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December 17, 1990

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTN: Document Control Desk

Subject: Dresden Nuclear Power Station Unit 2
Report on IGSCC Inspections during
the Fall 1990 Refueling Outage
NRC Docket No. 50-237

- References:
- (a) M. Richter (CECo) letter to T. Murley (NRC), dated September 17, 1990.
 - (b) Conference Call on November 9, 1990 between CECo (M. Richter et al.) and NRR (B. Siegel, W. Koo).
 - (c) Conference Call on November 19, 1990 between CECo (M. Richter et al.), NRR (B. Siegel, W. Koo) and Region III (J. Schapker).
 - (d) Conference Call on November 27, 1990 between CECo (M. Richter et al.), NRR (B. Siegel, W. Koo) and Region III (D. Danielson, J. Schapker).

Dr. Murley:

Reference (a) presented the Dresden Unit 2 Fall 1990 refueling outage (D2R12) inspection plan for piping susceptible to intergranular stress corrosion cracking (IGSCC). The purpose of this letter is to transmit the results of the ultrasonic examinations performed during the outage, and the design and evaluation criteria for the weld overlay repairs which were applied during the outage.

A total of one hundred sixty-six (166) welds were ultrasonically examined during the Unit 2 Fall 1990 refueling outage, an increase from the total presented in the inspection plan which was submitted by Reference (a). During the course of the examinations, four (4) welds with new IGSCC indications were identified. These welds were located in the Reactor Recirculation System and Shutdown Cooling System piping. The new IGSCC indications, and the resultant examination sample expansions, were discussed with your staff in References (b), (c) and (d). Attachment 'A' summarizes the results of the examinations and the weld overlay repair activities which were performed during the refueling outage. Additionally, Attachment 'A' addresses the surface indications identified on three (3) forged elbows in the Reactor Recirculation System.

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Attachment 'B' to this letter presents the design and evaluation criteria for the nineteen (19) weld overlay repairs which were applied during the outage. A final design report will be submitted which will provide as-built weld overlay dimensions and the disposition of any flaw indications in the weld overlays. It is expected that this final design report will be submitted within thirty (30) days after completion of the current Unit 2 refueling outage.

Please contact this office should further information be required.

Respectfully,



M.H. Richter
Nuclear Licensing Administrator

Attachments: A - Ultrasonic Examination of IGSCC
Susceptible Stainless Steel Weldments
Dresden Unit 2 - Fall 1990 Refueling
Outage (D2R12).

B - Design and Evaluation Criteria for
Weld Overlay Repairs at the Dresden
Nuclear Power Plant Unit 2 (1990 Outage).

cc: A.B. Davis - Regional Administrator, Region III
B.L. Siegel - NRR Project Manager
W.H. Koo - NRR Materials and Chemical Engineering Branch
D.E. Hills - Senior Resident Inspector, Dresden

MR:lmw
ZNLD652/5

ATTACHMENT A

ULTRASONIC EXAMINATION OF

IGSCC SUSCEPTIBLE STAINLESS STEEL WELDMENTS

DRESDEN UNIT 2 - FALL 1990 REFUELING OUTAGE (D2R12)

ATTACHMENT A

ULTRASONIC EXAMINATION OF IGSCC SUSCEPTIBLE STAINLESS STEEL WELDMENTS DRESDEN UNIT 2 - FALL 1990 REFUELING OUTAGE (D2R12)

INTRODUCTION

This attachment summarizes the results of the ultrasonic testing (UT) which was performed on Intergranular Stress Corrosion Cracking (IGSCC) susceptible stainless steel weldments during the Dresden Unit 2 Fall 1990 refueling outage (D2R12).

In addition, this attachment provides a description of the surface indications found on three 28" Recirculation system forged elbows.

EXAMINATION SCOPE

There is a total population of two hundred and ninety-six (296) welds at Dresden Unit 2 that are governed by Generic Letter 88-01 and NUREG-0313, Revision 2. Of those, two hundred and thirty-two (232) welds are considered to be susceptible to IGSCC (Non-category "A" weldments).

The original IGSCC inspection plan for D2R12 (submitted by M. Richter letter to T. Murley, dated September 17, 1990) committed to inspect one hundred and thirteen (113) welds.

During the course of the current refueling outage (D2R12) examinations, new flaw indications were detected in four (4) category "D" welds. The inspection sample for the category "D" welds was expanded, on three (3) separate occasions, to include the entire weld population in the category. These sample expansions were discussed with NRR on each occasion (teleconferences on November 9, 19, and 27, 1990).

As shown in Table 1, a total of one hundred and sixty-six (166) welds were ultrasonically examined during the current Dresden Unit 2 refueling outage (D2R12). The final inspection scope included:

- o Two (2) category "A" welds.
- o Fifty-three (53) category "C" welds.
- o All eighty-seven (87) category "D" welds.

- o All eighteen (18) category "F" welds: eleven (11) leak barrier weld overlay repairs which were built-up to standard overlay repairs during the current refueling outage; one (1) standard overlay repair which received local repairs during the current refueling outage; five (5) standard overlay repairs not inspected in the 1988 refueling outage (D2R11); and one (1) unrepaired flawed weld.
- o All six (6) accessible category "G" welds.

Lambert, MacGill, and Thomas, Inc. (LMT) performed the ultrasonic examinations using level II and III examiners qualified by EPRI after September 10, 1985. The manual UT technique was predominantly used for piping welds, while the automated UT technique was predominantly used for the overlay repaired welds.

RESULTS

1. Summary of Welds With New Reportable IGSCC Indications

Reportable IGSCC indications were identified for the first time in four (4) category "D" welds this outage. Three (3) of the new welds with IGSCC indications are in the 28" Recirculation system piping and one (1) weld is in the 16" Shutdown Cooling system piping.

a/ PS1A-D5 (28" Recirc, Elbow-to-Pipe, Category D)

1990	Axial	0.70"L x 14%TW	Elbow side
Manual			

b/ 202-5A/PD1B (28" Recirc, Pipe-to-Valve, Category D)

1990	Axial	0.75"L x 40%TW	Pipe side
Manual	Axial	0.50"L x 22%TW	Pipe side
	Circ (above 2 axials associated with this circ)	6"L x 26%TW	Pipe Side
	Circ with small axial tail	1.50"L x 20%TW	Pipe side

c/ PS2A/202-1B (28" Recirc, Pipe-to-Elbow, Category D)

1990	Circ	3.50"L x 20% Max TW	Pipe side
Manual	Circ	2.50"L x 10% Max TW	Pipe side
	Circ	1.00"L x 10% Max TW	Pipe side

d/ 16-8 (16" Shutdown Cooling, Tee-to-Elbow, Category D)

1990	Circ with 2 thru-	15.75"L x 34%TW pre-	Elbow side
Manual	wall leaks	dominantly, extending	
		to 100% at 2 leaks	
	Circ	3.50"L x 17%TW	Elbow side

2. Unrepaired Flawed Weld Examination

PD1A-D14 (28" Recirc, Elbow-to-Pipe, Category F)

Weld PD1A-D14 had been inspected during the two (2) previous outages (D2R10/1986 and D2R11/1988) and reported as containing a circumferential IGSCC indication. The previous inspections revealed that this flaw indication exhibited no significant change. This flaw indication had been evaluated by Commonwealth Edison Company (CECo) Engineering and approved for continued operation without repair.

Re-examination performed during the current outage (1990) showed no significant change in the characteristics of the circumferential flaw, therefore, no repair to the weld was performed.

1986	Circ	1.00"L x 8%TW	Pipe side
Manual			
1988	Circ	1.00"L x 10%TW	Pipe side
Manual	Also root, counterbore, and ID geometry for 360° intermittent		
1990	Circ	1.00"L x 11%TW	Pipe side
Manual	Root Geometry at 100% DAC		Pipe side
	Root Geometry at 80% DAC		Elbow side

3. Weld Overlay Activities

Four (4) new overlay repairs were applied to four (4) welds with new IGSCC during this outage (D2R12). They are:

PS1A-D5	-	Design overlay
202-5A/PD1B	-	Standard overlay
PS2A/202-1B	-	Design overlay (stress improvement)
16-8	-	Standard overlay

Eleven (11) weld overlay repairs applied during the Dresden Unit 2 1988 outage (D2R11) were built-up to "standard" overlays this outage (D2R12). They are:

PD1-D16	PD9-D7
PD1/L2	L5-D3
PD5-D21	8-K12
PD6-D18	8-K14
PD8-D9	8-K16
PD8-D10	

One (1) weld which received a standard weld overlay repair during the Dresden Unit 2 1988 outage (D2R11) had a number of overlay fabrication defects repaired followed by a GTAW machine layer during the current Dresden Unit 2 1990 outage (D2R12). Note that five (5) lack-of-bonding areas were not excavated and repaired because they were within the Section XI acceptance criteria. The weld overlay repair is:

PD5-D20

Three (3) standard overlay repairs were applied to three (3) unflawed welds in anticipation of future IGSCC and/or to act as "load leveling" repairs. They are:

8-16	
PD1-D15	- Load leveling
PD6-D19	- Load leveling

All of the aforementioned weld overlay repairs received a new baseline UT during this outage (D2R12) by EPRI qualified examiners. These welds will now be classified as category "E" weldments in the IGSCC examination program (shown on Table 2).

Attachment B of this report contains detailed design information for the weld overlay repairs discussed above.

4. Examination Limitation On Overlay Repair Of Weld 16-8

A standard overlay repair was applied to weld 16-8 (16" Shutdown Cooling Tee-to-Elbow weld) because of IGSCC found in the weld's heat affected zone (elbow side) during this outage (D2R12).

The overlay design thickness is 0.31". The overlay design width on the elbow side is 2.5". Because of local repair(s) and subsequent additional layer(s) of overlay material, the as-built overlay thickness after surface preparation was up to 0.6" while the overlay width on the elbow side remained at approximately 2.5".

In the as-built weld overlay configuration, a baseline UT in two directions covering all of the affected weld overlay

material and all of the upper 25% of the affected base material is not possible. On the "Tee" side of the weld, a baseline UT which covered 100% of the affected weld overlay material and the upper 25% of the affected base material could only be performed in one (1) direction (toward the Tee) due to the physical piping configuration. On the elbow side of the weld, a baseline UT which covered approximately 100% of the affected weld overlay material could be performed in two (2) directions. However, the upper 25% of the affected base material could only be examined for up to 50% of the weld circumference (in two (2) directions) due to the as-built weld overlay configuration.

CECo believes that crack growth into the overlay material can be effectively monitored and, therefore, has no plans to modify the existing weld overlay configuration.

5. Surface Indications on Recirculation 28" Elbows

During the current Dresden Unit 2 outage (D2R12), penetrant testing (PT) of weld PS1A-D5 (forged elbow-to-pipe weld in 28" Recirculation loop "A" on the suction side of the pump) and portions of the attached forged elbow revealed numerous linear indications, oriented predominantly in the axial direction on the OD surface of the elbow. The PT performed on weld PS1A-D5 was to satisfy a Section XI examination requirement for a B-J weld. The PT of part of the attached forged elbow was in preparation for the application of the overlay repair, as indicated in section 3 of this attachment.

Because of surface indications detected on the "A" pump suction forged elbow, additional penetrant testing was performed on the "A" pump discharge forged elbow and on the "B" pump suction and discharge forged elbows. Surface indications were found on the "A" and "B" pump discharge forged elbows. These forged elbows were fabricated to ASTM A403 by forming and welding together two (2) plates of A240-Type 304 stainless steel. The nominal pipe dimensions are 28" OD and 1.113" minimum wall thickness.

The indications were on both the intrados and extrados of the bend throughout the length of the elbows. The indications were closely spaced and located primarily in groups, at a distance of greater than two (2) inches from the longitudinal welds. The maximum indication length was approximately 0.5". Many of the indications were relatively wide at the surface. Some evidence of grinding was apparent in the regions where the surface indications existed. UT of these regions on the "A" pump discharge forged elbow using 0° and 45° shear wave could not detect any flaws.

Two (2) boat samples were removed from the "A" pump suction forged elbow, and one (1) boat sample was removed from the "A" pump discharge forged elbow. The boat samples were

approximately 0.5" deep. They were removed from the areas that appeared to contain the deepest indications.

Metallographic examinations were performed on cross-sections through the deepest appearing indications on each boat sample. The defects in all three (3) boat samples had similar characteristics. All defects were relatively shallow and filled with a grayish oxide that appeared to be magnetite (Fe_3O_4), which is a high temperature oxide. All indications were angled relative to the surface. Several of the indications exhibited a small amount of intergranular oxidation. No evidence of stress corrosion cracking or service related crack propagation was observed in any of the cross-sections. The maximum depth of the surface defects measured 0.035" for boat sample #1, 0.025" for boat sample #2, and 0.025" for boat sample #3.

Based on the examinations of the boat samples, CECO Engineering concluded that:

- a/ the flaw indications found were original fabrication defects and not a result of a service induced phenomena;
- b/ the maximum flaw depths do not exceed acceptable code limits; and
- c/ the defects do not present a structural or operability problem, and as such, are not required to be removed.

The boat sample cavities were weld repaired flush to the original surface.

Table 1

**Ultrasonic Examination Scope
Dresden Unit 2 - Fall 1990 Refueling Outage**

SYSTEM	SIZE	TOTAL EXAM.	NUREG-0313 WELD CATEGORY						New Flaw
			A	C	D	E	F	G	
RECIRCULATION									
Outlets	28"	29	0	10	18	0	1	0	3
Noz-SE	28"	2	0	1	1	0	0	0	0
Header	22"	11	0	2	8	0	1	0	0
Risers	12"	24	0	4	11	0	9	0	0
Noz-SE	12"	7	0	4	3	0	0	0	0
Bypass	4"	21	0	0	19	0	0	2	0
RHR									
SDC	16"	8	2	0	6	0	0	0	1
LPCI	16"	5	0	0	5	0	0	0	0
ISOLATION CONDENSER									
Supply	14"	16	0	12	4	0	0	0	0
Supply	12"	17	0	15	0	0	0	2	0
Return	12"	0	0	0	0	0	0	0	0
HPCI SUPPLY	14"	2	0	0	0	0	0	2	0
CORE SPRAY	10"	0	0	0	0	0	0	0	0
JPI									
	12"	4	0	2	2	0	0	0	0
	8"	2	0	1	1	0	0	0	0
	4"	4	0	2	2	0	0	0	0
RWCU									
	8"	7	0	0	0	0	7	0	0
CRD BOTTOM	7.5"	0	0	0	0	0	0	0	0
PENETRATION CAP									
CRD	4"	6	0	0	6	0	0	0	0
N-18 A,B Noz.	6"	0	0	0	0	0	0	0	0
HEAD VENT	4"	1	0	0	1	0	0	0	0
TOTAL EXAMINATIONS		166	2	53	87	0	18	6	
TOTAL NEW FLAWS									4

TABLE 2
DRESDEN UNIT 2
GENERIC LETTER 88-01 INSPECTION PROGRAM
(After Fall 1990 Outage - D2R12)

SYSTEM	SIZE	TOTAL	CATEGORIES							REMARKS
			A	B	C	D	E	F	G	
RECIRCULATION										
Outlets	28"	31	2	0	10	15(1)	3	1	0	1 unrepaired weld in category F. 2 category E welds are unflawed - overlaid for load leveling (PD1-D15 and PD6-D19).
Noz-SE	28"	2	0	0	1	1	0	0	0	
Header	22"	20	8	0	2	8(1)	2	0	0	
Risers	12"	40	0	0	8	11	21	0	0	
Noz-SE	12"	10	0	0	7	3	0	0	0	
Bypass	4"	28	7	0	0	21	0	0	0	
RHR										
LPCI	16"	25	0	0	20	5	0	0	0	
SDC	16"	8	2	0	0	5	1	0	0	
ISOLATION CONDENSER										
Supply	14"	26	0	0	21	4	0	0	1	1 inaccessible category G weld. 2 inaccessible category G welds.
Supply	12"	17	0	0	15	2	0	0	0	
Return	12"	14	0	0	12	0	0	0	2	
HPCI STEAM SUPPLY	14"	2	0	0	0	2	0	0	0	
CORE SPRAY	10"	14	14	0	0	0	0	0	0	
JET PUMP INST.										
4"	4"	4	0	0	2	2	0	0	0	
8"	8"	2	0	0	1	1	0	0	0	
RWCU										1 inaccessible category G weld. 1 category E weld is unflawed - overlaid in anticipation of IGSCC (8-16).
8"	8"	28	17	0	0	0	10	0	1	
CRD BOTTOM PENETRATION CAP	7.5"	8	8	0	0	0	0	0	0	
CRD	4"	6	0	0	0	6	0	0	0	
N-18 A,B NOZZLES	6"	4	4	0	0	0	0	0	0	
HEAD VENT	4"	3	2	0	0	1	0	0	0	
POPULATION		296	64	0	101	89	37(2)	1	4	

NOTES:

(1) L2-D17 and L5-D6 are now classified as 22" category "D" welds. They were classified as 28" category "D" weld prior to D2R12.

(2) Includes the 19 welds which received weld overlay repairs during D2R12.