PHILADELPHIA ELECTRIC COMPANY

NUCLEAR GROUP HEADQUARTERS 955-65 CHESTERBROOK BL .). WAYNE, PA 19087-5691

(215) 640-6000

March 21, 1991

Docket No. 50-277 License No. DPR-44

U.S. Nuclear Regulatory Commission Attn: Document Control Desk Washington, DC 20555

SUBJECT: Peach Bottom Atomic Power Station, Unit 2 Request for NRC Approval of Design and Repair Package in Accordance with Generic Letter 88-01

Dear Sir:

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In accordance with the "Staff Position on Reporting Requirements" provided in the Generic Letter 88-01 ("NRC Position on IGSCC in BWR Austenitic Stainless Steel Piping"), Philadelphia Electric Company (PECo) requests NRC approval of a design and repair package (attached) associated with the repair of a crack-like indication in the weld of the Reactor Water Cleanup System (RWCU) piping. Your approval is requested by March 28, 1991 such that Peach Bottom Atomic Power Station, Unit 2 can return to operation from its current outage.

Generic Letter 88-01 provides the NRC position on intergranular stress corrosion cracking (IGSCC) in BWR austenitic stainless steel piping. As stated in the "Staff Position on Reporting Requirements" of this Generic Letter, "if any cracks are identified that do not meet the criteria for continued operation without evaluation given in Section XI of the Code, NRC approval of flaw evaluations and/or repairs in accordance with IWB 3640 and IWA 4130 is required before resumption of operation." Philadelphia Electric Company is satisfying this position via this letter.

A crack-like indication in the heat affected zone of a weld was found at Peach Bottom Atomic Power Station, Unit 2 during the performance of augmented examinations. These augmented inspections were conducted in accordance with the Peach Bottom Atomic Power Station, Units 2 and 3, "Inservice Inspection (ISI) Program Second Ten Year Interval" (PECo Specification M-733, Revision 0), AUG-1 examination program. The indication is located

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March 21, 1991 Page 2

in the four (4) inch Reactor Water Cleanup System return line (from the Regenerative Heat Exchanger), adjacent to check valve 2-12-62. The indication was identified as IGSCC and exceeds the ac. ptance standards of ASME Section XI, Article IWB-3000, 1980 Edition through Winter 1981 Addenda.

A Nonconformance Report (NCR) was originated to address this IGSCC concern. The disposition of the NCR is to repair the weld using a standard design weld overlay, as allowed by Generic Letter 88-01 and NUREG-0313, Revision 2. The weld overlay was designed by General Electric for PECo in accordance with the requirements of ASME Section XI.

A final package containing all necessary information concerning completion of the weld repair shall be transmitted by April 5, 1991.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

asilio/ C. J. Beck, Manager

Licensing Section Nuclear Engineering & Services

cc: T. T. Martin, Administrator, Region I, USNRC J. J. Lyash, USNRC Senior Resident Inspector, PB

Design and Repair Package

Summary of Attachments

Attachment	I		Weld overlay design provided by General Electric, transmitted via letter dated March 19, 1991, Rev. 1.
Attachment	11	-	General Electric Specification (P50YP225, Rev. 3) which was used as a guideline by PECo for preparing the Work Instructions as defined in Attachment I.
Attachment	III	•	Work Instructions (WI-206, Rev. 1) created by PECo for performing the weld overlay. Resolution of differences between the Work Instructions and the G.E. Specification was performed by PECo Engineering.

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ATTACHMENT I PAGE 1 OF 4

GE Nuclear Energy

General Floothic Company 175 Eurther Aucouse, San Jose, CA 95125 SASR 91-26 DRF 137-0010

March 19, 1991

To:	P.A.	Tutton	(PECO)	ec:	S. J.P.	Ranganath Clark
From:	C.D.	Frederickson	(CE)			

Subject: Full Structural Overlay Design for RWCU Fiping Weld 12-I-1D at PB2

A circumferential indication was found at the inner surface of the RWCU piping near weld 12-I-1D at Peach Bottom Unit 2 (PB2). This indication located in the vicinity of the weld (about 0.8 inches from the weld centerline) was determined to have a n "imum depth of 0.14 inch and a circumferential length of approximately 2 i. hes. The affected pipe section is 4" schedule 80 made of ASTM A.376 TP 304 stainless steel. The thickness of the pipe wall was measured as 0.40" around the indication.

A full structural overlay has been designed to repair this section of pipe. The overlay design is shown on Figure 1.

- The full structural weld overlay has been designed in accordance with Section XI of the ASME code.
- o The attached Reference 1 specification may be used for guidance to develop a site specific overlay procedure. Some specific exceptions which may be taken to this specification are outlined below.
- The overlay thickness has been determined as 0.20 inches. Local regions of the overlay may have a minimum thickness as low as 0.175 inches. The ferrite content of each weld pass shall be measured per paragraph 3.2.3 of Reference 1. The first weld pass may be included in the total overlay thickness if the average ferrite content is at least 7.5FN. If the ferrite number of the first weld pass is less than 7.5FN due to dilution, the overlay thickness must be 0.20 inches in addition to the first weld pass thickness. The thickness of the first weld pass is not important as long as the overlay thickness is determined as described above.
- The full structural overlay design is conservative in that the cracking is assumed to extend through-wall for the full 360° circumference of the pipe. The overlay material alone is thus designed to be sufficient to support design loads with a factor of safety of 3.0 to collapse consistent with the ASME code. In actuality, the existing flaw extends less than 40% through wall for less than 20% of the pipe circumference. It is also unlikely that this flaw will grow significantly because the heat sink welding overlay procedure creates compressive residual stresses in the pipe which will arrest crack growth.

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ATTACHMENT I PAGE 2 OF 4

SASR 91-26 DRF 137-0010

- o Because no credit is being taken for the effect of weld residual stresses in arresting crack growth, the cooling water flow and temperature requirements given in section 3.6 of Reference 1 need not be strictly enforced. These values shall serve as a guide only.
- As shown in Figure 1, the overlay width shall extend at least 1.50 inches past the indication in the direction away from the valve. At the base of the overlay, the width shall be an additional 0.20 inches. This width is designed both to meet structural requirements and to ensure that UT inspection of the indication is possible after the overlay is completed.
- Weld overlay shrinkage should be measured to provide information only. Distortion during the weld overlay process does not impact the weld overlay design nor is it addressed in Section XI of the ASME code. Therafore, the distortion control given in paragraph 3.7.4 of Reference 1 serves as a guide only and is not mandatory. This distortion control is on the variation of shrinkage measured at four azimuth locations, not on the absolute value of the shrinkage.

The design records for this overlay are contained in DRF#137-0010, SASR# 91-26. If there is any further clarification needed on this design, please contact me.

Sincerely,

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Ching Freith

C.D. Frederickson Senior Engineer, Structural Analysis Services (408) 925-2699

Reference 1:

GE Document# P50YP225, Rev. 3, "Process Specification for Weld Overlay for Austeritic Stainless Steel Piping Welds," July 13 1987.

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Pipe Centerline

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 This is the thickness of the overlay to be upplied (not including the first weld pass if ferrite number < 7.5) Minimum local thickness is 0.175".

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ATTACHMEN I. PAGE 4 OF 4

Peach Bottom Unit 2 RWCU 12-1-10 Full Structural Overlay Design

Piping Loads: Pipe and Flaw Dimensions: Pressure, p: 1800 (psi) Axial Loads: Deadweight, Fd: 0 (lbs) OBE Seismic, Fs: 0 (lbs) 2) Moments: Deadweight, Md: 24905 (in-lbs) 4) OBE Seismic, Ms: 22222 (in-lbs) Pipe ID: 3.700 (in) Wall Thickness, d: 0.400 (in) Axial Load: Pipe OD: 4.500 (in) Pipe Area, Ap: 5.152 (in²) Momente: Pipe Inertia, Ip: 10.929 (in*4) 1) Assumed Flaw Depth, at 0.400 (in) Piping Stresses: Overlay Dimensions: Overlay Thickness, T: 0.175 (in) Membrane, Pmp: Min. Overlay Length, L: 1.109 (in) { Pmp = {p(PI/4)ID*2+Fd+Fa} / Ap) 3756 (pal) [L= Rt on each wide of indication] Bending, Pbp: 9702 (pei) [Pbp = (Md+Ms) OD / (2 Ip)) Pipe Overlay Stresses: Pipe + Overlay Dimensions: ------2506 (p#1) Wall+Ovrly Thickness, t: 0.575 (in) Kembrane, Pmo: [Pmo # (p(PI)R1^2+Fd+Fs) / A] [t = T + d] Pipe Inner Radius, Ri: 1.850 (in) Bending, Pbo: Overlay Outer Radius, Ro: 2.425 (in) [Pbo = (Md+Ns) Ro / I) Nominal Radius, R: 2.138 (in) Factor of Safety, FS: 6363 (pei) 3.00 Cross Sectional Area, A: 7.722 (in*2) MIN Critical Bending Stress: 24101 (psi) Bending Inertia, I: 17.961 (in'4) (Pbc > FS (Pmo+Pbo) - Pmo) Critical Bending Stress Calculation: Material Properties: the same part of the same and the same and the same same and the Pipe Material: TP 304 SS, ASTM A-376 Neutral Axle Angle, B: 0.6143 (rad) (B = PI (1-a/t-Pmo/Sf) / (2-a/t)) Overlay Material: Type 308L SS Design Stress, Sm: 16950 (pml) Critical Bending Stress, Pbc: 24339 (pml) Flow Strees, Sf = 3 Sm: 50850 (pei) (Pbc = 2 (Sf/PI) (2-a/t) winB) Critical Bending Stress, Pbc . 24339 (pel) is greater than the Required Notes: 24101 (psi) 1) The pipe is conservatively assumed Critical Bending Stress of Therefore, the Overlay Design to have a 360 degree through-wall 0.175 (in) Thickness of T = crack for this full structural 1.109 (in) and Length of L . ovarlay design. is sufficient.

OVERLAY. WK1

19-Mar-91

Fax Transmittal Memo + of pages > 3 From CHARS PREDEATERSO ______KANGANATH TO PAUL TUTTON GE Nuclear Energy CO. PECO Phone 1/408) 925 - 2699 Dept Fax # (215) 640 - 6364 (Fax # 408) 925 - 4175

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1. SCOPE

1.1 This specification defines the requirements for machine or automatically deposited weld buildup on the outside diameter of stainless steel pipe at butt weld locations. These deposits are made using heat sink (pipe water cooling) techniques.

1.2 <u>Definitions</u>. For the purposes of this specification the following definitions shall apply:

Buyer: The procurement activity of the General Electric Company. or subcontractors to General Electric, invoking this specification. For the products produced within General Electric manufacturing facilities which are not processed through procurement organizations, submittals to the Buyer referenced in this specification shall be directed to the appropriate engineering or quality assurance organizations according to existing policies and practices.

Weld Overlay. A weld metal buildup on the outside surface of a pipe or fitting butt weld joint and adjacent base metal for providing additional structural material and added stress corrosion protection to the existing pipe weld.

Well Thickness. Well thickness shall be the design minimum well thickness unless otherwise specified.

Restricted Access Weld. Any weld which must be performed with access for welding in any direction restricted to less than 14 inches.

2. APPLICABLE DOCUMENTS

2.1 General Electric Documents. The following documents form a part of this specification to the extent specified herein.

2.1.1 Supporting Documents, None

2.2 <u>Codes and Standards</u>. The following documents of the latest issue (or specified issue) form a part of this specification to the extent specified hereip.

2.2.1 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code

a. Section II, Material Specifications

b. Section III, Division 1, Nuclear Power Plant Components

c. Section V, Nondestructive Examination

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- 2.2.1 (Continued)
- d. Section IX. Welding and Brazing Qualifications
- e. Section XI, Division 1, Rules for Inservice Inspection of Nuclear Power Plant Components
- 2.2.2 American Welding Society (AWS) Standards
- a. AWS A4.2 Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic Stainless Steel Weld Metal
- 3. REQUIREMENTS
- 3.1 Geperal Requirements

3.1.1 All welds shall be performed in accordance with the requirements of ASME Section XI to the extent specified in the document(s) invoking this specification. The weld overlay shall be considered a structural buildup and shall be analyzed and qualified accordingly.

3.1.1.1 Application of weld overlay to piping welds containing indications exceeding the acceptance standards of ASME Section XI shall require approval of the Buyer.

3.1.2 Application of weld overlay to installed piping where longitudinal or circumferential shrinkage could affect system assembly stresses or adjacent components and fittings shall require approval of the Buyer.

3.1.3 All welding shall be performed using detailed written welding procedures that contain all applicable essential and nonessential variables of ASME Section IX and additional requirements of this specification. All welding and cooling procedures shall be approved by the Buyer prior to use.

3.1.4 Continuous water cooling of the ID pipe surface in the vicinity of the weld joint and overlay shall be employed during all welding.

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3.2 Material Requirements

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3.2.1 Base Material. The base material shall be anatomitic stainless steel piping or fitting. P8 of ASME Section IX.

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3.2.2 <u>Welding Material</u>. The welding materials shall be Type ER308L stainless steel in accordance with ASME Section II Part C, SFA 5.9. The maximum carbon content shall be 0.02 percent.

3.2.3 <u>Ferrite Control</u>. For all stainless steel welding materials the average ferrite content shall be a minimum of 8FN (Ferrite Number, FN) with no individual reading less than 5FN. Ferrite content shall be determined on undiluted weld deposits, by magnetic measurements as specified in ASME Section III, Division 1 (Winter 1976 or later). Either Magna Cage or Ferrite Scope type instruments calibrated in accordance with AWS A4.2 shall be used.

3.3 Miscellancons Material Requirements

3.3.1 Shielding Ges. The shielding gas for welding shall be welding grade Argon.

3.3.2 <u>Coolant</u>. The coolant for production overlay welding shall be demineralized water that meets the following requirements.

Demin, Mater

Conductivity (umbo/cm at 25°C)	3 Max.
Chloride	1 ppm mex.
Sulphide	1 ppm max.
Fluoride	2 ppm max.
	5.3 to 8.0 at 25°C

pH

3.4 Overlay Preparation Reopirements

3.4.1 The surfaces to be weld overlayed shall be cleaned to remove grease, oil, slag, spatter, moisture or other deleterious materials. The area to be overlayed shall be examined in accordance to Paragraph 4.1.1.1 requirements.

3.4.2 Weld Reinforgement for Existing Welds

3.4.2.1 <u>Entt Welds</u>. The crown or reinforcement on existing butt welds need not be removed for overlay welding.

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3.4.2.2 Longitudinal Welds. In the zone to be overlayed, the reinforcement height on longitudinal seam welds shall not exceed 0.062 inch, and shall blend smoothly (maximum of 3:1 slope) into the base metal.

3.4.3 <u>Transfer of Weld Location</u>. The centurline and edges of the existing circumferential butt weld shall be marked 'y a Buyer approved technique for subsequent location beneath the weld overlay. Acceptable techniques include match marks or similar reference lines adjacent to the weld overlay at a minimum of four equally spaced azimuths around the pipe.

3.4.4 Ultrasonic Thickness Measurement. When used to verify overlay thickness (Paragraph 4.2.2), the reference thickness of the existing weld and base material shall be determined in accordance with ASME Section V, Subsection A, Article 5 requirements. Reference thickness measurements shall be determined at a minimum of four equally spaced azimuths, and at a minimum of every 0.5 inch over the width of zone to be overlayed. The 0.5 inch spacing positions shall be measured and recorded relative to the reference marks or lines required in Paragraph 3.4.3.

3.4.5 <u>Distortion Control.</u> Suitable reference marks shall be located adjacent to the zone to be overlayed for measuring the longitudinal shrinkage due to overlay welding. Measurements shall be made at a minimum of four azimuths, and a.all meet Parsgraph 3.7.4 requirements at the completion of overlay welding.

3.5 Qualification Requirements

3.5.1 <u>Procedure</u>. The welding overlay procedure shall be qualified to ASME Section IX criteria for structural welds, with flowing water cooling as an additional essential variable.

3.5.2 <u>Performance.</u> Operator performance qualifications shall be in accordance with ASME Section IX criteria.

3.5.3 Mockup Requirements

3.5.3.1 General. A mockup weld overlay shall be performed by the fabricator for each welding position (horizontal-fixed, vertical-fixed, etc) to be qualified. A mockup is also required for 1) a restricted access weld, 2) pipe to fitting or fitting to fitting welds where the angle of the OD surface to be overlayed is greater than 30° (relative to the run of the pipe) on either side of the weld, and 3) joint geometries or piping system locations where the water flow provisions of Paragraph 3.6 cannot be assured. Mockup qualification on any given pipe size will qualify for other pipe sizes within the following limitations:

Pipe Size of Mockup	Pipe Size Qualifies		
< 10 inch	>4 to 1 size of mockup		
> 10 inch	<u>></u> 10		

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3.5.3.2 <u>Mockup Materials</u>. Unless otherwise specified, the base and filler material used in the mockup shall be the same type and grade as used in production. However, any P8 material may be substituted for any other P8 raterial.

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3.5.3.3 <u>Configuration</u>. The mockup configuration shall simulate the production configuration as closely as practical. As a minimum, restricted access, adjacent components, fixturing, and water cooling techniques (where applicable according to Paragraph 3.6) shall be simulated.

3.5.3.4 <u>Welding</u>. The mockup shall be welded in accordance with the approved welding procedure with no added precautions which will not be used in production. Welding shall be monitored and records of welding parameters, start and stop positions, longitudinal shrinkage, repairs, or any other events affecting the quality or reproducibility of the mockup welds shall be retained.

3.5.3.5 Acceptance Criteria. Unless otherwise specified, the following shall constitute cause for rejection of the muckup:

- a. Ommission of, or deviation from the specified mockup requirements and Buyer approved description.
- b. Failure to pass examinations specified in Paragraph 4.1.2.
- c. Failure to maintain longitudinal shrinkage within the limits of Paragraph 3.7.4.

3.5.3.6 Operator Proficiency. Each welding operator shall demonstrate adequate proficiency on the overlay mockup with all access restrictions, overlay positions, and equipment configurations that simulate production welding in place. Adequate proficiency shall also be demonstrated by each operator for remote monitoring and/or remote control of the process. Acceptable mockup welding proficiency shall be formally documented and certified by the fabricator for each operator.

3.5.3.7 Alternate Mockup Qualification. For situations requiring the performance of a mockup by the fabricator according to the requirements of Paragraph 3.5.3.1 a formal, detailed record of recent weld overlay experience maybe submitted in lieu of performing the mockup. This document shall be submitted to the Buyer for Engineering approval prior to the start of production welding, and shall contain as a minimum sufficient description of the experience to allow verification that the requirements of Paragraph 3.5.3 were met for each situation for which relief from mockup fabrication is requested. When prior experience is submitted for process mockup qualification, the operator profiency requirements of Paragraph 3.5.3.6 shall still apply.

Certification of operator proficiency can be based on an operator's recent mockup experience, with Buyer approval obtained prior to production welding.

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3.5.3.6 Mockup Examination. Mockup examination shall be in accordance with Paragraph 4.1.2.

3.6 Water Cooling Requirements

3.6.1 <u>General</u>. The water cooling technique for overlay welding shall comply with the requirements of this document. Water flow conditions shall be varified by a mockup or other Buyer approved technique if the production weld is located in a portion of the piping system where the minimum flow velocities of this specification cannot be assured.

3.6.2 Water Flow Velocities

s. The minimum flow velocities shall be as follows:

Pipe Type	Water Flow Velocity
Horizontal Pipe Butt Welds, Properly Pitched ¹	1.6 Ft/sec
Horizontal Pipe Batt Welds, Unpitched	3.9 Pt/sec
Vertical Pipe Butt Welds	1.6 Ft/sec
Pipe to Fitting Butt Welds	3.9 Ft/sec
All Other Joints	3.9 Ft/sec

b. Demonstration of Coverage: (When Paragraph 3.6.2 requirements cannot be met).

- (1) For welds in special fittings or in locations where the minimum flow velocity specified in Paragraph 3.6.2.a above cannot be assured. it shall be demonstrated by use of the mockup, or other buyer approved technique, that flowing cooling occurs continuously during welding, around the entire ID surface of the weld root, weld joint counterbore and pipe base metal beneath the weld overlay.
- (2) It shall be demonstrated that the minimum water flow rate can be maintained during welding. Flow rates shall be recorded during welding.

Properly pitched pipe for the purposes of this specification is considered to have a minimum slope of 0.25 inch per 1 foot of run pipe length.

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- c. Alternate Techniques As access permits, special dams, air tubes or water spargers may be used to provide local water cooling. Such techniques shall be evaluated in the mockup, and approved by the Buyer prior to use.
- d. Flow velocities less than specified in Paragraph 3.6.2. a above shall be approved by Buyer prior to use.
- 3.6.3 Miscellancons Water Cooling Requirementa:
- a. The maximum inlet temperature of the water shall be 120°F.
- b. Welding shall not be initiated on wet surfaces.

3.7 General Welding Requirements

3.7.1 The weld overlay shall be deposited using mechanized pipe wolding equipment that controls welding current and voltage, wire feed speed and travel speed as a minimum.

3.7.2 Individual weld layers of the buildup shall consist of a row of circumferentially-deposited weld passes. Each weld layer shall be completed for its entire length along the pipe prior to depositing the next layer. except that passes may be added to the ends of the overlay as required to meet minimum slope or weld overlay tie-in requirements.

3.7.3 The maximum interpass temperature for all welding shall be 350°F (177°C).

3.7.4 <u>Distortion Control</u>. The weld stop and start positions, and if necessary, the weld rotational direction shall be sequenced to provide uniform longitudinal abrinkage of the pipe assembly. Longitudinal abrinkage shall be considered uniform if held within 0.02 W (Figure 1), or 0.032 inches. whichever is greater, when measured at the completion of overlay welding at a minimum four equally spaced azimuth locations. This limit shall be applied to all mockup and production weld overlays.

3.8 Repair Requirements

3.8.1 Repair of weld overlay buildups shall be performed with the restrictions listed below. If pipe size and pipe thickness criteris conflict, then pipe thickness shall determine the repair requirements applicable.

- a. In pipe sizes less than 10 inches, or for pipe design well thickness less than 0.625 inch:
 - (1) The weld repair, if deeper than the layer in progress, shall be one or more full circumferential passes, including circumferential preparation as necessary by finding or machining. Buyer approval is required for weld repairs which extend into the base metal.

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- (2) The weld repair, if in the layer in progress, shall be blend ground for welding as necessary. The weld repair shall be one or more circumferential passes extending a minimum circumferential distance of five (5) inches.
- b. In pipe sizes 10 inches and larger, or for pipe wall thickness greater than or equal to 0.625 inch:
 - (1) The weld repair shall be blend ground or machined prior to welding as necessary. The weld repair shall be one or more circumferential passes and shall extend a minimum circumferential distance of five inches for each 0.12 inch in depth, but not less than five inches, Buyer approval is required for weld repairs which extend into the original weld or pipe base material.

3.8.2 Grinding (not requiring local wold fill) is acceptable, providing the requirements of Paragraph 3.9 are met.

3.8.3 All weld repairs of weld overlays shall be performed using qualified procedures with ID cooling per this specification and approval of the Buyer prior to use.

3.9 Overlay Finishing Requirements

3.9.1 Weld overlay buildups shall meet the dimensional requirements of this specification in the final finished condition. At the junction of the weld overlay with the base material, the height of reinforcement or depth of undercutting shall not exceed 0.032 inch.

3.9.2 The transition alope between the pipe and the overlay top surface shall be free of overlap or abrupt ridges and valleys greater in any dimension than 0.062 inch.

3.9.3 The top surface of the weld overlay shall be prepared for subsequent inservice ultrasonic examination in accordance with the requirements of Figure 2.





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4. QUALITY ASSURANCE REQUIREMENTS

4.1 Eramination

4.1.1 Nondestructive Examination of Production Weld Overlays

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4.1.1.1 Prior to application of the weld overlay, the base metal, weld surfaces and adjacent base metal for 0.5 inch on either side of the edge of the area to be built up shall be liquid penetrant examined in accordance with ASME Section III, NB5000.

4.1.1.2 The surface of the first layer and of the final weld overlay plus adjacent 0.5 inch of the base metal shall be liquid penetrant examined in accordance with NE5000.

4.1.1.3 The final weld overlay shall be volumetrically examined by radiographic techniques according to NB5000. Alternately, ultrasonic examination according to NB5000 may be used.

4.1.1.4 For all welds subjected to inservice inspection provision of ASME Section XI, a new baseline examination shall be performed for the existing butt weld. A baseline examination shall also be performed for the weld overlay buildup, except that the width of the area to be examined need only be W as defined on Figure 1. The overlay shall be included in the required ultrasonic calibration standards. The finished weld overlay shall be examined for uniformity of longitudinal shrinkage according to Paragraph 3.7.4 requirements.

4.1.2 <u>Examination of Weld Mockup</u>. As a minimum, the examinations required for the production welds shall be required for the mockup. In addition, a radiographic examination shall be performed in accordance with the ASME Code, Section III, NB5000. Mockup welds which do not meet the acceptance criteria of Subsection NB5220 shall be rejected.

4.2 Overlay Thickness Examination

4.2.1 The finished weld overlay shall be examined per Paragraph 4.2.2 or 4.2.3 to determine that minimum thickness requirements of this specification have been met.

4.2.2 Ultrasopio Thickness Determination

4.2.2.1 The overlay thickness shall be determined by measuring the final thickness of overlay, the thickness of the first layer of the overlay and the underlying pipe/pipe weld in accordance with ASME Section V. Subsection A. Article 5 requirements. The overlay thickness shall be the difference between the total thickness measurement and the reference thickness (Paragraph 3.4.4) minus the thickness of the first overlay layer. Measurements shall be taken at a minimum of four equally paced azimuths, and at a minimum of 1.0 inch over the width (W) of the overlay.

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NUCLEAR ENERGY BUSINESS OPERATIONS

P50YP225 SH NO.

REV 3

PG 18 OF 14

13

4.2.2.2 Ultrasonic Thickness Criteria. The overlay shall meet the minimum thickness defined in Paragraph 3.1.5.

The thickness of the designed overlay should be at least two layers of weld metal after the surface has passed surface examination by penetrant inspection (PT). If credit is taken for the thickness of the first layer, it must be shown by actual test to contain a minimum of 8% ferrite, and the original surface must have passed PT.

4.2.3 Alternate Dimensional Thickness Measurement

4.2.3.1 As an alternate to Paragraph 4.2.2, dimensional measurements may be taken at the ends of the weld overlay at a minimum of four equally spaced azimuths to determine the finished overlay thickness.

4.2.3.2 <u>Dimension Thickness Criteris (Minimum)</u>. The minimum overlay thickness for dimensional measurement examination shall be the sum of:

a. The minimum of Paragraph 3.1.5

b. The measured concevity in the weld overlay for the corresponding azimuth.

4.2.3.3 Deleted

4.3 <u>Material Control.</u> All welding filler materials shall be controlled, identified, and traceable to the Certified Materials Test Reports required by ASME Code.

4.4 Overlay Ferrite Measurement

4.4.1 Delts ferrite measurements shall be in accordance with Paragraph 4.4.1.1 for each weld overlay layer. Measurements shall be evaluated against the acceptance criteria of Paragraph 4.4.2.

4.4.1.1 Measurement procedures are as follows:

- a. Magna Gage or Ferrite Scope instruments, per AMS A4.2, shall be used for all measurements.
- b. Measurements shall be taken at four equally spaced azimutha around the joint on the as-deposited weld surface. (Grinding or finishing of the surface shall not be performed prior to ferrite measurements.)
- c. Measurements at each azimuth shall be taken at the approximate weld center and edge of the weld crown in the overlay layer. When using double tip probes, measurements shall be taken as pairs with the probe: rotated 90° between individual readings.

4.4.2 Ferrite acceptance criteria are the following:

- a. Average 8FN minimum
- b. No individual reading less than SFN

NUCLEAR ENERGY GENERAL SELECTRIC

PSOYP225 SH NO. 1 REV 3 FINAL

14

ATTACHMENT II

FG 14 OF 14

5. SUBMITTALS AND RECORDS

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5.1 The following procedures shall be submitted to the Buyer for approval prior to use.

5.1.1 Mockup Description and Procedure

5.1.2 Welding Procedures

5.1.2.1 For weld overlay buildup.

5.1.2.2 For repair welding.

5.1.3 Water Cooling Procedures

5.1.4 Nondestructive Examination Procedures

s. Liquid Penetrant Examination

b. Radiographic Examination

c. Ultrasonic Examination

5.1.5 Dimensional Checking Procedures

5.2 The following information shall be recorded during the course of work, and submitted to the Buyer as a fabrication data package.

5.2.1 Detailed records of each repair made after the overlay was completed, including location, size of cavity, probable cause, and repair technique.

5.2.2 Dimensional or ultrasonic thickness test results and longitudina! distortion measurements.

5.2.3 Nondestructive examination results.

ATTACHMENT III PAGE 1 OF 6

NCR #P91214 (Option #3) WI-206, Rev. 1 MRF #9101668 DATE: 03/21/91

SUBJECT: Work instructions for weld overlay to be performed on Reactor Water Clean-Up Weld #12-I-ID. PBAPS, Unit No. 2

 Clean surfaces to be overlayed to remove grease, oil, slag, moisture, etc.

Job Leader/Supv

2. In order to document the longitudinal shrinkage due to welding, take initial reference measuring points (scribe lines) at four equally spaced azimuths (0, 90, 180, 270 degrees) on each side of the weld overlay area using a calibrated tool. Document the distance between each two corresponding measuring points:

Calibrated Tool I.D. #

0	degree	points	
90	degree	points	
180	degree	points	And the second of the second s
270	degree	points	
	403.00	B.A.W.C.A.M.	BRANDER CONTRACTOR DESIGNATION AND AND AND AND AND AND AND AND AND AN

Job Leader/Supv

3. NDE Services to perform P.T. and U.T. thickness examination of pipe surface to be overlayed. As a minimum, a 6" wide band (360 degrees) shall be P.T. examined. Document results by including NDE report within MRF package, Acceptance criteria for P.T. exam shall be Paragraph NB-5000 of ASME Section III, 1980 Edition with addenda thru Winter 1981, by

U.T. Thickness measurements shall be taken as follows:

			A	В	C	D	E
			886 G8 897		the set of		
0	degree	points		An at the function of the spectral strength of		-	
100	109100	posino		sensemble was in the sense of the sense		Antonio da la caratte da manda anas	
270	degree	points			an education can only responde		
	003100	Por res con	THE R. P. LEWIS CO., LANSING MICH.	NAME AND ADDRESS OF OTHER POST OF THE OWNER OF THE OWNER			

Notes:

1, Reference points A, B, and C shall be equally spaced across the width of weld overlay

NDE Services

ATTACHMENT III PAGE ZOF6 4. Verify with operations that water flow through the pipe has been established. Water flow shall be maintained throughout entire welding process. Job Leader/Supv Begin welding overlay as per attached WID sheet 5. and NCR P91214. Upon completion of first weld layer, Metallurgy Lab 6. Technician to perform ferrite content examination on the first weld layer using a Magna Gage or Ferrite Scope (or equivalent). Acceptable ferrite content shall be 7.5FN (ferrite number) or greater. Measured Ferrite Number = Note: If ferrite number is less than 7.5FN, then credit will not be taken for thickness of first weld layer. Measurements taken in step 8 shall then be considered as baseline. Met Lab Tech. Prepare surface for P.T. and U.T. thickness exam-7. instions. Job Leader/Supv NDE Services to perform P.T. and U.T. thickness 8. examinations of the first weld overlay layer. Acceptance cri., ia for P.T. exam shall be Paragraph NB-5000 of ASME Section III, 1980 Edition with addenda thru Winter 1981, by U.T. Thickness measurements shall be taken as follows: A B C D E ------------------0 degree points 90 degree points 180 degree points 270 degree points Notes: 1. Reference points A, B, and C shall be equally

spaced across the width of weld overlay

NDE Services

 Apply second layer of weld overlay, staying within guidelines as specified on attached WID sheet and NCR P91214.

WI-206, Rev. 1

10.	Upon completion of second weld layer, Metallurgy Lab Technician to perform ferrite content examination on the second weld layer using a Magna Gage or Ferrite Scope (or equivalent). Acceptable ferrite content shall be an average of 8FN (ferrite number) or greater, with ro individual number less than 5FN.	PAGE 3 OF 6
	Measured Ferrite Number =	Met Lab Tech.
11.	Prepare surface for U.T. thickness examinations (information only).	
	Note: Job Leader to confer with Maint. Eng. to determine if steps 11 and 12 may be deleted. If U.T. measuements are not required, then N/A steps 11 and 12.	Job Leader/Supv
12.	NDE Services to perform U.T. thickness examination of the second weld overlay layer.	
	U.T. Thickness measurements shall be taken as follows: A B C 0 degree points 180 degree points 270 degree points	D E
	Notes: 1. Reference points A, B, and C shall be equally spaced across the width of weld overlay	NDE Services
13,	Apply third layer of weld overlay, staying within guidelines as specified on attached WID sheet and NCR	P91214.
14.	Upon completion of third weld layer, Metallurgy Lab Technician to perform ferrite content examination on the third weld layer using a Magna Gage or Ferrite Scope (or equivalent). Acceptable ferrite content shall be an average of 8FN (ferrite number) or greater, with no individual number less than 5FN.	

Measured Ferrite Number = _

Met Lab Tech.

WI-206, Rev. 1

		ATTACHMENT III
15.	Frepare surface for U.T. thickness examinations (information only).	The 4 OF 5
	Note: Job Leader to confer with Maint. Eng. to determine if steps 15 and 16 may be deleted. If U.T. measurements are not required, then N/A steps 15 and 16.	Job Leader/Supv
16.	NDE Services to perform U.T. thickness examination of the third weld overlay layer.	
	U.T. Thickness measurements shall be taken as follows: A B C 0 degree points 90 degree points 180 degree points	D E
	270 degree points	analise and an and a second se
	Reference points A, B, and C shall be equally spaced across the width of weld overlay	NDE Services
17.	If the third weld overlay layer is considered the final pass, then N/A steps 18 through 20. Prepare surface for final NDE examinations and contour measurements per GE requirements in NCR P91214 to be performed in steps 21, 22, and 26.	
18.	Apply fourth layer of weld overlay (if required) staying within guidelines as specified on attached WID sheets.	
19.	Upon completion of fourth weld layer, Metallurgy Lab Technician to perform ferrite content examination on the fourth weld layer using a Magna Gage or Ferrite Scope (or equivalent). Acceptable ferrite content shall be an average of 8FN (ferrite number) or greater, with no individual number less than 5FN.	
	Measured Ferrite Number =	Met Lab Tech.
20.	Prepare surface for final NDE examinations and contour measurements per GE requirements in	
	1140 21414.	Job Leader/Supv
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21,	Take contour measurements of final prepared surface at four equally spaced quadrants around overlay O.D. before the final P.T. examination. Verify contour readings are per NCR P91216 and record on attached	ATTACHMENT III. PAGE 5066
	wata sileet.	Maintenance Eng
22.	NNE Services to perform P.T. examination of final overlay surface. Document results by including NDE report within MRF package. Acceptance criteria for P.T. exam shall be Paragraph NB-5000 of ASME Section III, 1980 Edition with addenda thru Winter 1981	NDE Services
23.	NDE Services to perform U.T. thickness examination of the fourth weld overlay layer.	
	U.T. Thickness measurements shall be taken as follows:	D E
	0 degree points 90 degree points 180 degree points 270 degree points	
	Notes: 1. Reference points A, B, and C shall be equally spaced across the width of weld overlay	NDE Services
24.	Post welding measuring points shall be taken using a calibrated tool at four equally spaced azimuths (0, 90, 180, 270 degrees) on each side of the weld overlay area to determine the longitudinal shrinkage due to welding. Document the distance between each two corresponding measuring points:	
	Calibrated Tool I.D. #	
	O deserves and the	

0	degree	points	
90	degree	points	NAMES OF TAXABLE PARTY AND AND ADDRESS OF TAXABLE PARTY.
180	degree	points	
270	degree	points	The subscription of the su
			An other than the second

Job Leader/Supv

WI-206, Rev. 1

APPECHMENT III PAGE 6 OF 6

25. Maintenance Engineering to document the overall , shrinkage below. Refer to NCR P91214.

Final Shrinkage values:

	and the second second second second						
			Step #3 Values	minus	Step #24 Values		
0	degree	points					
90	degree	points	And a state of the		manufacture and the second sec		Constant and a second participation of the second s
180	degree	points	Statement and the second second		and because of the second second second second	*	Photo-contract and an and a second se
2/0	aegree	points	and the second se	-	and the second second second second	-	Construction of Streams Streams and a rest water

26. Perform final U.T. examination and baseline U.T. examination in accordance with U.T. procedure CE-UT-103 provided by GECo. The recorded data shall be reviewed and evaluated in accordance with Paragraph NB-5330 of ASME Section III, 1980 Edition with addenda thru Winter 1981 and in accordance with Article IWB-3000 of ASME Section XI, 1980 Edition with addenda thru Winter 1981, by PECO's U.T. Level III.

NDE Services