U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report Nos. 50-277/85-38
50-278/85-37

Docket Nos. 50-277
50-278

License Nos. DPR-44
DPR-56 Priority -- Category C

Licensee: Philadelphia Electric Company

2301 Market Street

Philadelphia, Pennsylvania 19101

Facility Name: Peach Bottom Atomic Power Station, Units 2 and 3

Inspection At: Delta, Pennsylvania

Inspection Conducted: October 1, 8 and 21-25, 1985

Inspector: Samuel D. Reynolds 11/14/85
S. D. Reynolds, Jr., Lead Reactor Engineer, M&PS, EB, DRS — date

E. H. Gray 11/15/85
E. H. Gray, Lead Reactor Engineer, M&PS, EB, DRS — date

Approved by: Samuel D. Reynolds for 11/19/85
J. Wiggins, Chief
Materials and Process Section, EB, DRS — date

Inspection Summary: Combined Inspection on October 1, 8 and 21-25, 1985 (Inspection Report Nos. 50-277/85-38 and 50-278/85-37)

Areas Inspected: Routine unannounced inspection of the licensee's program for repair of the N-1 and N-2 nozzle safe ends, overlay pipe weld repairs, and core spray junction box repairs. The inspection involved 42 hours onsite by two region-based inspectors.

Results: No violations were identified.

DETAILS

1.0 Persons Contacted

Philadelphia Electric Company (PECo)

#N. Gazda, Health Physicist Supervisor
T. Bazzani, Lead Engineer/Pipe Replacement
R. Zong, R&T Division/NDE
*D. Smith, Station Manager
#*R. Fleischmann, Station Superintendent
#N. Alexakos, Maintenance Engineer
A. Hilsmeier, Senior HP
J. Winzenried, Superintendent, Plant Services
J. Madara, Supervisor, Maintenance
W. McFarland, Mechanical Construction Head
K. Wilson, Senior Engineer, Maintenance

General Electric Company, A&ESO (GE)

D. DiFilippo, Q.C. Welding Supervisor
A. Giansanti, Q.C. Inspector
R. Boone, QC Inspector
L. Proulx, Welding Supervisor
J. McClure, Welding Supervisor
M. Krause, Welding Supervisor
R. Lebre, Program Manager
P. Mayo, Project Supervisor
M. Thomasian, Drywell Operations Supervisor
J. Foreman, Welding Operator
R. Coulstring, Welding Operator
R. Young, Welding Operator

Hartford Steam Boiler Inspection and Insurance Company

J. Fuhrman, ANII

U. S. Nuclear Regulatory Commission

#*T. P. Johnson, Senior Resident Inspector
#*J. H. Williams, Resident Inspector

Present at E. H. Gray's exit meeting on 10/8/85
* Present at S. D. Reynolds, Jr.'s exit meeting on 10/25/85

2.0 General

The inspection report covers the review of licensee activities related to the repair of Unit 3 stainless steel piping systems affected by IGSCC. The inspection includes a PECo/GE/NRC meeting in Bethesda, Maryland, on

October 1, 1985, an inspection conducted by a regionally-based inspector on October 8, 1985 related to repair of the core spray junction box, and an inspection conducted by a regionally-based inspector on October 21-25, 1985.

3.0 Recirculation System Outlet Nozzle (N-1) Safe End Cracking Meeting

A meeting was held on October 1, 1985, in Bethesda, Maryland, with representatives of PECo, GE (San Jose and King of Prussia), NRR and Region I in attendance to discuss the detected indications in the 28" recirculation system outlet nozzle (N-1) safe ends. The minutes of the meeting are reported in a summary letter written on October 9, 1985, by R. A. Hermann, PM, ORB2, NRR, to PECo. A summary of the licensee's conclusions, as presented at the meeting, is as follows:

- The L grade stainless steel weldments (such as that found in the N-1 safe ends) are highly resistant to intergranular stress corrosion cracking (IGSCC) but cracking can initiate in normally stressed creviced and/or severely cold worked regions.
- Crack growth can occur in nonsensitized stainless steel but the growth rate would be lower than in sensitized stainless steel.
- The extent and mechanism of cracking in the Peach Bottom Unit 3 outlet safe ends is not fully understood. A plug sample will be removed and analyzed to provide further information.
- UT qualification requirements of IE Bulletin 83-02 were utilized and found suitable for flaw detection and sizing.
- Controls have been instituted to limit cold work in piping replacement work.
- Leak-before-break analyses are still valid (for the cracks in these safe ends).
- Outlet safe ends will be overlayed with a full structural overlay.
- Peach Bottom Unit 3 can be operated safely for 18 months (with the indications detected in the N-1 and N-2 safe ends).

4.0 Modification of Core Spray Junction Box

The Licensee Event Report (LER 3-85-14) dated September 25, 1985, for PB #3 was submitted in accordance with IE Bulletin No. 80-13. This LER reported cracking of core spray piping in the vicinity of the 240 degree azimuth core spray supply in vessel junction box.

On October 8, 1985, inspection was performed of licensee activities in progress to provide for structural integrity of both the 120 degree and 240 degree junction boxes. The modification, as shown on Drawing 797E551

and accomplished to GE Design Specification 23A4901, consisted of the addition of two stainless steel brackets welded to the core spray piping and the junction box at both junction box locations. The modification was performed to the applicable portions of the ASME Code Section III (Subsection NG), Section XI and Section IX, 1980 edition, including Winter 1981 Addenda.

The design specification, safety evaluations on both the core spray line cracking and repair of core spray piping and notes from the September 17, 1985, PECo-NRC meeting provided the basis for the onsite NRC inspection. The complete welded brackets at the 240 degree location were observed by binoculars and the in process work activity on the 120 degree brackets was observed. The presence of controlling documentation was noted. The installation procedure, Welding Procedure 8.8.3, Revision 3, using E308L electrode, steps to minimize radiation exposure, prewelding mockup training and welder qualification records were reviewed.

No violations were identified.

5.0 IGSCC Pipe Weld Joint Overlay

On October 8, 1985, in-progress weld overlay repairs on welds 2AS-7, 2AS-4, and 2AS-2, all "A" loop 28 inch piping were observed. Weld records were current with the welding status and QC was noted to be conducting regular review of welding variables for comparison to the weld overlay procedure operating range.

No violations were identified.

6.0 Safe End Core Sample

Ultrasonic examinations of the 28" diameter, N-1 safe end to pipe welds disclosed indications determined to be flaws. The licensee decided to remove a core sample to determine the extent of cracking.

The inspector reviewed the procedure (GE letter G-HE-5-532 dated 10/8/85) for the removal of a 1" diameter radial core sample from the safe end side of the safe end-to-pipe weld 2-BS2 of the 28" recirc. outlet nozzle N-1B. Following core sample removal, this procedure proposes macroscopic examination for ID surface grinding and fracture mapping. Optical microscopy will be conducted for microstructural details including cold work survey. A microhardness survey, Scanning Electron Microscopy (SEM) of the fracture face crack morphology, and a microprobe analysis will be conducted to determine possible synergistic effects of inclusions. EPR sensitization studies will also be conducted. Figure 1 of the procedure shows the coring operation in relationship to the weld, safe end, weld root area HAZ and estimated crack location.

The coring sample removal was conducted in accordance with GE/PECo PB3, file 5.2.11, Special (procedure) No. 866.

Preliminary metallurgical results of the core sample which were received by phone during the inspection period indicated no IGSCC cracking on either side of the weld, minimum cold worked material on the 316L side, and

welding defects at the root and at the bevel angle change which is about 0.6 inches above the ID.

No violations were identified.

7.0 GTAW-ME Overlay Performance Qualification

The inspector reviewed and observed the GE program to qualify welding operators for the pipe overlay IGSCC repairs. GE requires welders to pass a 6G manual GTAW pipe weld test assembly prior to taking a welding operator 5G orbital GTAW-ME welding test. The GTAW-ME orbital welding test is conducted on a pipe weld joint using the Arc Machines Incorporated (AMI) equipment. The welding operator controls the orbital welding at the weld joint with a pendant control box. The orbital welding test assembly is then radiographically examined for soundness. Upon completion of the orbital butt welding performance qualification, the welding operator is given 24 hours overlay proficiency training with the AMI equipment where the welding is controlled at the AMI control console and viewed by TV optics.

Review of the performance qualification records showed that 25 welding operators were qualified for welding on July 3, 1985, and passed their proficiency training on July 14, 1985. The inspector questioned these records and further investigated the operation. The investigation showed there were some questions concerning the radiography conducted by an NDE Subcontractor which were rectified, however, the film disposition date for the 25 test assemblies was all signed off on July 3, 1985. The proficiency training records were also all signed off on the same day, i.e., July 14, 1985. Regardless of the date of actual welding, the welding operators are not considered qualified until the radiographic soundness tests are dispositioned. The inspector spot-checked the backup paper work including the radiographic disposition forms which are on file in the GE QA office. The program used by GE to qualify the overlay machine welding operators meets current ASME SCIX QW360 rules and meets the intent of the applicable proposed revisions to QW360, i.e., QW361.2 Essential Variables - Machine Welding. The inspector observed orbital GTAW-ME performance qualification welding, proficiency training, and training of the operators who visually observe the welding at the pipe and verbally communicate information to those operating the equipment at the console.

No violations were identified.

8.0 Observation of Welding

The inspector observed GTAW-ME overlay pipe repair overlay welds being conducted on five AMI welding consoles using TV optics visual techniques. Welding of the first layer, and 3rd, 6th and 7th layers was being conducted on 12", 20" and 28" pipes. (Joints 2-AHJ-4, 2-BS-2, 10-0-18, 2-AS-3 and 2-BS-9.)

No violations were observed.

9.0 Licensee QA/QA Activities

The inspector reviewed the licensee's audit report AP85-60 ISI on "Clad Overlay Welding and Pipe Inspection PBAPS Unit 3." This covered processing of GE Travelers and Joint Process Control Sheets, equipment calibration, tours of various work areas, review of NDE personnel qualification, maintenance of controlled access areas, purchased weld filler materials, NDE materials, WDS and PQR documents, performance qualification records, qualified welding operator list and many other items. The inspector also reviewed the licensee's Detailed Monitoring Checklist System (DMC 8.19) for licensee surveillance inspection of the overlay welding operations.

No violations were identified.

10.0 Review of Documents

The inspector reviewed the following documents:

- GE/PECo PB3, File 5.2.11, Special No. 866 (Rev. 0), "Removal of Core Sample and Installation of Plug in N-1B Safe End"
- Diefenderfer (GE) to Aldan (PECo) letter G-HE-5-532 dated October 8, 1985, Subject - "Recirc. Outlet Safe-End Plug Sample Program Description"
- GE/PECo PB3, File 5.9.4 - GE Specification P50YP225 (Revision 2), Subject - "Weld Overlay for Austenitic Stainless Steel Piping Welds"
- FDDR HE-3-418, File 5.12.21 on use of stagnant water in lieu of flowing water for overlay welding on 28" diameter piping to P50YP225
- Sandvik CMTR for GE P.O. 320N6699-A08 for 3/32" SFA5.4 E 308L-16
- GE file 7.1 - Inspection Reports including P.O.'s, product specifications and supporting document (including CMTR for material used to plug the core sample hole on N-1B safe end)
- GE file 5.7.3 - Specific example of record of welder and welding operator performance qualification tests for overlay welding application (including record of proficiency training, copy of photo badge, UTTL record of radiographic testing and GE disposition sheet on UTTL film)
- GE File 5.2.1 - Weld overlay procedure PB-85-CLAD-1.0 (Revision 2)
- GE File 9.1.12 and 9.1.25 - Travelers CLAD-T-19 for weld joints 2-AS-7 and 2-BS-2
- Chapman to Lebre (GE) - Memo on Ferrite Measurements dated October 24, 1985

The preceding documents were found to be acceptable for the application intended. The inspector questioned, however, the engineering method used to evaluate first layer ferrite measurements as indicated in PB-85-CLAD-1.0, paragraph 4.8, and P50YP225, paragraph 4.4. This method indicates that measurement pairs shall be made at 4-90 degree azimuths at the weld center and edge of the weld crown on the first layer. This is interpreted to mean measurements at both ends of the overlay and over the weld. A technical discussion of this subject is indicated in the Independent Measurements section of this report.

No violations were identified.

11.0 Independent Measurements

The inspector conducted sample Cr and Ni equivalent calculations to illustrate the effect of the base metal and circumferential butt weld metal dilution on the ferrite measurements.

As an example, the inspector took the base metals from weld 2-BS-2 and the Sandvik E308L-16 CMTR, chemistry reviewed in the document review section.

Effective Elemental Chemistry

	304 Pipe	316L Safe End	E308L-16
C	0.055	0.019	0.033
Mn	1.56	1.67	1.82
Si	0.53	0.80	0.46
Cr	18.31	17.05	20.84
Ni	9.8	13.49	10.04
Mo	---	2.19	---
Cb	---	---	0.01

Chromium/Nickel Equivalents

(DeLong Constitution Diagram AWS Welding Handbook, Volume 4, 7th Edition, page 106)

Nickel Equivalent = (%) Ni + 30xC + .5xMn

Chromium Equivalent = (%) Cr + Mo + 1.5xSi + 0.5xCb

	304 Pipe	316L Safe End	E308L-16
Cr. Eq.	19.1	20.44	21.62
Ni. Eq.	12.23	14.9	12.3

Estimating the location on the DeLong diagram for these materials, you would have over 12% ferrite for an overlay on undiluted filler metal deposit, 5% ferrite for the 304 and 4% ferrite for the 316L. (The wrought materials should measure 0% ferrite even when you can calculate the presence of ferrite.) Assuming the same dilution % for the overlay over the base metals and weld metals, the effect of the weld metal Cr/Ni equivalent ratios on the overlay is 3 to 4 times that of the base metal.

It is concluded, however, that although the overlay first layer requirement is 8 FN average and 5 FN minimum, the 5 FN minimum governs. The inspector discussed the technical merits of using measurements over high ferrite weld metal in determining an average first layer ferrite with the licensee who indicated they would commit to review this engineering question. When full structural thickness multiple layer (average effective thickness per layer less than 0.09") overlays are utilized, the acceptability of the first layer is less critical than when thinner overlays are utilized.

No violations were identified.

12.0 Weld Overlays as a Substitute for Pipe Butt Welds

PECo/GE Special Procedure 866 covers removal of the core sample and installation of a seal welded plug in N-1B safe end joint 2-BS-2. The inspector reviewed the engineering justification for the weld overlay over the 1-3/8" diameter hole in the pipe (with a seal welded plug) and concurs with the engineering justification, however, questioned the licensee on what Code Case permitted substitution of the overlay for the butt weld in the case of the core sample hole area. In this case, the normal volumetric requirements for a butt weld cannot be fulfilled in the overlay weld deposit. The licensee committed to review the Code Case significance of the overlay over the seal welded hole in the pipe weld. This is considered an unresolved item. (50-278/85-37-01)

No violations were identified.

13.0 Ultrasonic Inspection for Overlay on 2-BS-2

The inspector discussed with the licensee's ISI personnel the UT inspection to be conducted on 2-BS-2 which has the overlay over a seal welded plug. The licensee indicated that no special examination will be conducted on this overlay in the hole area. The joint overlay will be examined manually with GE procedure TP-508.1203.

No violations were identified.

14.0 Licensee's Actions on Previous Inspection Findings

(Open) Unresolved Item (277/85-04-01): This item concerns radiographic film anomalies termed "Transverse molecular alignment indications." This item is also discussed in combined report 50-277/85-30; 50-278/85-27. Region I received copies of radiographic film which show the subject anomalies and have forwarded the film with a segment of a pipe weld reputed to also contain the indications through NRC Research to Oak Ridge National Laboratories (ORNL) for metallurgical and NDE evaluation. This item will be closed upon receipt and review of the ORNL report which will verify that the film anomalies are not related to rejectable defects.

(Closed) Unresolved Item 50-278/83-25-01: This item is closed based on the licensee response to the subject item which addresses each of the subitems satisfactorily. The licensee response is reported in the Madara (PECo) to Reynolds (NRC) letter dated January 26, 1984.

(Closed) 83-BU-02: This item is closed based on the licensee following the more current requirements stated in Generic Letter 84-11.

(Closed) 79-BU-03A: This item is closed based on the acceptability of the licensee response, Daltroff to Grier letter dated August 1, 1980, and the information written in 50-277/84-15 and 50-278/84-13.

15.0 Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain if they are violations or deviations. An unresolved item is discussed in paragraph 12.0.

16.0 Exit Interview

Mr. Gray met with the licensee representative and the NRC Resident Inspector at the conclusion of the inspection of October 8, 1985. Mr. Reynolds met with the licensee on October 25, 1985. The inspectors summarized the scope and their findings of the inspection. No written information was given to the licensee by the inspectors during the course of the inspection.