UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-259/94-16, 50-260/94-16, and 50-296/94-16

Licensee: Tennessee Valley Authority
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1101 Market Street
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Docket Nos.: 50-259, 50-260 and 50-296

License Nos.: DPR-33, DPR-52, and DPR-68

Facility Name: Browns Ferry Nuclear Power Station Units 1, 2, and 3

Inspection Conducted: June 13-17, 1994

Inspector: _____ 6/30/94
J. L. Coley, Jr. Date Signed

Approved by: _____ 6/30/94
J. J. Blake, Chief Date Signed
Materials and Processes Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of augmented inservice inspection - observation of work and work activities for the reactor vessel core shroud (Unit-3) and review of completed weld records for Units 2 and 3 reactor water cleanup system (RWCU).

Results:

In the areas inspected, violations or deviations were not identified. Ultrasonic equipment used by General Electric (GE), the vendor contracted by the licensee to inspect the Unit 3 reactor core shroud, operated very effectively during the examinations witnessed by the inspector. GE Personnel performing the data acquisition and data evaluation activities were observed making decisions which would insure that the inspection results were conservatively obtained. TVA's Level III ultrasonic examiner was also observed effectively monitoring the core shroud work activities. Completed weld records for the Unit 2 and 3 RWCU system replacement activities were also found to be satisfactory.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*T. Abney, Manager, Technical Support
*H. Crisler, Site Engineer
*F. Froscello, Inservice Inspection (ISI) Site Engineer
*E. Hollins, Milestone Manager, Recovery
*R. Jones, Superintendent, Operations
*J. Maddox, Manager, Maintenance and Modifications
*P. Salas, Manager, Licensing
*D. Stinson, Manager, Recovery
*A. Sorrell, Acting Plant Manager
*R. Wells, Compliance Licensing Manager

Other licensee employees contacted during this inspection included engineers, technicians, and administrative personnel.

Other Organizations

* G. Nelson, Project Manager, General Electric
R. Seals, Manager, Unit 3 Shroud Examination Activities

NRC Resident Inspectors

*C. Patterson, Senior Resident Inspector
*R. Musser, Resident Inspector
*G. Schnebli, Resident Inspector

* Attended Exit Interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2. Observation of Augmented Inservice Inspection (ISI) Work Activities for the Unit 3 Reactor Core Shroud (73753)

Background

In October 1990, GE's Rapid Information Communication Service Information Letter (RICSIL) No. 054 reported that cracking was found near the circumferential seam weld at the core beltline area of the shroud in a GE BWR/4 located outside the United States. The crack indications, initially observed at three locations on the inside surface of the shroud, were confined to the heat affected zone of a circumferential seam weld. In July 1993, while performing examinations in accordance with the recommendations of RICSIL No. 054, Revision 1, cracking was found in the stainless steel core shroud assembly of a GE BWR/4 located in the United States. A 360 degree circumferential crack was confirmed near the top guide support ring weld, designated the H-3 weld at this plant. Circumferential and axial cracking was also

detected to a lesser degree in the heat affected zone of other shroud circumferential welds.

Based on the above two shroud observations, GE issued Service Information Letter (SIL) No. 572, Revision 1, to provide an overview of the situation and to provide recommendations on suitable inspection techniques, and frequency, to detect cracking that could lead to structural integrity concerns. Revision 1 to SIL No. 572 recommended that BWR licensees visually examine the accessible areas on both inside diameter (ID) and outside diameter (OD) surfaces of the shroud at the next refueling outage for all plants with type 304 stainless steel shrouds, with six or more years of power operation; and for all plants with L-Grade stainless steel shrouds with eight or more years of power operation. The SIL recommended that the inspections should be done with an enhanced VT-1 system that can resolve a standard one mil wire on the inspection surface. As an acceptable alternative to the visual examinations the SIL also recommended that a qualified ultrasonic examination of accessible shroud welds from the outer shroud surface be used.

a. Observation of Work Activities

The applicable code for nondestructive examinations for Browns Ferry Unit 3 is Section V to the American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B&PV) Code, 1986 Edition with no Addenda. Nondestructive examinations for the Unit 3 core shroud were being conducted in accordance with the intent of ASME B&PV, Section V and General Electric's (GE's) Service Information Letter (SIL) No. 572, Revision 1 (Core Shroud Cracks.) Enhanced inspection techniques had to be utilized for the examination of these welds; these enhanced techniques were developed on mockup specimens and demonstrated to the NRC and the licensee at GE's San Jose, California facility. The licensee's plan for the inspection of the core shroud was to examine welds H-1 through H-5 using the ultrasonic method and visually examine specific areas on welds H-6 and H-7.

The inspector reviewed GE's Ultrasonic Procedure No. UT-BFN-503V1, Revision 1, and Visual Procedure No. VT-BFN-202V2, Revision 0. This review was conducted to determine whether the procedures had been approved by the licensee, and to determine whether the technical instructions delineated in the examination procedures were adequate to effectively examine and size indications of intergranular stress corrosion cracking (IGSCC) or irradiation assisted stress corrosion cracking (IASCC) in the core shroud.

Data acquisition activities started with examination of the H-3 weld. Since the GE Smart 2000 system took two shifts to examine each weld, the inspector only witnessed portions of the data acquisition activities for shroud welds H-1, H-2, and H-3. These ultrasonic examinations were conducted from the OD surface of the reactor core shroud utilizing GE's new shroud OD-tracker

ultrasonic inspection tool. During the data acquisition activities witnessed by the inspector, the Smart 2000 ultrasonic system with the OD-tracker inspection tool operated very effectively. Areas verified by the inspector during the acquisition process included transducer fixture positioning on the weld; equipment used for the examination and sizing of indications; adequate examination coverage obtained; examiners following the parameters of the approved examination procedure; examiners knowledge of the enhanced examination and sizing techniques; and preliminary evaluations documented on the examination finding sheets by the data acquisitionist were based on reasonable assumptions.

The inspector also observed the GE Level III examiners performing the final evaluation of the ultrasonic data for welds H-3 and H-1. The inspector observed the evaluation process to determine whether the evaluation process included plots of an indication's location; reasonable conclusions were being derived from the data presented; and automated sizing was performed, as demonstrated by GE at their San Jose facility.

The inspector's observation of the above work activities revealed that the core shroud ultrasonic examination activities were being performed by knowledgeable personnel, using well engineered equipment. The examination results for the two welds evaluated while the inspector was on site (H-1 and H-3) revealed that H-3 had no ID-connected indications. H-1 had five small ID-connected indications with an accumulative length total of less than 3.5 inches. The inspector also noted that TVA's Level III Ultrasonic Examiner effectively monitored the shroud examination processes.

b. Review of Personnel and Equipment Certifications

In addition to the inspector observations of the above processes the inspector reviewed the personnel and equipment certification records as delineated below:

Examiner Certifications Reviewed	Methods Certified
A. A. Conti, Level II	Smart 2000 Detection, Analysis, and Shroud Weld UT
G. E. DuBose, Level III	Smart 2000 Detection, Analysis, Manual Sizing, and Shroud Weld UT
P. R. Johnson, Level II	Smart 2000 Detection, Analysis and Manual Sizing

W. C. Money, Level III	Smart 2000 Detection, Analysis, Automated Sizing and Shroud Weld UT
T. S. Rockwood, Level II	Smart 2000 Detection Shroud Weld UT
D. J. Walker, Level II	Smart 2000 Detection, Analysis, Manual Sizing, and Shroud Weld UT

Equipment Certification Reviewed

TEC-RAD, Tomoscan Instrument S/N TTS-10091108

Sigma Transducers S/N's 2290-94011, 2290-9412, 2290-94015, 2290-94016, 2290-9023, 2290-94024, 3511-94001, 3511-94003, 3511-94008, 3511-94013, 3511-94014, 2298-94005, 2298-94006, 3510-94010, 3510-94011, 211-94001 and 211E-94002

Within the areas examined, no violation or deviation was identified.

3. Review of Completed Weld Records for Units 2 and 3 Reactor Water Cleanup (RWCU) System Pipe Replacement (55050)

The inspector reviewed the completed weld records listed below as well as the implementing codes, procedures, and licensee audits to determine whether the pipe replacement activities performed by General Electric (GE) on Units 2 and 3 RWCU system piping were conducted in accordance with the applicable codes, regulatory, and contract requirements. Radiographic film for the Units 2 and 3 RWCU welds had been previously reviewed by the inspector and documented in Region II Inspection Reports 93-26 and 92-38.

The applicable construction code for Units 2 and 3 was USAS B31.1.0, 1967 Edition with supplemental requirements referenced in Construction Specification G-28. This Code was also used as the basis for replacement of the existing RWCU pipe on both Units. The installation of the new RWCU piping was installed to Design Change Notice (DCN) W17811 for Unit 3 and DCN W18298 for Unit 2. The DCN's referenced GE's Specification 25A5101, "Reactor Water Cleanup Piping Replacement." GE utilized their installation specification to install the new RWCU piping. The GE installation specification was based on the ASME Section III, 1983 Edition with Summer 1983 Addenda. Nondestructive examinations were performed at Browns Ferry Nuclear Facility to ASME Section V, 1986 Edition.

The inspector reviewed the following Codes prior to verifying GE's and TVA's procedure requirements for the new pipe installation and Nondestructive examinations.

Codes Reviewed to Confirm Pipe Replacement Activities

USAS B31.1.0, 1967 Edition
ASME, Section III, 1983 Edition with Summer 1983 Addenda
ASME, Section V, 1983 Edition with Summer 1983 Addenda
ASME, Section XI, 1983 Edition with Summer 1983 Addenda
ASME, Section III, 1986 Edition
ASME, Section V, 1986 Edition
ASME, Section XI, 1986 Edition

The following GE and TVA documents were reviewed to determine whether the above requirements were properly invoked:

Document No.

TVA Visual Procedure No. N-VT-3
GE General Visual Examination Procedure No.25, Revisions C and D
GE General Welding Procedure No. GE-86-5.0-BF, Rev. 1
TVA Radiographic Examination Procedure No. N-RT-1, Rev. 18
TVA Manual Ultrasonic Examination Procedure No. N-UT-18, Rev. 15
GE Liquid Penetrant Procedure No. 26, Rev. B
TVA Detail Welding Specifications WPS 8.8.1-BF, 8.8.3-BF, 8.8.4-BF, and 8.8.6-BF

The inspector's review of the above procedures revealed some inconsistencies between GE's visual requirements delineated in their General Welding Procedure GE-86-5.0-BF, Rev. 1, and the visual requirements delineated in GE's Visual Examination Procedure No. 25. The differences observed, however, exceeded the requirements delineated in TVA's Visual Examination Procedure No. N-VT-3 and the applicable ASME Code.

GE's visual procedure No. 25, paragraph 6.1.7.2, states: "Tack and intermittent welds shall be visually inspected using a minimum of 5 power (5X) magnification." In addition, paragraph 6.1.8 states that, "Weld joints which have been excavated and have been open in the root shall be examined visually using a minimum of 5X magnification to assure no defects are present. Liquid penetrant shall not be used in such cases."

GE's General Weld Procedure No. GE-86-5.0-BF, Rev. 1, requires only visual examination (not 5X magnification) for tack welds which are consumed in the weld. In addition, paragraph 12.5.1.1 states: "Weld metal defects when repaired by welding, shall be removed by mechanical means. The area prepared for repair shall be MT'd or PT'd except where metal removal results in exposed crevices. Where a crevice exists visual examination with a 3-5X magnification shall be made."

TVA's Visual Procedure N-VT-3 and the ASME Code, however, only require visual examination with no enhanced magnification. The inspector also noted that, during the same time period GE was performing the RWCU pipe replacement to the requirements of their enhanced visual examination procedure, TVA's Maintenance personnel replaced a RWCU Valve and examined the new welds using the requirements of the TVA's visual examination procedure which did not require enhanced magnification.

Considering that the pipe replacement activities were completed for Unit 3 in 1992 and for Unit 2 in mid 1993 and the procedural differences noted in the GE instructions produced an examination of the welds that was more conservative than required by the ASME Code, the inspector concluded that administrative corrective action to make the GE procedures more consistent would be inappropriate.

The inspector reviewed the following completed weld records for the RWCU pipe replacement:

Weld Identification	Unit
RWCU-3-001-G001	3
RWCU-2-003-G002	2
RWCU-2-001-G001	2
RWCU-2-001-G002	2
RWCU-3-001-G021	3
RWCU-3-004-002 *(Valve replaced by TVA)	3

The inspector's review of documentation for the above welds revealed that, welding and NDE examinations had been properly performed and documented in accordance with the applicable ASME Codes.

The following TVA audits of GE's pipe replacement activities were also reviewed by the inspector:

Document Identification No.	Document Description
QBF-R-92-3958	Monitoring Report
NQA-BF-93-023	Assessment Report
QBF-R-92-3588	Monitoring Report
QBF-R-92-3583	Monitoring Report
QBF-R-92-3589	Monitoring Report
QBF-M-92-0042	Monitoring Report

Document Identification No.	Document Description
QBF-R-92-3873	Monitoring Report
QBF-R-92-3890	Monitoring Report
93-I-06	Internal Audit

Within the areas examined, no violation or deviation was identified.

4. Exit Interview

The inspection scope and results were summarized on June 17, 1994, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

5. Acronyms and Initialisms

ASME	-	American Society For Mechanical Engineers
BFN	-	Browns Ferry Nuclear Plant
B&PV	-	Boiler and Pressure Vessel Code
BWR	-	Boiling Water Reactor
DCN	-	Design Change Notice
GE	-	General Electric
IASCC	-	Irradition Assisted Stress Corrosion Cracking
ID	-	Inside Diameter
IGSCC	-	Intergranular Stress Corrosion Cracking
ISI	-	Inservice Inspection
NDE	-	Nondestructive Examination
No.	-	Number
NRC	-	Nuclear Regulatory Commission
OD	-	Outside Diameter
PT	-	Liquid Penetrant Testing
QA	-	Quality Assurance
RICSIL	-	GE's Rapid Information Communication Service Information Letter
RPV	-	Reactor Pressure Vessel
RWCU	-	Reactor Water Cleanup System
SIL	-	Service Information Letter
TVA	-	Tennessee Valley Authority
UT	-	Ultrasonic Testing
VT	-	Visual Examination