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December 6, 1999
NG-99-1716

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station 0-P1-17
Washington, D. C. 20555-0001

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Licensee Event Report #1999-006
File: A-120

Dear Sirs:

Please find attached the subject Licensee Event Report submitted in accordance with 10CFR50.73. There are no new commitments made in this letter.

Should you have any questions regarding this report, please contact this office.

Sincerely,

Richard L. Anderson

Richard L. Anderson
Plant Manager - Nuclear

cc: Mr. James Dyer
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60532

NRC Resident Inspector - DAEC
DOCU

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2NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(6-1998)

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Duane Arnold Energy Center	05000331	1 OF 5

TITLE (4)

Indications in Recirculation Riser Nozzle-to-Safe End Welds

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
11	05	1999	1999	- 006 -	00	12	06	1999	FACILITY NAME	DOCKET NUMBER

OPERATING	5
POWER LEVEL (10)	000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)(C)		Specify in Abstract below or in RC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Clara Rushworth, Licensing Engineer	(319) 851-7157

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

In November 1999, during refueling outage (RFO) 16 at the Duane Arnold Energy Center (DAEC), ultrasonic (UT) examinations identified indications in three recirculation riser nozzle-to-safe end welds (RRB-F002, RRD-F002 and RRF-F002). The indications in RRB-F002 and RRD-F002 were found to be indicative of intergranular stress corrosion cracking (IGSCC), while the indication reported in RRF-F002 was determined to be a flaw remaining from the 1978/1979 safe end replacement, not IGSCC.

Weld overlays were completed on RRB-F002 and RRD-F002. NRC authorization to use ASME Code Cases N-504-1 and N-606, as modified for an inconel overlay, was obtained for the repairs. The indication in RRF-F002 was evaluated under the ASME Code to be acceptable to leave as-is. This event had no effect on the safe operation of the plant.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Duane Arnold Energy Center	05000331	1999	- 006 -	00	2 OF 5

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. DESCRIPTION OF EVENT:

During refueling outage (RFO) 16 for the Duane Arnold Energy Center (DAEC), inspections of welds susceptible to intergranular stress corrosion cracking (IGSCC) identified flaw indications on three recirculation riser nozzle-to-safe end welds (RRB-F002, RRD-F002 and RRF-F002). The indications were identified while performing examinations using GE's SMART 2000 automated ultrasonic (UT) system with TOMOVIEW analysis software.

The original scope of examinations included three recirculation riser and one core spray nozzle-to-safe end welds. On November 5, 1999, at approximately 0830, two indications indicative of IGSCC were identified in weld RRB-F002 - one indication approximately 44% through wall and one approximately 65% through wall. The inspection scope was therefore expanded to include all of the remaining F002 recirculation riser nozzle-to-safe end welds, as well as the other similarly-designed core spray nozzle-to-safe end weld. One (at least 65% through wall) indication was identified in the RRD-F002 weld on November 9, 1999 at approximately 1030. On November 10, 1999 at approximately 1900, an indication was identified in weld RRF-F002. (This indication was later determined not to be due to IGSCC.)

Weld overlays using IGSCC-resistant Alloy 52 were completed on the B and D riser F002 welds. IES Utilities received authorization to use ASME Code Cases N-504-1 and N-606, as modified for an inconel overlay, to perform these repair activities (by NRC Safety Evaluation dated November 19, 1999). The repair was applied using machine Gas Tungsten Arc Welding (GTAW) technology.

As stated previously, an indication was identified in weld RRF-F002. The 1999 automated data was reviewed to confirm and further assess this flaw. Based on a review of the 1996 and 1999 automated data, it was determined that the weld crown geometry did not allow adequate access to disposition the indication. As a result, additional scans were performed after the weld had been ground flush.

The re-inspection of RRF-F002 showed that the flaw was subsurface with no connection to the inside or outside surface of the piping. Review of the 1978/1979 radiographs and repair records confirmed that this was likely a small area of internal incomplete fusion between weld beads, and not attributable to IGSCC. The flaw was evaluated under the ASME Code and determined to be acceptable to leave as-is due to the size and lack of exposure to the surface.

II. CAUSE OF EVENT

While the DAEC's investigation into the cause of the cracking is not yet complete, the IGSCC indications appear to be the result of welding quality problems that occurred when the eight recirculation inlet nozzle safe ends were replaced in 1978/1979 with redesigned safe ends and thermal sleeve adapters. F002 is the nozzle-to-safe end weld and consists of a low alloy nozzle, buttered with Inconel 182 weld metal, welded to an alloy 600 safe end. Records indicate that the welds were made with a combination of Inconel 82 and Inconel 182 weld metal.

During the safe end replacements in 1978/1979, the welders had difficulty making satisfactory inconel welds, resulting in numerous weld rejections and repairs. Lack of fusion was the leading cause of welds being rejected. The F002 weld on the N2B and N2D safe ends each required significant repairs. These welding problems appear to have resulted in a root pass which was significantly degraded in its resistance to IGSCC. The existence of lack of root pass fusion likely resulted in a crevice condition which would have allowed initiation of IGSCC. The areas of cracking seen in the RRB-F002 weld coincide with these repair areas. Weld RRD-F002 was completely filled out with Inconel 182, which is not resistant to IGSCC in Normal Water Chemistry (NWC), even if a crevice does not exist. (NWC existed at the DAEC prior to the implementation of Hydrogen Water Chemistry (HWC) in 1987.)

Also of note, a review of the safe end replacement records shows that there were disagreements involving the interpretation of the weld radiographs. Two main items in dispute involved root pass lack of fusion and root pass oxidation. The welds on the safe ends of the N2B and N2D nozzles were of particular concern. The final radiographs show areas of root pass lack of fusion and root pass oxidation in the areas coinciding with the IGSCC found in welds RRB-F002 and RRD-F002.

It therefore appears that weld quality problems which occurred during the safe end replacements in 1978/1979 created conditions favorable to IGSCC to initiate and propagate prior to the implementation of HWC in 1987.

Weld RRD-F002 was examined using an automated system in 1995, 1996, and 1999. Available data from these examinations were reviewed to further assess the indication. With knowledge of the presence of the flaw, the discontinuity can be seen in the 1995 examination. The flaw was present in the 1996 data, however during data acquisition (initial scanning), an incorrect offset input into the system appears to have resulted in an incorrect interpretation of the indication as a metallurgical reflector. Loading the 1996 data in the new GE analysis system resulted in being able to clearly define that the indication was the same one found in 1999. The base of the crack had not measurably grown from 1996 to 1999, indicating that the crack was arrested in the HWC environment.

The B riser weld was last inspected in 1992 with manual UT. Although weld root irregularities were reported, the exam did not show either of the indications reported in 1999. This is probably because dissimilar metal joints are difficult to examine with UT. The acoustic differences in the materials cause significant attenuation of the sound beam making any reflectors respond weakly at low amplitudes. Inconel material is particularly difficult for ultrasound transmission. The new GE TOMOVIEW system provides enhanced capabilities for data analysis especially in these types of conditions where the flaw response is small.

III. ANALYSIS OF EVENT

Although this LER reports a degraded plant condition, none of the indications were through-wall, there were no leaks, and therefore, there was no effect on the safe operation of the plant. As discussed in Bases Section 3.4.5, the Technical Specifications contain leakage rate limits well below the rates predicted for critical crack sizes. This ensures that leakage is detected, and actions are taken, before a significant break in the recirculation system could occur. There were no structures, systems, or components that were inoperable at the beginning of the event that contributed to the event.

IV. CORRECTIVE ACTIONS

As discussed previously, upon discovery of the indications in weld RRB-F002, the inspection scope was expanded to include all of the remaining F002 recirculation riser nozzle-to-safe end welds, as well as the other similarly-designed, core spray nozzle-to-safe end weld. Immediate corrective actions included weld overlays (RRB-F002 and RRD-F002) and evaluation in accordance with the ASME Code (RRF-F002).

A root cause evaluation was initiated, and assistance from a technical expert, as well as EPRI, was obtained. Records from the 1978/1979 safe end replacements were reviewed. The construction radiographs were digitized. Previous UT examination data were reviewed. As discussed previously, while the root cause evaluation is not yet complete, it is apparent that welding problems that occurred during the 1978/1979 safe end replacement contributed to the potential for IGSCC. If additional significant information regarding the root cause of the IGSCC is identified by the ongoing investigation, a supplement to this LER will be submitted.

V. ADDITIONAL INFORMATION

A. Previous Similar Events
LERs 85-010 and 78-030 reported indications in recirculation system welds.

B. EIIS System Code
AD Reactor Recirculation System

This report is being submitted pursuant to 10CFR50.73(a)(2)(ii).