



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

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Report Nos.: 50-259/92-43, 50-260/92-43, and 50-296/92-43.

Licensee: Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-259, 50-260
and 50-296

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

Facility Name: Browns Ferry 1, 2, and 3

Inspection Conducted: December 14-18, 1992

Inspector:

N. Economos

1/8/93
Date Signed

Approved by:

J. J. Blake, Chief
Materials and Processes Section
Engineering Branch
Division of Reactor Safety

1/8/93
Date Signed

SUMMARY

Scope:

This routine, unannounced inspection was conducted onsite in order to observe weld overlay activities on recirculation and residual heat removal (RHR) pipe welds. Areas examined during this inspection included completed weld overlays, observation of surface examination on completed welds, fit up and welding of structural members (beams) to a safety related support, review of work specifications, completed work records, surveillance reports, and certifications for material and personnel used on this project.

Results:

The completed weld overlays exhibited good physical characteristics and met minimum dimensional requirements. Fabrication records and completed nondestructive test records were in order. Welders, NDE technicians and QC inspectors were adequately qualified to perform their assigned tasks.

One violation was identified for failure to follow installation specification requirements paragraph 3.



REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *M. Bajestani, Technical Support Manager
- *P. Burrell, Engineering
- R. Craig, Quality Assurance
- *M. Harrell, Operations Manager
- *J. Johnson, Quality Assurance
- E. Knuttel, Licensing Engineer
- *G. Pierce, Manager, Site Licensing
- T. Pitchford, Project Coordinator, Pipe Replacement
- *J. Smithson, Modifications Engineer
- J. Wallace, Compliance Engineer
- *S. Wetzel, Site Licensing

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

Contractors

General Electric, Nuclear Energy (GENE)

- *R. Cameron, QC Manage, Level III Examiner, NDE
- L. Grycko, Welding Specialist
- J. Mason, Quality Engineer, Project Modifications
- R. Lietzak, QC Supervisor
- E. Ridgell, Acting Compliance Manager

NRC Resident Inspectors

- *C. Patterson, Senior Resident Inspector

- *Attended exit interview

2. Weld Overlay on Recirculation and Residual Heat Removal Piping Unit 3

This report is a continuation of work activities performed by regional inspectors to observe and monitor the progress on the replacement of recirculation piping and certain sections of reactor water cleanup piping. Similar work performed in this area has been documented in Region Report 92-31.

a. Codes and Standards

The applicable codes and standards used and/or referenced in the application of weld overlay are as follows:

American Society of Mechanical Engineering Boiler and Pressure Vessel (ASME), B&PV) Code Sections III, V, and XI, 1986 Edition.

ASME, B&PV Code Section II (89); Section IX, Latest Edition.

American National Standards Institute (ANSI) B31.1, 1967 Edition.

American Society for Nondestructive Testing (ANST) SNT-TC-1A, 1984 (GE)

GE-NE-532-101-0792, Standard Overlay Design for the Browns Ferry 3 Recirculation and RHR System Welds

GE-25A5195 Rev. 0 BFN-3, Weld Overlay for Recirculation and RHR Piping System Welds

NUREG 0313 Rev. 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping."

US-NRC Generic Letter 88-01, "NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping.

b. Background:

The need to apply weld overlay on some of the welds in the recirculation and RHR systems resulted from the presence of code rejectable, intergranular stress corrosion cracks (IGSCC), that were found during volumetric inservice examinations. When cracks of significant magnitude are discovered in BWR piping, NUREG-0313, Rev. 2, provides guidelines for repairs or replacement of the affected piping that must be performed before the plant can be returned to service.

The weld overlay reinforcement, or repair, consists of applying weld metal over the weld and for a specified minimum distance beyond the weld on both sides. This is done completely around the outside surface of the pipe overlapping each pass. IGSCC-resistant, low-carbon, high-ferrite type 308L weld metal is used, and the process is usually performed with an automatic welding machine using the Gas Tungsten arc (GTAW) process. Weld overlay is performed with cooling water in the pipe during welding. This assures high compressive residual stresses on the pipe inside diameter, which tend to retard IGSCC growth during future plant operation.

c. Weld Overlay Design Criteria:

NUREG-0313, Rev. 2, provides two acceptable overlay designs which are identified as STANDARD overlay and DESIGN overlay. The STANDARD overlay, selected by the licensee, assumes that the cracks were completely through the wall for 360°. Accordingly the overlay weldment is designed to provide a nominal margin of 2.77 against limit load failure. The method of calculation is based on methods and criteria in IWB-3640, -3641, 3642 of ASME Section XI.



The controlling GE specification, GE-NE-523-101-0792 provided the technical basis for the design of the subject weld overlays and the analyses performed. These included a shrinkage analysis to determine the influence of shrinkage from the process on the piping systems involved and a flood-up evaluation to assure structural integrity of the piping systems prior to and during the weld overlay application.

By review of the GE specification, and other related documents, the inspector ascertained that GE had determined the overlay designs were consistent with applicable code and regulatory requirements, that all shrinkage stresses associated with the welding process were well below material yield strength and as such acceptable, and that flood-up evaluation confirmed that net section failure of the pipe at the cracked sections would not occur prior to and during weld overlay repair. The actual thickness of the overlays was designed so that a factor of safety of 3.0 is maintained against net section collapse for normal and upset load conditions, and of 1.5 on emergency and faulted load conditions.

The GE specification also required the use of 308L filler metal welding wire with high delta ferrite content. Specific acceptance criteria were established on the ferrite content of the first layer in that the average ferrite content had to exceed 8FN with no individual reading being less than 5FN.

3. Production Welding (IP55050)

a. Weld Operator Proficiency Review

The document used to describe requirements for the fabrication of field weld-overlays is GE-25A5195, Rev. 0. As such, this specification referenced the applicable codes identified earlier in this report; material requirements; qualification requirements; general welding requirements which included process control, heat input distortion control, repairs, and weld surface finish conditions; and QA requirements.

Additional welding requirements were included in GE's general welding procedure GWP-86-5.0 BF, Rev. 1. Weld procedure specification, WPS No. 8.8.20 - BF, Rev. B, with procedure qualification records PQR(s) 82-12-1 and 82-12-2 were used to qualify welding operators and fabricate the overlay weldments. Metal deposition was accomplished with the machine gas tungsten arc welding (GTAW), process using pulse mode and remote control. Filler metal used, was 308L low carbon stainless steel wire, 0.035 inch diameter with ferrite content in the 9FN range.

In addition to the areas addressed above, paragraph 3.5.3 of specification GE-25A5195 Rev. 0 provided requirements for mockups, simulating the production weldment configuration and space



limitations, to be welded, with the approved welding procedure, in order to demonstrate acceptable proficiency. This proficiency was to be demonstrated by each welding operator scheduled to work on this project.

Paragraph 3.5.3.7, of the specification, provides an alternative to mockup qualification. This alternative method requires that the contractor (GE) prepare a formal document for the TVA engineer to review and approve prior to commencing production welding. The document is to contain a detail record of the operator's weld overlay experience or recent experience in operating the same type of equipment, in the same environment as a weld overlay, and as a minimum, provide adequate description of the work experience to allow verification that mockup requirements had been met for each situation for which relief from mockup fabrication was requested.

On December 17, 1992, the inspector discussed this area of the specification with the cognizant GE welding specialists to determine which of the two options was followed, so as to proceed with the retrieval and review of the appropriate records. From this discussion, the inspector ascertained that GE had elected to pursue the alternative to mockup qualification approach. Also at this time, the inspector ascertained that overlay proficiency mockup welds were performed in the lab shop but that this was done on an informal basis, meaning that detail records of each operator's activity/participation had not been generated. Moreover, the inspector was informed that TVA had performed an ultrasonic examination on a proficiency mockup, but neither GE nor TVA could retrieve the record because the examiner was on vacation and was not expected to return to work until sometime near the end of December. Additional discussions with GE's cognizant quality engineering personnel and supervision disclosed that the formal document, described in paragraph 3.5.3.7 of the subject specification, which was required by the GE specification, to be generated by GE and submitted to TVA for review and approval prior to the start of production welding, was never issued. On December 18, 1992, GE issued nonconformance report 5-1BNH9-116 Rev. 0, to address this finding and take appropriate corrective action. At the time of this finding seven of the nine welds had been completed. On December 18, 1992 the inspector informed the licensee that a failure to follow installation specification/procedures for activities affecting quality was a violation of Title Ten Code of Federal Regulations, Part 50 (10 CFR 50), Appendix B, Criterion V. This violation was identified as 50-296/92-43-01: Failure to Implement Weld Overlay Installation Specification Requirements.

b. Inspection of In-Process and Completed Welds.

At the time of this inspection, seven of the nine welds designated for weld overlay had been welded, ground flat for inservice inspection purposes, thicknesses had been taken and recorded, and

liquid penetrant testing had been completed. The inspector examined each of the completed welds for appearance, surface condition of the overlay material near and adjacent to the overlay for evidence of undercut, identification, weld width, uniformity and cleanliness. Weld identification and results obtained from fabrication records and the specification were as follows:

<u>Weld</u>	<u>Description</u>	<u>Overall Width</u>	<u>Minimum Thickness</u>	<u>Thickness Range</u>	<u>Ferrite Number</u>	<u>Shrinkage</u>
GR-3-03	Elbow to Valve	6 3/4"	0.50	0.500"-0.705"	9.5	1/16"
GE-3-54	Elbow to Pipe	7.0"	0.45"	0.472"-0.658"	9.6	3/64"
GR-3-60	Elbow to Pipe	7.0"	0.45"	0.480"-0.578"	10.7	1/16"
DSRHR-3-11	Elbow to Pipe	7.0"	0.45"	0.494"-0.674"	10.7	1/8"
GR-3-27	Pump to Pipe	7 1/4"	0.50"	0.561"-0.797"	10.0	1/4"
GR-3-57	Valve to Pipe	6 1/2"	0.40"	0.403"-0.634"	10.5	0.109"
GR-3-64	Elbow to Pump	7.0"	0.45"	0.493"-0.708"	10.7	7/32"

A nonconformance report (NCR), No. 067, had been issued to document a PT indication found in the toe of overlay GR-3-57, extending out to the valve body. Details of the indication were documented in PT report OL-3-57-1.0-1-5B PT-1, dated October 15, 1992. The indication was removed by excavation to a depth of less than 0.035." No repair welding was required.

Welds GR-3-54 and -60 had undergone baseline ultrasonic examination to satisfy ASME Code Section XI requirements. The examination involved automatic and manual scanning techniques, using 0°, 60°L, 70°RL and OD creeping wave 85° transducers. No indications greater than 20% of full screen height were observed/documented. Those indication that were observed in the greater than 20% range were evaluated/dispositioned as surface irregularities resulting in nonrelevant lift-off type indications.

c. Procedures and Documents Reviewed

The inspector reviewed the following documents and procedures for technical content, completeness and accuracy.

DCN-W18848	Weld Overlays for Unit 3 RHR and Recirculation Piping
Q19155A	Safety Assessment/Safety Evaluation for Temporary Supports
GE-TVA-5.0 Rev.	Cleanliness Control

N-UT-24 Rev. 8 Ultrasonic measurement of Wall Thickness

TVA-25.0 Rev. C. General Visual Examination

TVA-26.0 Rev. B. General Liquid Penetrant Examination

In addition to the above, the inspector reviewed GE's Special Process Manual, containing weld procedure specifications and associated procedure qualification records (PQR) used for the overlay welds and other welding in progress at the time of this inspection. Through this review, the inspector noted that the two PQR(s), used for the qualification of weld procedure specification (WPS-8.8.20 - BF Rev. B), used on the overlays, were missing from the manual. This occurred even though the manual was a controlled copy and had been reviewed by the appropriate personnel. Upon further review, GE determined that PQRs were missing from two other weld procedure specifications, WPS-3.3.6-BF and WPS-8.8.13-BF. Following a document search/investigation and through discussions with document control management (DCRM), GE determined that the PQRs had been incorrectly removed from the WPS package by DCRM personnel, and mis-filed with the general welding procedures. Copies of the missing PQRs were made available for inclusion in the subject manual, which corrected the problem. GE instructed DCRM personnel on the proper handling of these documents.

d. Record Review

For each of the seven completed weld overlays, the inspector reviewed the fabrication records including travelers, joint and special process control sheets and nondestructive examination records to assure that critical inspections, measurements, and hold points, etc., were being performed in the prescribed manner and on a timely basis. In addition, the inspector reviewed performance qualification records for fifteen (15), weld operators who participated in the weld overlay application. All had attended the prejob briefing held on September 3, 1992 and had qualified to weld under the applicable weld specification.

Quality records in the form of certified material test reports for the filler metal used were reviewed and found to be in order - these were as follows:

<u>Type</u>	<u>Size</u>	<u>Heat</u>	<u>Ferrite No.</u>
ER308L	0.035"Ø	XT6207	9FN

Other quality records reviewed included those for liquid penetrant materials and ultrasonic equipment listed below:



Liquid Penetrant:

<u>Agent</u>	<u>Manufacturer</u>	<u>Batch No.</u>
Cleaner	Sherwin/DR-60	224-F4 and 24-L4
Penetrant	Sherwin/DP-40	18-D1
Developer	Sherwin/D-100	126-BG

Ultrasonics:

Instrument

Model: USK7D
S/N E17127
S/N E16545

Transducers

S/N 54304, 0.5" diam. 4KHz, 0°
54303, 2(5x10) 2MHZ

Calibration Blocks

BL #BF-83
Simulator 6026-83

Within the areas examined violations or deviations were not identified except for the one identified in sub-paragraph 3.a.

4. Pipe Anchor Support - Penetration X14, Unit 3 (IP55100)

Other work in progress at the time of this inspection included the fabrication of anchor ring No. 3-47B406-273 and pipe anchor support structure in penetration X14. The support and anchor ring will secure the six inch (6"), reactor water cleanup (RWCU) pipe going through this penetration. This work was being performed under Design Change Notice (DCN), W18484 and Work Plan 3783-92. The applicable drawing was No. 3-48E1032-2. Work was being documented on Traveler N X14ANC. The controlling standard for fabrication and erection was the AISC 8th Edition and TVA's specification G-29C. NDE requirements for structural steel joints called for visual inspection per G-29C. The inspector observed the fit-up of horizontal beam No. 9 (W8x31x4'-6") to embed No. EMB-3-48NI008-126. The beam was fit-up and tack welded in place, well within the applicable tolerance. The inspector reviewed an NCR issued to document rejectable indications (gouges) in the two embeds, No. 3-48NI008-126 and -128, in the area of the penetration. The gouges were weld repaired and ground flush. Within the areas inspected violations or deviations were not identified.

5. Inspection on Completed Welds: (57060PT), (57050VT)

In addition to the above work effort, GE was involved in the installation/replacement of small bore piping in the RWCU system located in the non-regenerative heat exchanger room and the pump room. Work was being performed under DCN No. W17810A, Project No. 92NJ81550D. In the heat exchanger room, the inspector observed visual and liquid penetrant examination of five (5) welds. Two of these were on instrument lines, and three on vent and drain lines, of the RWCU system. Weld identification and location were as follows.

Instrument Line

<u>Weld</u>	<u>MAP#</u>	<u>Size</u>	<u>Type</u>	<u>Inspection</u>
G001	WP370392-1 Rev. 0	One Inch	Socket Weld	VT/PT
G015	WP370392-15 Rev. 1	One Inch	Socket Weld	VT/PT
G024	WP370592-24 Rev. 0	One Inch	Socket Weld	VT/PT
G025	WP370592-24 Rev. 0	One Inch	Socket Weld	VT/PT
G030	WP370592-24 Rev. 0	One Inch	Socket Weld	VT/PT

Welds G025 and G030 exhibited rejectable PT indications that were removed by grinding, and weld repaired. A subsequent PT examination showed both welds were acceptable. Quality records including those of liquid penetrant materials, identified earlier in this report, and examiner certifications were reviewed for completeness, accuracy and compliance with applicable standards.

Within the areas inspected, violations or deviations were not identified.

6. Review of Onsite Audit Activities, (40704) Unit 3

The inspector reviewed reports of audits/surveillance performed by GE and TVA on work activities related to the pipe replacement project and the ongoing weld overlay effort. The review included reports of audits performed from June to November of 1992. Activities audited by both organizations included machining, welding, review of field generated records (travelers), material certifications, review of radiographs, weld repairs, and implementation of the QA program requirements. Problem areas identified were investigated and dispositioned in a satisfactory and timely manner.

Within the areas inspected, violations or deviations were not identified.

7. Exit Interview

The inspection scope and results were summarized on December 18, 1992, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

(Open) Violation 50-396/92-43-01: Failure to Implement Weld Overlay Specification Requirements

