June 7, 2001

Mr. J. A. Scalice
Chief Nuclear Officer
and Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: BROWNS FERRY, UNIT 2 — SAFETY EVALUATION OF INTERGRANULAR STRESS CORROSION CRACKING INDICATION ON RESIDUAL HEAT REMOVAL SYSTEM PIPING WELD DRHR-2-09 (TAC NO. MB1684)

Dear Mr. Scalice:

By letter dated April 12, 2001, Tennessee Valley Authority submitted, for U.S. Nuclear Regulatory Commission (NRC) review and approval, an evaluation of an intergranular stress corrosion cracking indication in the heat-affected zone of weld DRHR-2-09 in the Browns Ferry Unit 2 residual heat removal system piping. A review was conducted, to support restart, as described in the staff's April 20, 2001, letter. The enclosure is a follow-up safety evaluation to document the NRC staff's review. It concludes that Unit 2 can be operated for at least two additional 24-month fuel cycles, without repair of weld DRHR-2-09.

This completes our efforts under TAC No. MB1648. If you have any questions regarding this issue, please contact me at 301-415-3026.

Sincerely,

/RA/

William O. Long, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-260

Enclosure: Safety Evaluation

cc w/enclosure: See next page

Mr. J. A. Scalice June 7, 2001
Chief Nuclear Officer
and Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: BROWNS FERRY, UNIT 2 — SAFETY EVALUATION OF INTERGRANULAR STRESS CORROSION CRACKING INDICATION ON RESIDUAL HEAT REMOVAL SYSTEM PIPING WELD DRHR-2-09 (TAC NO. MB1684)

Dear Mr. Scalice:

By letter dated April 12, 2001, Tennessee Valley Authority submitted, for U.S. Nuclear Regulatory Commission (NRC) review and approval, an evaluation of an intergranular stress corrosion cracking indication in the heat-affected zone of weld DRHR-2-09 in the Browns Ferry Unit 2 residual heat removal system piping. A review was conducted, to support restart, as described in the staff's April 20, 2001, letter. The enclosure is a follow-up safety evaluation to document the NRC staff's review. It concludes that Unit 2 can be operated for at least two additional 24-month fuel cycles, without repair of weld DRHR-2-09.

This completes our efforts under TAC No. MB1648. If you have any questions regarding this issue, please contact me at 301-415-3026.

Sincerely,

/RA/
William O. Long, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-260

Enclosure: Safety Evaluation

cc w/enclosure: See next page

DISTRIBUTION:

PUBLIC	ACRS, RidsAcrsAcnwMailCenter	PMadden, RidsNrrDlpmLpdii2
BClayton (hard copy)	WLong, RidsNrrPMWLong	OGC, RidsOgcRp
PDII-2 Reading	PFredrickson, RidsRgn2MailCenter	WKoo

DOCUMENT NAME: C:\B1684ltr.WPD

ADAMS ACCESSION NUMBER: ML011580245

OFFICE	PDII-2/PM	PDII-2/LA	PDII-2/SC (A)	
NAME	WLong	BClayton	KJabbour for PMadden	
DATE	06/ 6 /2001	06/ 6 /2001	06/ 6 /2001	

OFFICIAL RECORD COPY

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INTERGRANULAR STRESS CORROSION CRACK INDICATION

IN A RESIDUAL HEAT REMOVAL WELD (DRHR-2-09)

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY, UNIT 2

DOCKET NO. 50-260

1.0 INTRODUCTION

During the Cycle 11 refueling outage at Browns Ferry, Unit 2, Tennessee Valley Authority (TVA, the licensee) performed ultrasonic test (UT) inspections of austenitic stainless steel piping welds that are susceptible to intergranular stress corrosion cracking (IGSCC) in accordance with Generic Letter (GL) 88-01. An IGSCC indication was found in the heat affected zone of weld DRHR-2-09 in the residual heat removal (RHR) piping system. The IGSCC indication is reported to have a length of about 2 inches and a maximum depth of 0.25 inch, and is located on the pipe side of the weld. The subject weld is a pipe-to-tee weld joint. The RHR pipe and the tee are made of type 304 stainless steel and the pipe has a nominal diameter of 24 inches with a wall thickness of 1.2 inches.

TVA performed a crack-growth evaluation of the subject IGSCC indication. The results of TVA's evaluation has shown that Unit 2 can be operated, without repair of weld DRHR-2-09, for at least two additional 24-month fuel cycles. By letter dated April 12, 2001, TVA submitted their evaluation for U.S. Nuclear Regulatory Commission (NRC) review and approval of Unit 2 start up. NRC reviewed TVA's evaluation and approved Unit 2's start-up in a letter dated April 20, 2001. This safety evaluation is a follow-up to document the NRC staff's review of the licensee's submittal to support Unit 2's resumption of operation.

2.0 EVALUATION

The staff has reviewed the licensee's crack growth evaluation and has determined that weld DRHR-2-09 is acceptable, without repair, for Unit 2 continuous operation of two 24-month operating cycles. The bases of the staff's determination are based on the following considerations:

Review of 1994 UT Inspection Results

The subject IGSCC indication is not a new flaw because its existence can be traced back to UT examination performed in 1994 refueling outage. In a review of the 1994 UT inspection results, the subject indication was present in the record of utilizing a 60-degree refracted longitudinal search unit and its length was estimated to be about 2 inches. However, it was not called IGSCC because the indication was masked by

weld geometry when examined with the 45-degree shear wave probe. During the Cycle 11 outage, enhanced UT techniques and procedures qualified to Appendix VIII, Supplement 2, requirements of American Society of Mechanical Engineers (ASME) Code, Section XI, were used for inspection. The 60 degree and 70 degree shear wave probes not previously used were incorporated into the inspection scheme of the Cycle 11 outage which helped to discriminate and characterize the UT indications.

Review of Implementation Record of IHSI Process

The licensee has reviewed the induction heating stress improvement (IHSI) process control parameters and has determined that the actual IHSI data recorded for this weld met all the control parameters in the process specification. Therefore, the IHSI treatment of this weld is expected to be effective in mitigating the initiation and growth of cracks. Thus, weld DRHR-2-09 will continue to be classified as Category E weld. Per GL 88-01 inspection schedule, Category E welds are required to be inspected every two refueling cycles.

Monitoring of Other IGSCC Flaws

Early in a 1989 refueling outage, an IGSCC flaw was found in the subject weld which was similar in size to the indication found in a Cycle 11 outage and was located about 7 inches away. This 1989 flaw was re-inspected in 1994, 1997 and 2001 outages and the reinspection results showed that there is no significant growth in size. TVA also reviewed the inspection results of seven IHSI treated welds with IGSCC flaws. The inspection results showed that there is no flaw growth since IHSI mitigation.

Crack-Growth Evaluation

TVA performed a crack-growth evaluation considering the crack growth from both IGSCC and fatigue. The affected RHR pipe has a nominal pipe diameter of 28 inches and a nominal wall thickness of 1.2 inches. TVA reported that the crack growth due to fatigue was small and did not exceed 0.009 inches over a period of two fuel cycles. In the performance of the IGSCC crack growth, TVA used the pc-CRACK computer program. The evaluation of crack growth due to IGSCC was performed in accordance with the procedures delineated in ASME Code, Section XI, Sub-section IWB-3640. In the IGSCC crack-growth evaluation, the initial crack indication was assumed to have a depth of 0.27 inches and extending 360 degrees around the circumference of the pipe. The crack-growth equation provided in NUREG 0313, Revision 2, was used. The allowable crack depth for the controlling normal/upset condition at the subject RHR weld was determined to be 45% of the wall thickness (0.54 inch). The through-wall residual stress distribution used for crack-growth calculations assumed a compressive stress of -14 ksi at the inside pipe surface with a linear variation to +14 ksi on the outside pipe surface. This residual stress distribution was based on the results of a laboratory test program documented in the Electric Power Research Institute NP-3375 report. The subject test program was designed to demonstrate the benefit of performing IHSI on welds. The final crack depth at the end of two refueling cycles was determined to be 26% of wall thickness (0.315 inch) which is well within the Code allowable. In an IHSI treated weld, the slow growth of the IGSCC crack is expected.

The staff notes that TVA did not expand the inspection scope based on the considerations that the subject indication is not a new flaw and that there is no apparent growth in length since 1994. The staff has determined that this is acceptable because it meets the sample expansion guidelines in GL 88-01.

3.0 CONCLUSION

Based on the staff's review of the licensee's submittal, the staff concludes that weld DRHR-2-09 is acceptable, without repair, for Unit 2 continuous operation for two 24-month operating cycles, because there is reasonable assurance that the structural integrity of the subject weld will be maintained during the period.

Principal Contributor: William H. Koo, NRR

Date: June 7, 2001

cc:
Mr. Karl W. Singer, Senior Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Jack A. Bailey, Vice President
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Karl W. Singer, Site Vice President
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

General Counsel
Tennessee Valley Authority
ET 10H
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. Robert J. Adney, General Manager
Nuclear Assurance
Tennessee Valley Authority
5M Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Ashok S. Bhatnagar, Plant Manager
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Mr. Mark J. Burzynski, Manager
Nuclear Licensing
Tennessee Valley Authority
4X Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Timothy E. Abney, Manager
Licensing and Industry Affairs
Browns Ferry Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Decatur, AL 35609

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Browns Ferry Nuclear Plant
l0833 Shaw Road
Athens, AL 35611

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

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