee on August 9, 1993. The alternate repair method allows utilities to use weld overlays on the outside of austenitic stainless steel pipe found to have defects.

The use of Code Case N-504-1 as an alternate repair method provides an acceptable level of quality and safety.

Alternate repair:

BFN will adopt the provisions of ASME Code Case N-504-1 for repair of Code Class 1, 2, and 3 austenitic stainless steel piping.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TVA'S REPLY TO NRC'S OCTOBER 20, 1994 TELEPHONE INFORMATION REQUEST

I. PURPOSE

The purpose of this enclosure is to provide TVA's reply to NRC's October 20, 1994, telephone information request.

II. BACKGROUND FOR RECIRCULATION WELD GR-2-64

Weld GR-2-64 is a 28 inch pump inlet to elbow weld on the recirculation system loop B. The elbow is A358 TP304 stainless steel material. The pump is a SA 351 CF8 austenitic stainless steel casting.

Weld GR-2-64 was previously examined in December 1984, prior to induction heat stress improvement (ISHI) during the Unit 2, Cycle 5 outage. No indication of intergranular stress corrosion cracking (IGSCC) was identified. Post IHSI examination was performed in March 1985, with no indication of IGSCC. These examinations were performed with manual examination techniques utilizing a Krautkramer USL-38 flaw detector and a KB Aerotech ⅜ inch by ¾ inch dual element 1.5 Megahertz search unit.

On October 10, 1994, TVA found three intergranular stress corrosion cracking circumferential indications in reactor recirculation piping weld GR-2-64, while performing augmented examinations. The examinations were conducted with the Intraspect (I/98) automated ultrasonic imaging system, utilizing EPRI IGSCC detection techniques. Prior to weld GR-2-64 examination, TVA removed the weld crown to enhance the inspection process. The three circumferential indications were categorized as follows: the first indication was 1.1 inches in length and 0.37 inches through wall (0.9 inches remaining ligament); the second indication was 1.5 inches in length and 0.37 inches through wall (0.9 inches remaining ligament); and the third indication was 5.6 inches in length and 0.47 inches through wall (0.80 inches remaining ligament).

TVA performed an engineering evaluation in accordance with ASME Section XI which determined that BFN could operate approximately twenty months without repair to weld GR-2-64. However, TVA decided to repair weld GR-2-64 during the Unit 2 Cycle 7 refueling outage by performing a full structural weld overlay in accordance with Code Case N-504-1.

TVA also examined a similar weld (GR-2-58) on recirculation loop A during the Unit 2 Cycle 7 outage, utilizing Intraspect (I/98) automated ultrasonic imaging equipment, EPRI techniques, and weld crown reduction. No indications of IGSCC were identified.

Weld GR-2-64 was reexamined (Unit 2 Cycle 7) with advanced automated ultrasonic imaging equipment and supplemental confirmatory techniques such as 60 degree refracted longitudinal wave search units. These actions were taken under the guidelines of GE SIL No.117 which recommends (1) Adhere to recommendations provided in NUREG 0313 revision 2 "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping"; (2) utilize procedures, personnel and equipment qualified under the NRC-EPRI-BWROG coordination plan for detection and sizing IGSCC; (3) use automated ultrasonic testing data acquisition equipment to increase inspection reliability and comparison for subsequent inspections; and (4)condition the outside surface weld crown of all piping welds to provide a good surface for ultrasonic testing.

III. DISCUSSION OF WELD OVERLAY

Weld GR-2-64 reinforcement (weld overlay) consists of applying weld metal over the weld and a specific minimum distance beyond the weld on both sides. This is performed completely around the surface of pipe overlapping each pass. A low-carbon, high-ferrite type 308L weld metal is used and the process is performed with an automatic welding machine using the Gas-Tungsten-Arc (GTAW) process. The weld overlay is performed with cooling water inside the pipe during welding.

The weld overlay material is compatible with the original base material. The welding process is controlled with applicable welding procedures. Interpass temperatures and heat input are controlled to minimize any affect on the heat affected zones of the welds.

The overlay is designed assuming that the original flaw is completely through the wall for 360 degrees. By making this assumption, the weld overlay design is independent of the size of the flaw. Also the flaw is unlikely to grow due to the residual compressive stresses created at the inner surface of the pipe because of the water cooling during the weld overlay process. The weld overlay effectively increases the pipe wall thickness with weld material that is resistant to IGSCC. Therefore, should a flaw grow through the wall of the pipe it is unlikely to extend into the overlay.

IV. **NRC Request**

Discuss why TVA found IGSCC cracks in reactor recirculation weld GR-2-64.

TVA Reply

In preparation for the inspection this outage, TVA performed weld crown reduction on this weld which enhanced the inspection method. In addition, TVA contributes lessons learned concerning characterizations, detection, interpretation, and analysis of IGSCC in BWR piping. Also improved examination personnel training, advanced technology, and enhanced imaging capabilities of commercially available equipment are major factors in the ability to more accurately detect and evaluate IGSCC today.

NRC Request

Discuss how often weld GR-2-64 will be reinspected.

TVA Reply

After repair by deposition of weld metal (weld overlay), weld GR-2-64 is recategorized as a Category "E" piping weldment, in accordance with Generic Letter 88-01. Weld GR-2-64 will receive a preservice examination during this outage Unit 2 Cycle 7. TVA will reexamine weld GR-2-64 during the Unit 2 cycle 8 refueling outage and every subsequent second refueling outage in accordance with the recommendations of Generic Letter 88-01.

Weld GR-2-64 is currently categorized as a "C" category weld per Generic Letter 88-01. This outage Unit 2 Cycle 7 all "C" category welds are being examined, therefore no sample expansion is necessary.

V. **Matrix which demonstrates TVA compliance with Code Case N-504-1 for weld GR-2-64**

Code Case N-504-1 states that the acceptability of a defect in austenitic stainless steel piping may be established in accordance with IWB-3640 by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe, provided the following requirements are met:

1. Code Case Requirement - (a)

   The repair shall be performed in accordance with a repair program satisfying the requirements of IWA-4000 in the Edition and Addenda of Section XI applicable to the plant in-service inspection program, or later Edition and Addenda.

   TVA's Reply - BFN maintains an ASME Section XI Repair and Replacements program in accordance with 10 CFR 50.55a and IWA 4000 of the ASME Section XI 1986 Code Edition. The program is documented in Site Standard Practice (SSP)-6.9. TVA performs repairs in accordance with the requirements of SSP 6.9.

2. Code Case Requirement - (b)

   Reinforcement weld metal shall be low carbon (0.035%max.) austenitic stainless steel applied 360 degrees around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification identified in the Repair program.

   TVA's Reply - Weld GR-2-64 reinforcement weld metal was low carbon (0.035%max.) austenitic stainless steel applied 360 degrees around the circumference of the pipe.

   Weld GR-2-64 overlay was performed in accordance with design change notice (DCN) W-21635A. DCN W-21635A requires that all welding shall be done by the GAS TUNGSTEN ARC welding (GTAW) process using ER308L weld metal conforming to ASME SFA 5.9. The delta ferrite content of deposited weld metal shall be 8 FN. minimum as determined by the magnetic instrument method of ASME Section III, paragraph NB-2400."

3. Code Case Requirement - (c)

Prior to deposition of the weld reinforcement, the surface to be repaired shall be examined by the liquid penetrant method. Indications greater than 1/16 inch are unacceptable and shall be prepared for weld reinforcement in accordance with (1) or (2) below:

1. Unacceptable indications shall be excavated to the extent necessary to create a cavity that can be repaired using qualified welding procedures.

2. One or more layers of weld overlay shall be applied to seal unacceptable indications in the area to be repaired without excavation. The thickness of these layers shall not be included in meeting weld reinforcement design thickness requirements.

TVA's Reply - Prior to deposition of weld GR-2-64 reinforcement, the surface to be repaired was examined by liquid penetrant. No unacceptable surface indications for weld GR-2-64 were found.

4. Code Case Requirement - (d)

If the preparation of (c)(1) or (2) above is required, the area where the weld reinforcement is to be deposited, including any local repairs or initial weld overlays, shall be examined by the liquid penetrant method, and shall contain no indications greater than 1/16 in. prior to application of the structural layers of the weld overlay.

TVA Reply - Surface preparation in accordance with (c)(1) or (2) above were not required for weld GR-2-64.

5. Code Case Requirement - (e)

The weld reinforcement shall consist of a minimum of two weld layers having as-deposited delta ferrite content of at least 7.5 FN. The first layer of weld metal with delta ferrite content of at least 7.5 FN shall constitute the first layer of the weld reinforcement design thickness. Alternatively, first layers of at least 5 FN may be acceptable based on evaluation.

TVA'S Reply - TVA performed weld GR-2-64 overlay in accordance with design change notice (DCN) W-21635A. DCN W-21635A, requires that all welding shall be done by the GAS TUNGSTEN ARC welding (GTAW) process using ER308L weld metal conforming to ASME SFA 5.9. Delta ferrite content of deposited weld metal on the first layer shall be 8 FN minimum as determined by the magnetic instrument method of ASME Section III, paragraph NB-2400. Additional layers of filler weld metal will be applied meeting the delta ferrite requirement 7.5 or greater and thickness requirement.

6. Code Case Requirement - (f)

Design of the weld reinforcement shall provide for access for the examinations required by (i) and (j) below, and shall be in accordance with (1), (2), or (3) below:

1. For circumferentially oriented flaws greater than 10% of the pipe circumference, axial flaws greater than 1.5 in. in length, or more than 5 axial flaws of any length, the weld reinforcement shall provide the necessary wall thickness to satisfy the flaw evaluation procedures of IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda. The flaw shall be assumed to be 100% through the original pipe wall thickness for the entire circumference of the pipe. The axial length and end slope of the reinforcement shall be sufficient to provide for load redistribution from the pipe into the deposited weld metal and back into the pipe without violating applicable stress limits of Section III for primary local and bending stresses and secondary peak stresses. (These requirements will usually be satisfied if the overlay full thickness length extends axially at least 0.75 of the square root Rt beyond each end of the observed flaws, where R and t are the outer radius and nominal wall thickness of the pipe, prior to depositing the weld overlay, and the end slope is no steeper than 45 deg.)

2. When there are fewer than five axial flaws, each less than 1.5 inch in length, and short circumferential flaws, the combined length of which does not exceed 10% of the pipe circumference, an alternative weld reinforcement thickness may be used. In determining the combined length of

circumferential flaws for comparison with this limit, multiple flaws shall be treated as one flaw of length equal to the sum of the lengths of the individual flaws characterized in accordance with IWA-3300. The flaw shall be assumed to be 100% through the original pipe wall thickness with circumferential length equal to the combined circumferential length of the flaws. Following application of weld reinforcement, the assumed flaw shall meet the flaw acceptance criteria of IWB-3640 from the 1983 Edition with the Winter 1985 Addenda or later Editions and Addenda. The axial length and end slope requirements shall meet the criteria of (1) above.

3. For weldments with four or fewer axial flaws, each less than 1.5 inch in length, and no circumferential flaws, the weld reinforcement shall have sufficient thickness to satisfy the requirements of (e) above. No additional structural reinforcement is required. The axial length of the weld overlay shall cover the weldment and the heat affected zone on each side of the weldment, with a minimum overlap of ½ inch on each end of the observed flaws. The end slope shall meet the criteria of (1) above.

TVA 's Reply - TVA's weld overlay design complies with the requirements of Code Case N-504-1 as stated in (f) above.

7. <u>Code Case Requirement</u> - (g)

An evaluation of the repaired weldment, as well as other welds and components in the system affected by the weld reinforcement, shall be performed in accordance with (1) through (3) below.

1. The Owner shall comply with IWA-1400(p) from the 1989 Edition with the 1990 Addenda.

2. For repaired welds the evaluation shall consider residual stresses produced by weld overlay with other applied loads on the system. The effects of water backing on the repair weld shall be considered. The evaluation shall demonstrate that the requirements of IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda, are satisfied for the design life of the repair, considering potential flaw growth due to fatigue and the mechanism believed to have caused the flaw.

The flaw growth evaluation shall be performed in accordance with Appendix C. When structural credit is taken for SAW or SMAW weld metal in the original pipe weldment or the weld overlay, the evaluation requirements of Table IWB-3641-5 and IWB-3641-6 shall be applied.

3. The evaluation of other welds and components in the system shall consider potential increases in loading, including shrinkage effects, due to all weld overlays in the system, and shall identify and record the magnitude and location of the maximum shrinkage stress developed. These welds and components shall meet the applicable stress limits of the construction Code. Shrinkage stresses shall be included with other applied loads on the system in any IWB-3640 flaw evaluation required for the system. In addition, the effect of shrinkage from weld overlays on the affected portion of the system restraints, supports, and snubbers shall be evaluated to determine whether design tolerances are exceeded.

TVA's Reply - TVA will comply with Code Case N-504-1 requirements stated in (g) above.

8. Code Case Requirement - (h)

The completed repair shall be pressure tested in accordance with IWA-5000. If the flaw penetrated the original pressure boundary prior to welding, or if any evidence of the flaw penetrating the pressure boundary is observed during the welding operation, a system hydrostatic test shall be performed in accordance with IWA-5000. If the system pressure boundary has not been penetrated, a system leakage, inservice, or functional test shall be performed in accordance with IWA-5000.

TVA's Reply - TVA will perform a pressure test on the completed repair as required by Code Case N-504-1 in accordance with the 1986 Edition of the ASME Section XI Code IWA-5000.

9. Code Case Requirement - (i)

Preservice examination of the completed repair shall be performed in accordance with IWB-2200. For all classes of components, liquid penetrant and ultrasonic examination of the completed weld repair shall be performed. Examination procedures shall be specified in the repair program. The

acceptance standards of Table IWB-3514-2 shall apply. Ultrasonic examinations shall verify the integrity of the newly applied weld reinforcement. Examinations shall also be performed to identify the original flaws in the outer 25% of the underlying pipe wall as a benchmark for subsequent examinations of the overlay. Grinding and machining of the as-welded overlay surface may be used to improve the surface finish for such examinations, when the overlay thickness is not reduced below design requirements.

TVA's Reply - TVA will comply with Code Case N-504-1 requirements in (i) above.

10. Code Case Requirement - (j)

Nondestructive examinations shall include the weld and volume identified in (i) above.

TVA's Reply - TVA will comply with Code Case N-504-1 requirements in (i) above for the weld and volume to be examined.

11. Code Case Requirement - (k)

After completion of all repair activities, the affected restraints, supports, and snubbers shall be visually examined (VT-3) to determine if design tolerances are met.

TVA's Reply - TVA will perform visual examination, VT-3 of the affected restraints, supports and snubbers to determine if design tolerances are met following completion of all repairs.

12. Code Case Requirement - (l)

All other applicable requirements of IWA-4000 and IWB-4000, IWC-4000, or IWD-4000 shall be met.

TVA's Reply - TVA will comply with all applicable requirements of IWA-4000 and IWB-4000, IWC-4000 or IWD-4000.

13. Code Case Requirement - (m)

Use of Code Case shall be documented on an NIS-2 form.

TVA's Reply

TVA will document on the NIS-2 form when Code Case N-504-1 is used.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TVA'S COMMITMENT SUMMARY

VI. Commitment

1. TVA will reexamine reactor recirculation weld GR-2-64 during the Unit 2 Cycle 8 refueling outage and every subsequent second refueling outage in accordance with the recommendations of Generic Letter 88-01.

2. TVA will comply with Code Case N-504-01 for weld GR-2-64.