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Address Reply to: Post Office Box 767
Chicago, Illinois 60690 - 0767

May 31, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Quad Cities Station Unit 1
Response to Request for Additional
Information (RAI) Regarding Fall
1987 Unit 1 Intergranular Stress
Corrosion Cracking (IGSCC) Inspection
NRC Docket No. 50-254

Reference: Letter from T.M. Ross to L.D. Butterfield
dated April 13, 1988.

Dear Mr. Murley:

In the above referenced letter, members of your staff requested additional information pertaining to the completed Quad Cities Unit 1 Fall 1987 Intergranular Stress Corrosion Cracking (IGSCC) Inspection. Attached, please find the responses to the eight RAI items. We are also providing a copy of a NUTECH Engineer's report entitled "Evaluation and Disposition of Flaws at Quad Cities Nuclear Power Plant Unit 1 (1987 Outage)", Revision 1 dated May 1988.

We believe these documents address the concerns raised by your staff in their review of the results of the completed IGSCC Unit 1 Fall 1987 inspection.

Please direct any questions you may have regarding this matter to this office.

Very truly yours,

I. M. Johnson
Nuclear Licensing Administrator

lm

Attachment

cc: T. Ross - NRR (w/Att.)
NRC Resident Inspector - Quad (w/Att.)

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Item 1: During the Unit 1 refueling outage in the Fall of 1987, all but four (04) large bore ($\geq$ 12" n.p.s) recirculation welds were ultrasonically examined due to cracking found in the expanded sample welds. The four recirculation weld that were not examined this outage were: 02AD-S6, 02AS-S3, 02BD-S2 and 02BD-S6. These welds were previously examined during the refueling outage in the Winter of 1986 (January 1986) by examiners qualified at the EPRI NDE Center after September 1985, and they were found free of flaw indications.

Since the aforementioned welds were examined in 1986 to the same inspection standards used today, Commonwealth Edison (CECo) feels that the 1986 inspection results are accurate and representative of the current welds condition, especially after only one operating cycle.

Re-examination of these four welds at this time (in 1987) would, therefore, provide little safety benefits. It would, however, incur additional unnecessary radiation exposure to inspecting personnel, and it could also affect the unit start-up scheduled for December 21, 1987.

Item 2: As a mitigation for IGSCC, the IHSI process was applied to selected susceptible austenitic stainless steel piping welds in the recirculation, shutdown cooling and residual heat removal systems at the Quad Cities Unit 1 between April 12, and May 8, 1984. A total of 88 welds were treated by Nutech Engineers. Five welds were deleted from the original 93 weld IHSI program: four because a pre-IHSI ultrasonic (UT) examination revealed flaws which required weld overlay repair, and one because the configuration was not conducive to IHSI.

During the Fall 1987 UT examinations of the austenitic stainless steel piping, new IGSCC-like flaw indications were observed in a total of eight welds previously IHSI treated in 1984. Reviews of the IHSI heat treatment records and the construction radiographs of these joints were performed at that time. Results of this records review are discussed.

To date, the IHSI review has focused on those welds where Nutech Engineers has issued nonconformance reports (NCRs) following the IHSI heat treatments. A total of five NCRs were prepared involving four welds. Two of the welds producing NCRs, welds 02D-F6 and 02K-F2, were observed each to have one thermocouple which slightly exceeded the maximum prescribed OD temperature of 575-degrees C per the EPRI IHSI criteria. (The maximum temperatures were 595-degrees C for 02D-F6 and 577 degrees C for 02K-F2 respectively.) The slight temperature excursion was found in the NCR to have no detrimental IHSI heat treatment effect. This independent review concurs with that conclusion. Two large diameter welds, welds 02BS-S5 and 02B-S10, were observed to have through wall temperature gradients which were below the EPRI guideline of 275-degrees C (495-degrees F). One weld, weld 02BS-S5, was found to produce a through-wall temperature gradient of 487-degrees F (later corrected to 504-degrees F) and the other weld, weld 02B-S10, produced a through-wall temperature gradient of 466-degrees F. Additional analysis performed by Nutech and others has confirmed that these temperature gradients should be sufficient to produce compressive ID residual stresses.

More recent experimental evidence suggests that in large diameter pipes, the ID surface may not be placed into compression unless the temperature gradient is significantly larger than that prescribed by the EPRI criterion. In addition, a preexisting condition such as postweld grinding which can produce a cold worked layer, surface abuse and unfavorable tensile residual stress on the ID surface, can further reduce the ID crack initiation mitigation effectiveness of the IHSI heat treatment. Consequently, when grinding is present, the ID surface may remain in tension, even following a successful IHSI treatment. However, the through thickness residual stress benefit of the IHSI treatment remains. The IHSI treatment for the two large diameter welds identified in the NCR's is acceptable by analysis and meets the EPRI residual stress guidelines.

The question which remains is whether the EPRI guidelines are stringent enough for large diameter welds and for welds in which postweld grinding has occurred. The answer to that question is outside the scope of this investigation.

The NRC has asked in Question 2 for Commonwealth Edison to discuss the industry-wide experience in applying the IHSI process to mitigate IGSCC. Commonwealth Edison believes that it does not have the in-house capability to reply to this portion of the question. It is understood, however, that EPRI is currently investigating the industry-wide performance of IHSI treated welds. In addition, laboratory studies of degraded pipe followed by an IHSI heat treatment have been completed and a final report is about to be released by EPRI.

Item 3.a.: The contractor providing Inservice Inspection services for the Fall 1987 refueling outage was General Electric Co. (G.E.). Most of the ultrasonic examination data were manually collected and analyzed. Some examination data were recorded automatically by means of the GE's SMART UT system. The automated examination usually was supplemented by localized manual examination. In general, automated inspection system was used on overlaid welds, welds in high radiation field and welds with known flaw(s).

Item 3.b.: All level II and III ultrasonic testing personnel and equipment employed for IGSCC inspection were qualified at the EPRI NDE Center for detection, sizing and/or overlaid weld examination in accordance with the applicable "NRC/EPRI/BWROG Coordination Plan". Specifically, all IGSCC detection examiners (Level II and III) were qualified at the NDE Center after September of 1985.

Item 3.c.: Procedures used for IGSCC UT were:

- NDT-C-2, rev. 15: CECo's procedure for inspection of piping welds.
- NDT-C-40, rev. 0: CECo's procedure for inspection of Inconel 182 buttered welds.
- NDT-C-37, rev. 0: CECo's procedure for inspection of overlaid welds.
- UT-46, rev. 4: GE's procedure for inspection of piping welds using the automated SMART UT system.

Techniques used for IGSCC UT were:

- Flaw detection: 45^{o} or 60^{o} shear wave, 60^{o} or 70^{o} refracted longitudial wave and/or WSY-70 ID creeping wave.
- Flaw sizing: 45^{o} or 60^{o} shear wave, 60^{o} or 70^{o} refracted longitudinal wave, WSY-70 ID creeping, SLIC-40 and/or OD creeping wave.
- Examination or re-examination of overlaid welds: 60^{o} or 70^{o} refracted longitudinal wave and/or OD creeping wave. For examination of new overlaid welds, a 0^{o} longitudinal wave was also used to detect possible lack of bonding.

Item 3.d.: Limitations of UT examination for each weld are tabulated in the following table:

System	Size	Weld I.D.	Weld Configuration	Limitation
Recirculation	28"	02AS-F2	Safe End-Pipe	Safe end OD geometry
	28"	02AS-F8	Pipe-Valve	Valve OD geometry
	28"	02AS-F9	Valve-Elbow	Valve OD geometry
	28"	02AS-F14	Pipe-Elbow	Elbow is made of cast stainless steel
	28"	02AD-S2	Pipe-Tee	Tee OD geometry
	28"	02AD-F8	Elbow-Valve	Valve OD geometry
	28"	02AD-F9	Valve-Pipe	Valve OD geometry
	28"	02AD-F12	Pipe-Pump	Pump OD geometry
	28"	02BS-F2	Safe End-Pipe	Safe end OD geometry
	28"	02BS-F6	Tee-Valve	Valve OD geometry
	28"	02BS-F7	Valve-Pipe	Valve OD geometry
	28"	02BS-S5	Pipe-Tee	Tee OD geometry
	28"	02BS-S12	Elbow-Pipe	Weldolets in area
	28"	02BS-F14	Pipe-Elbow	Elbow made of cast stainless steel
	28"	02BD-F1	Tee-Cross	Cross OD geometry
	28"	02BD-F8	Elbow-Valve	Valve OD geometry
	28"	02BD-F9	Valve-Pipe	Valve OD geometry
	28"	02BD-F12	Pipe-Pump	Pump OD geometry
	22"	02-F1	Pipe-Valve	Valve OD geometry
	22"	02-F2	Pipe-Valve	Valve OD geometry
	22"	02A-F1	Valve-Pipe	Valve OD geometry
	22"	02A-F5	Pipe-Cross	Cross OD geometry
	22"	02A-S2	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02A-S3	Pipe-Cross	Cross OD geometry
	22"	02A-S4	Cross-Reducer	Cross OD geometry
	22"	02A-S6	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02A-S7	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02A-S8	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02B-F1	Valve-Pipe	Valve OD geometry
	22"	02B-F5	Pipe-Cross	Cross OD geometry
	22"	02B-S2	Pipe-Sweepolet	Sweepolet OD geometry

Item 3.d.: Limitations of UT examination for each weld are tabulated in the following table:

System	Size	Weld I.D.	Weld Configuration	Limitation
	22"	02B-S3	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02B-S4	Pipe-Sweepolet	Sweepolet OD geometry
	22"	02B-S6	Cross-Reducer	Cross OD geometry
	22"	02B-S9	Pipe-Sweepolet	Sweepolet OD geometry and adjacent overlaid weld
	12"	02C-F6	Sweepolet-Pipe	Sweepolet OD geometry
	12"	02D-F6	Sweepolet-Pipe	Sweepolet OD geometry
	12"	02E-F6	Sweepolet-Pipe	Sweepolet OD geometry
	12"	02F-F6	Pipe-Reducer	Reducer OD geometry
	12"	02G-F6	Sweepolet-Pipe	Reducer OD geometry
	12"	02H-F6	Sweepolet-Pipe	Sweepolet OD geometry
	12"	02K-F6	Sweepolet-Pipe	Sweepolet OD geometry
	12"	02L-F6	Pipe-Reducer	Reducer OD geometry
	12"	02M-F7	Sweepolet-Pipe	Sweepolet OD geometry
	4"	02AB-S10A	Pipe-Sweepolet	Sweepolet OD geometry
	4"	02AD-S5	Pipe-Sweepolet	Sweepolet OD geometry
	4"	02BD-S5	Pipe-Sweepolet	Sweepolet OD geometry
	4"	1-195-75-1A11	Sweepolet-Pipe	Sweepolet OD geometry
	4"	1407-77-1A	Sweepolet-Pipe	Sweepolet OD geometry
RHR-LPCI	16"	10AD-F1	Tee-Pipe	Tee OD geometry
	16"	10AD-F4	Elbow-Valve	Valve OD geometry
	16"	10AD-F5	Valve-Pipe	Valve OD geometry
	16"	10AD-F12	Pipe-Valve	Valve OD geometry
	16"	10AD-F13	Valve-Pipe	Valve OD geometry
	16"	10BD-F1	Tee-Pipe	Tee OD geometry
	16"	10BD-F5	Elbow-Valve	Valve OD geometry
	16"	10BD-F6	Valve-Pipe	Valve OD geometry
	16"	10BD-F15	Pipe-Valve	Valve OD geometry
	16"	10BD-F16	Valve-Pipe	Valve OD geometry
RHR-SDC	20"	10S-F1	Tee-Pipe	Tee OD geometry
	20"	10S-F5	Pipe-Valve	Valve OD geometry

Item 3.d.: Limitations of UT examination for each weld are tabulated in the following table:

System	Size	Weld I.D.	Weld Configuration	Limitation
Core Spray	10"	14A-F4ER	Pipe (Buttered)-Pipe	Adjacent sockolet weld on the downstream pipe side
	10"	14A-F6	Pipe-Valve	Valve OD geometry
	10"	14A-F7	Valve- Elbow	Valve OD geometry
	10"	14A-S18	Penetration-Elbow	Intradose region
	10"	14B-F7	Valve-Elbow	Valve OD geometry
	10"	14B-F12	Elbow-Valve	Valve OD geometry
	10"	14B-F13	Valve-Pipe	Valve OD geometry
	10"	14B-F16	Penetration-Pipe	Penetration OD geometry

Item 4.a: IHSI Treated Welds - A total of eight recirculation system welds which were IHSI treated in 1984, exhibited evidence of IGSCC-like indications in the UT examination performed at the Fall 1987 outage. These eight welds are identified and the location and extent of the flaw indications for each are detailed in the December 4, 1987 report (Section II-Inspection Results). Five of the joints identified in the table are 12 inch diameter shop welded joints. All five joints were observed to contain axial flaw indications during the 1987 UT examination and were repaired using a standard design weld overlay repair. THe other three remaining joints were large diameter (22 and 28 inch) welds. The presence of new IGSCC or growth of IGSCC in each of these welds following IHSI is discussed.

12 inch Diameter Riser Welds

All five 12 inch diameter welds identified as having IGSCC-like indications during the Fall 1987 outage contained only axial indications. Experience with IHSI treatment of laboratory and plant piping, as well as supporting analyses, indicates that IHSI should be effective for this size weld. A review of the NCR's for the Quad Cities Unit 1 treatment revealed no evidence of problems with the IHSI treatment of these joints. The IHSI treatment records were also reviewed for these joints and the treatments were well within the EPRI guidelines.

Review of the construction radiographs revealed very "wide welds (i.e. wide roots and crowns). The as-welded residual stress distributions from such welding practices are anticipated to be conducive to the initiation of axially-oriented IGSCC flaws. Additionally, other factors, such as the existence of the weld crown and the increased training requirements on UT examiners were considered. The evaluation of the limited number of axial flaws in all five welds and the existence of the weld reinforcement, leads to the conclusion that these axial flaws may have been "missed" in prior examinations.

Finally, the likelihood of postweld grinding in shop welds may create conditions where incipient IGSCC was present prior to IHSI and the IHSI process application in fact retarded crack growth.

Large Diameter Recirculation System Welds

A total of three large diameter recirculation system welds exhibited the presence of either new or growth of IGSCC-like indications during the 1987 UT examination. They include:

- 02B-F1, a 22 inch diameter valve-to-pipe weld;
- 02BS-85, a 28 inch diameter pipe-to-tee weld; and
- 02BS-S9, a 28 inch diameter pipe-to-elbow weld.

A review of the IHSI heat treatment records and the construction radiographs was performed as part of this investigation. The results of these reviews are presented as follows:

Radiograph Review-

A review of the original construction radiographs revealed that significant evidence of post weld ID grinding had occurred in each of the three welds examined. The 22 inch diameter joint, 02B-F1, appeared to be post weld ground over essentially the entire ID surface. Only slight evidence of the weld root or counterbore was present. This observation is somewhat surprising since this is a field weld where access to the ID is available only through the cross-tie valve.

The 28 inch diameter pipe to tee weld which exhibited IGSCC-like indications for the first time this outage, weld 02BS-S5, appeared to be heavily ID post weld ground. No evidence of weld root or counterbore was visible on the construction radiographs. This condition is not unexpected for this class of welds as ID access is readily available to large diameter shop welds following welding. These welds are often post weld ground in order to improve inspection quality of the construction radiographs and for preservice and inservice UT.

The third large diameter weld examined was the 28 inch pipe to elbow weld, weld 02BS-S9, which contained reported IGSCC prior to the IHSI treatment in 1984. This weld exhibited new indications during the Fall 1987 outage and increased length and depth of the prior indications. The construction radiograph review revealed extensive regions of post weld grinding, accompanying regions where the weld root and counterbore appeared to be unaffected. A more detailed review of the construction radiographs attempting to correlate the grinding with the IGSCC indications was attempted and is described below.

IHSI Record Review -

A review of the ISHI treatment records for the three large diameter welds indicated that one of the treatments was performed in a manner which was consistent with the EPRI guidelines, one weld appeared to be marginally treated due to coil and component configuration problems, and one joint was improperly heat treated due to insufficient heating coil length. The IHSI heat treatment results are summarized below for each of these welds. The IHSI heat treatment record for the pipe to cross tie valve (weld 02B-F1) revealed that the heating zone for the heat treatment was significantly less than that required for a successful heat treatment. This is due to the fact that the coil was centered over the joint to be treated and the heat treatment was performed so as to minimize heating of the cast stainless steel valve side of the joint. Consequently, approximately one-half of the coil was shorted out (on the valve side) during the heat treatment. This reduced heating zone and coil length produces a less effective IHSI treatment. Whereas all other IHSI treatment parameters appeared to meet the EPRI guidelines, the reduced heating zone length undermined the IHSI effectiveness for this joint.

Review of the IHSI heat treatment record for the pipe to tee joint (weld 02BS-S5), indicate that the heat treatment was extremely difficult to perform successfully due to the configuration of the tee in the vicinity of the joint, the significant differences in thickness between the tee and the pipe, and the decision of the IHSI contractor to center the coil over the joint. Consequently, the weld only barely achieved the minimum acceptable temperature for successful heat treatment, even assuming high flow velocity in the line. Consequently, it is believed that this joint, which meeting the EPRI guidelines, may be a marginally heat treated joint, from a crack initiation prevention perspective. However, the IHSI process application was performed in a manner which has been demonstrated to be beneficial in retarding crack growth.

A review of the IHSI heat treatment records for the 28 inch diameter pipe to elbow joint, weld 02BS-S9, indicates that the IHSI treatment was performed without incident and appears to be within the EPRI guidelines for a successful IHSI treatment. Based upon this heat treatment records review, this joint appears to have received a successful heat treatment. The intermittent post weld grinding of weld 02BS-S9, combined with the UT reports of pre and post IHSI cracking in this joint, prompted and attempt to correlate the observed IGSCC-like UT calls with grinding locations in the joint. The correlation revealed that all new indications observed in the current 1987 inspections have occurred in post weld ground regions, with one small possible exception, whereas the UT indications identified prior to the IHSI treatment in 1984, occurred in regions where root and counterbore are present. The excellent correlation of the new UT IGSCC-like indications with the grinding locations supports the hypothesis that the IHSI treatment residual stress and surface abuse caused by post weld grinding.

Item 4.b. <u>Weld Overlay Repaired Welds</u>

The details of the weld overlay examinations, the comparisons of the current examinations (three) with those performed in 1985 and the resolution of any flaws were addressed in detail on pages 13 and 14 of the December 4, 1987 report transmitted to the NRC. No additional information is available.

Item 5: The assumed flaw in the finite element model (figure 5.3-1) is on the pipe side of the original weld. Please refer to revision 1 of the attached NUTECH's report, item 3.3 page 3.4, for additional details.

Item 6: The corrections in Table 5.2-1 and 5.2-2 result in Weld 02G-S3 having a final overlay repair thickness slightly below a NUREG-0313, Revision 2 "standard" overlay thickness. As shown in attached NUTECH Drawing CECO73.0133 and its associated Weld Overlay Data Sheet, the surface conditioning grinding of Weld 02G-S3 resulted in a final overlay thickness (0.229") below NUTECH's requested full-structural (standard) thickness (0.24"). Due to the heavy outage duration pressures caused by unplanned overlays during the Quad Cities Unit 1 1987 outage, this overlay was left as-is eventhough it was clearly below NUTECH's requested design thickness. During the rush to support an expedited final report submittal date, the data entry errors made in Tables 5.2-1 and 5.2-2 hid the fact that Weld 02G-S3 did not meet "standard" overlay criteria.

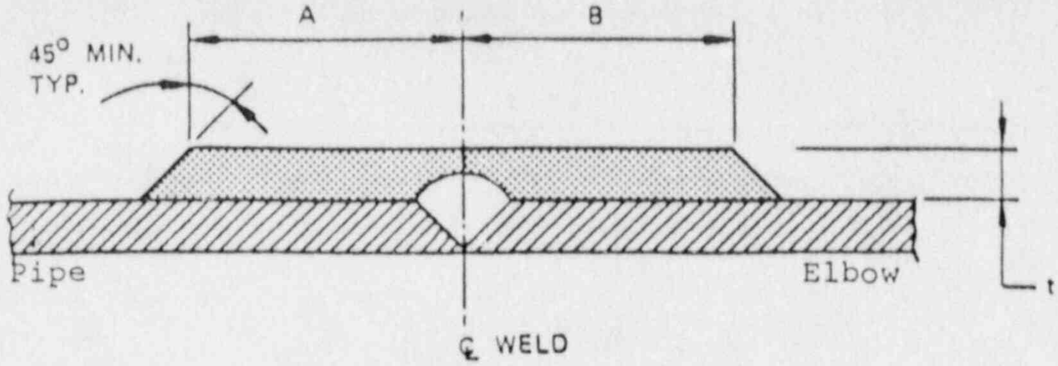
As stated in Section 5.2 of the revised flaw disposition report, the decision to leave the overlay is appropriate for the following reasons:

a. The predicted flaw depth ratio of 0.77 can be shown to meet "standard overlay repair thickness criteria using the alternate flaw evaluation requirements of ASME Section XI Paragraph IWV-3642,

b. Because only 0.03" of additional thickness is required to meet the arbitrary maximum allowable flaw depth ratio of 0.75 in Table IWB-3641-1, the man-REM exposure that would be expended to build up, surface condition, and reinspect the overlay cannot be justified, and

c. Because the predicted flaw depth ratio is based upon the assumption that an IGSCC indication could eventually propagate through the 0.15" thick low delta ferrite first layer, but actual observed circumferential flaws have not been detected in the outer 25% of the original pipe wall and axial flaws have not been detected in the overlay, the inspection frequency associated with a "standard" overlay in NUREG-0313, Revision 2 Category E is sufficient.

It should also be noted that NUTECH's requested design thickness for weld 02G-S3 of 0.24" provides a "standard" thickness over a low delta ferrite first layer with a "normal" average thickness of 0.10" instead of the actual first layer thickness of 0.15". As demomnstrated by the first layer thicknesses for Welds 02C-S4, 02F-S4, and 02B-S7 in Table 5.2-1, 0.10" is a reasonable assumption for a first layer thickness, but did not provide for a conservative "standard" thickness for Weld 02G-S3 in spite of the 0.229" thickness provided by the welding contractor.



WELD OVERLAY REPAIR DETAILS

U. S. Patent
Number 4,624,402

WELD NUMBER	FLAW CHARACTERIZATION	DESIGN DIMENSIONS			COMMENTS
		t	A	B	
02G-S3	100% x 360°	0.24"	2.0"	2.0"	Full structural weld overlay

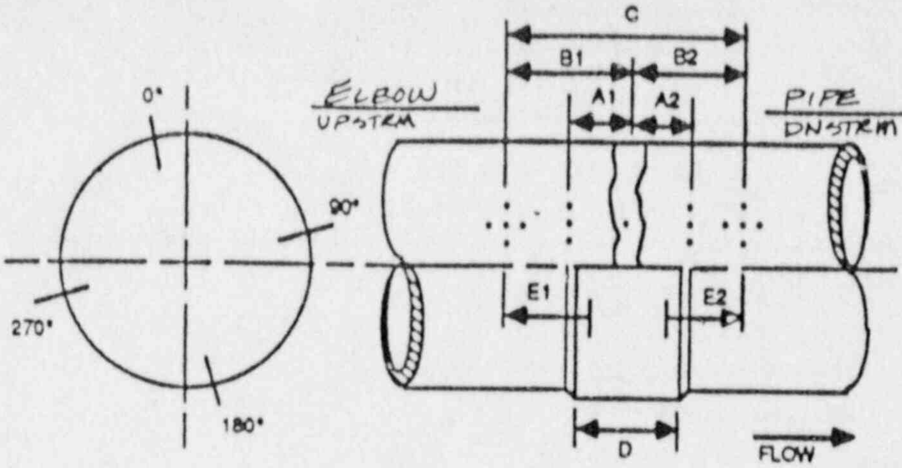
REV.	PREP. BY/ DATE	CHK. BY/ DATE	P.E. APPR./ DATE	E.M. APPR./ DATE	P.M. APPR./ DATE	DESCRIPTION
0	PAEK/ 3-30-87	NGC 4/2/87	NGC 4/2/87	CHJ 4/3/87	CHJ 4/3/87	Initial Issue

JOB NO: CEC-73	PLANT: Quad Cities 1	nutech	SHT. 1	REV. 0
FILE NO: CEC-73.0133	DWG. NO: CEC-73-133		OF 1	

WELD OVERLAY DATA SHEET REV. 1

026-53
WELD NO.

Q57176
WORK REQUEST NO.



Record Calibrated Measuring Instrument Number (s) for shrinkage:	
BEFORE OVERLAY	AFTER OVERLAY
N/A	N/A

Define 0° location: AWAY FROM REACTOR
90° = RIGHT WHEN FACING RX.

E1	E2
1.75	1.75

Record Calibrated Instrument Numbers for Thickness Measurements:	
BEFORE OVERLAY	N/A
AFTER FIRST LAYER	N/A
AFTER OVERLAY	DM-2 121541

NOTES

1. Azimuths are read clockwise looking in direction of flow.
2. Layer Thickness = Total Thickness - Pipe Wall Thickness
3. C = Shrinkage measurement taken after punchmarks are located on pipe. "C" does not equal B1 + B2 for curved segments.
4. D = Width of overlay at design thickness.
5. E1 & E2 should be to a point approximately 1/2" inboard of overlay shoulder.

DELTA FERRITE	MEASUREMENTS			AVERAGE
AFTER FIRST OVERLAY LAYER			[illegible]	11/3/87
DELTA FERRITE INSTR. NUMBER				

DATA IS FROM ORIGINAL OVERLAY DATA SHEET.
NOTE: 1ST LAYER OF ORIGINAL OVERLAY FAILED THE DELTA FERRITE CRITERIA. [initials] 11/3/87

		THICKNESS UPSTRM	THICKNESS DWNSTRM
AFTER FIRST OVERLAY LAYER	0	0.825	0.768
	90	0.833	0.749
	180	0.802	0.751
	270	0.827	0.757

		A1	A2	B1	B2	C	D	ELBOW THICKNESS UPSTRM	PIPE THICKNESS DWNSTRM
DESIGN DIMENSIONS		N/A	N/A	N/A	N/A		N/A	0.24	0.24
BEFORE OVERLAY	0	N/A	N/A	N/A	N/A	N/A		0.689	0.606
	90	N/A	N/A	N/A	N/A	N/A		0.687	0.606
	180	N/A	N/A	N/A	N/A	N/A		0.664	0.604
	270	N/A	N/A	N/A	N/A	N/A		0.706	0.608
AFTER OVERLAY	0					N/A	N/A	1.054	0.994
	90					N/A	N/A	1.125	0.987
	180					N/A	N/A	1.145	0.996
	270					N/A	N/A	1.058	0.965

AVERAGE SHRINKAGE	N/A

AVERAGE THICKNESS	0.251

AVERAGE THICKNESS UPSTRM	AVERAGE THICKNESS DWNSTRM
0.274	0.229

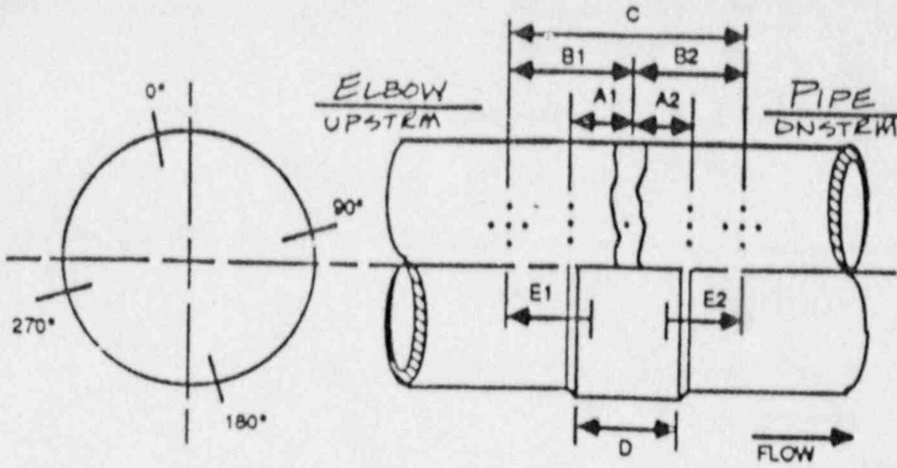
SEE WELD OVERLAY DATA SHEET REV. 0, FOR ALL INFO NOT SHOWN. [initials] 11/3/87

WELD OVERLAY DATA SHEET

Rev. 0

02G-53
WELD NO.

Q57176
WORK REQUEST NO.



Record Calibrated Measuring Instrument Number (s) for shrinkage:	
BEFORE OVERLAY	AFTER OVERLAY
045123Q	045119Q

Define 0° location: AWAY FROM Rx
90° = RIGHT WHEN FACING Rx

E1	E2
1.75	1.75

Record Calibrated Instrument Numbers for Thickness Measurements:	
BEFORE OVERLAY	N/A
AFTER FIRST LAYER	DM-2 121541
AFTER OVERLAY	121541 DM-2

NOTES

1. Azimuths are read clockwise looking in direction of flow.
2. Layer Thickness = Total Thickness - Pipe Wall Thickness
3. C = Shrinkage measurement taken after punchmarks are located on pipe. "C" does not equal B1 + B2 for curved segments.
4. D = Width of overlay at design thickness.
5. E1 & E2 should be to a point approximately 1/2" inboard of overlay shoulder.

DELTA FERRITE	MEASUREMENTS			AVERAGE
AFTER FIRST OVERLAY LAYER	N/A HWW 11/3/87			
DELTA FERRITE INSTR. NUMBER				

DATA IS FROM ORIGINAL OVERLAY DATA SHEET. NOTE: 1ST LAYER OF ORIGINAL OVERLAY FAILED DELTA FERRITE. HWW 11/3/87

		THICKNESS UPSTRM	THICKNESS DWNSTRM
AFTER FIRST OVERLAY LAYER	0	0.825	0.768
	90	0.833	0.749
	180	0.802	0.751
	270	0.827	0.757

DESIGN DIMENSIONS		A1	A2	B1	B2	C	D	ELBOW THICKNESS UPSTRM	PIPE THICKNESS DWNSTRM
		2.24	2.24	3.24	3.24		4.0	0.24	0.24
BEFORE OVERLAY	0	2.458	2.422	3.472	3.439	6.637		.689	.606
	90	2.425	2.428	3.407	3.431	6.560		.687	.606
	180	2.421	2.433	3.455	3.431	6.615		.664	.604
	270	2.424	2.459	3.433	3.435	6.632		.706	.608
AFTER OVERLAY	0					6.628	4.339	1.074	.995
	90					6.561	4.450	1.128	.979
	180					6.587	4.389	1.139	.985
	270					6.612	4.409	1.070	.976

AVERAGE SHRINKAGE	0.014 *

AVERAGE THICKNESS	.396

AVERAGE THICKNESS UPSTRM	AVERAGE THICKNESS DWNSTRM
.416 **	.377 **

* DUE TO 1987 OVERLAY

** See Weld Overlay Data Sheet, Rev. 1

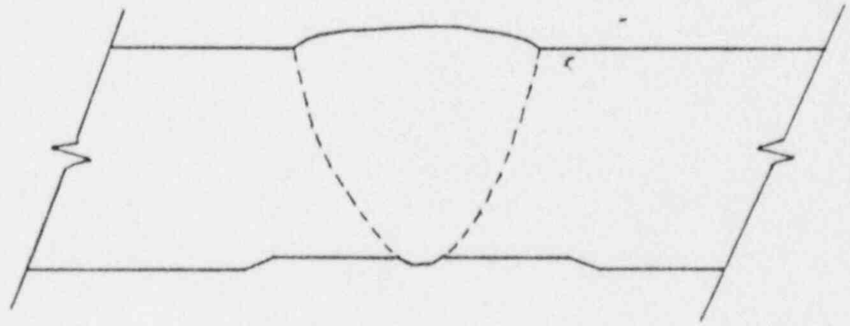
ADDITIONAL GRINDING REQ'D SEE MAINT/MOD. PROCEDURE REV. 1. HWW 11/3/87

CEC-D87.01M

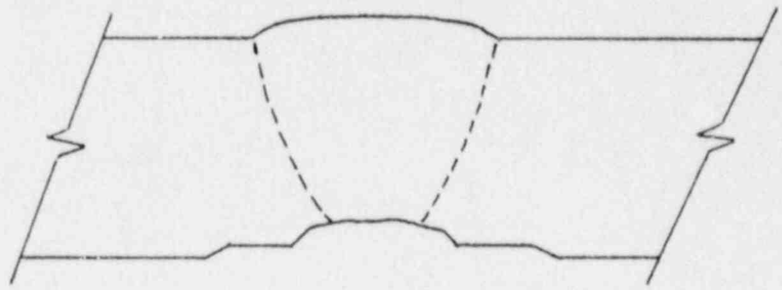
Item 7: In 1983 and 1984, the manual ultrasonic (UT) examination of some large diameter shop welds in the recirculation system at both Dresden Unit 3 and Quad Cities Units 1 and 2 revealed UT signals which were interpreted as intergranular stress corrosion cracking (IGSCC). The flaw characterizations associated with these signals were relatively long circumferential flaws with depths of 10 to 20% through-wall. In order to evaluate these UT reflectors, the "ID creeping wave" technique was used. This technique did not confirm the presence of IGSCC in several of these weldments. In order to resolve the apparent disagreement, metallurgical plug samples (approximately 1-1/4 inch diameter) were removed from the welds and metallographically examined. The inside surface of these weldments were visually examined using a boroscope and radiographed prior to being repaired. These additional examinations confirmed that there was no IGSCC present.

The metallographic examinations did reveal though that the welds were "backwelded," that is root of the weld was welded from the inside of the pipe. The fabrication sequences is illustrated as follows:

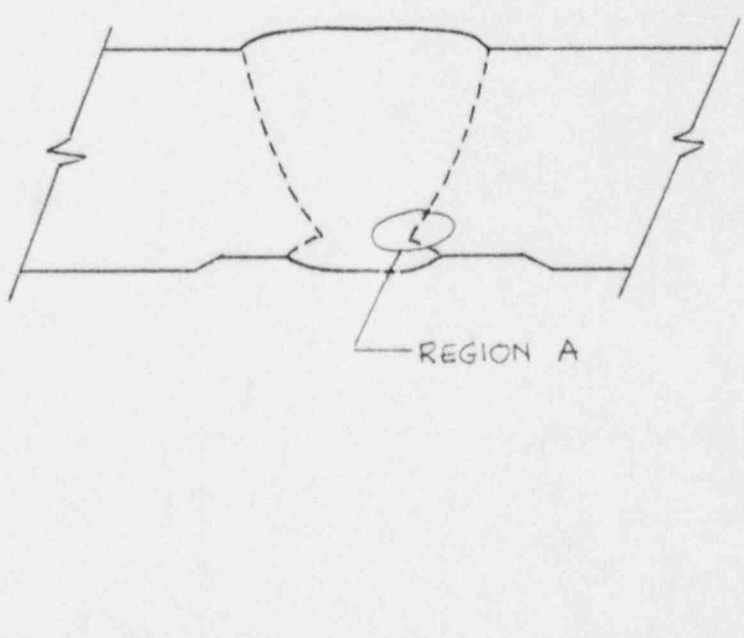
- The weld joint was fit-up and welded in the normal manner from the outside of the component.



- The weld root was excavated from the component ID.



- The excavation was then re-welded from the inside and ground in preparation for examination.



The "corner" created in Region A of the above sketch provides the conditions necessary to produce an ultrasonic reflector or signal (similar to a crack tip) in a region of the weldment (heat affected zone) where IGSCC is commonly seen during typical shear wave examinations.

Since 1983, ultrasonic examinations have continued to identify the signals from welds believed to have this geometric condition. No significant changes have been observed in the large majority of these weldments, thereby evidencing the geometric nature of the ultrasonic signals. Recent automated ultrasonic examinations have evaluated the signals from these locations as geometric reflectors.