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FPLEnergy.

Duane Arnold Energy Center

August 30, 2006

NG-06-0573

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Duane Arnold Energy Center
Docket 50-331
License No. DPR-49

Licensee Event Report #2006-003-00

Please find attached the subject Licensee Event Report (LER) submitted in accordance with 10 CFR 50.73. This letter contains no new NRC commitments.

Gary D. Van Middlesworth
Site Vice President, Duane Arnold Energy Center
FPL Energy Duane Arnold, LLC

cc: Administrator, Region III, USNRC
Project Manager, DAEC, USNRC
Resident Inspector, DAEC, USNRC

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose 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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Duane Arnold Energy Center	05000 331	1 OF 5

4. TITLE

Residual Heat Removal Service Water Pump Inoperability due to Motor Cooler Failures

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
06	30	2006	2006	- 3 -	0	08	30	2006	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

1

10. POWER LEVEL

100%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☑ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☑ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Robert J. Murrell Regulatory Affairs Engineering Analyst	(319) 851-7900

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

○ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ◉ NO

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

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

On June 30, 2006, while operating at 100% power, operators identified water in the upper sight glass of the "A" Residual Heat Removal Service Water (RHRSW) Pump, 1P-22A, Motor Oil Reservoir. An extent of condition review determined that the "B" and "C" RHRSW Pumps were also inoperable based on the same type and vintage motor cooler installed. As a result, 1P-22A, B, and C were declared inoperable. The inoperability of the three RHRSW pumps placed the plant in an 8 hour Technical Specification Limited Condition for Operation (LCO) to restore at least one pump in each train to operable status. The pump was restored prior to the expiration of the 8 hour LCO on July 1, 2006 with the restoration of the "C" RHRSW Pump. The cause of the motor cooling coil failures were determined to be erosion due to high Emergency Service Water (river water) flow through the copper coils of the motor coolers. This event resulted in the plant being in a condition that could have prevented the fulfillment of a safety function of a system that is needed to remove residual heat and therefore, is reportable under 10 CFR 50.73(a)(2)(v)(B).

There were no actual safety consequences and no effect on public health and safety as a result of this event.

I. Description of Event:

On June 30, 2006, while operating at 100% power, operators identified water in the upper sight glass of the "A" Residual Heat Removal Service Water (RHRSW) Pump, 1P-22A, Motor Oil Reservoir. After identification of the coil leak on the "A" RHRSW Pump Motor Cooler, Engineering completed Operability Recommendation, OPR000336, which requested a Condition Evaluation be performed for the 'A', 'B' and 'C' RHRSW pumps, based on conditions observed on the 'A' RHRSW pump (reference CAP042982 and CAP042987). The results of this OPR determined that the three RHRSW pumps were not assured of being able to perform their safety function for the required mission time of 30 days. The 'A' RHRSW pump motor cooling coil was confirmed to have a through wall leak, and the 'C' RHRSW pump motor cooling coil was observed to have significant wall thinning present. Based on those observations, the 'B' RHRSW pump was declared inoperable based on a likely common cause failure mechanism, due to common fabrication techniques used for all RHRSW pump motor cooling coils. The 'D' RHRSW pump remained Operable because its cooling coil was replaced approximately 1 month previously. As a result, 1P-22A, B, and C were declared inoperable. The inoperability of the three RHRSW pumps placed the plant in an 8 hour Technical Specification Limited Condition for Operation (LCO) to restore at least one pump in each train to operable status. The pump was restored prior to the expiration of the 8 hour LCO on July 1, 2006 with the restoration of the "C" RHRSW Pump. The cause of the motor cooling coil failures were determined to be erosion due to high Emergency Service Water (river water) flow through the copper coils of the motor coolers. This event resulted in the plant being in a condition that could have prevented the fulfillment of a safety function of a system that is needed to remove residual heat and therefore, is reportable under 10 CFR 50.73(a)(2)(v)(B).

There were no actual safety consequences and no effect on public health and safety as a result of this event.

II. Assessment of Safety Consequences:

The RHRSW system has the primary purpose to remove heat from the Residual Heat Removal (RHR) heat exchangers during shutdown cooling, containment cooling, and torus cooling modes of RHR. A secondary purpose is to provide a source of water for emergency injection into the Reactor Pressure Vessel or containment flooding if needed after a Loss Of Cooling Accident.

Because of these safety related RHRSW system functions, this condition is of nuclear safety significance. Both trains of the primary residual heat removal system were degraded simultaneously.

An increase in core damage frequency (CDF) for a loss of one RHRSW pump is approximately 1.1E-6/yr. The change in CDF for the loss of both RHRSW pumps in one train is near 3.8 E-4/yr. Loss of one RHRSW pump from each train is approximately 2.3 E-5 /yr. As a comparison for relative worth, a loss of an emergency diesel generator increases CDF approximately 4.7E-5.

Although three of the pumps were originally called inoperable, subsequent analysis has determined that the "C" RHRSW pump remained operable. Additionally, each of the pumps, except while undergoing maintenance, was maintained in an available status and no Emergency Core Cooling Systems were degraded. While each of these items lessens the safety significance of the condition, the condition still

caused an increase of 2.3 E-5/yr. in CDF due to the loss of one RHRSW pump from each train for about one day.

III. Cause of Event:

The Root Cause Evaluation performed for this event determined the cause of the motor cooling coil leaks to be erosion due to high Emergency Service Water (ESW) flow through the copper coils. High flow through the coils has historically been an issue due to the fact that the supply to coils comes immediately off of the ESW pump discharge. This condition was originally countered by having the flow through the RHRSW motor cooling coils throttled at the cooler discharge valves. In 1995 the line-up of the "B" train cooler discharge valves was changed to have the valves full open. About 2½ years after this first valve line-up change, in late 1997, the first motor cooler leak occurred and all the coolers were replaced. The root cause at that time stressed erosion/corrosion at a coupling in the middle of the cooling coil and not the underlying high flow cause.

A second valve line-up change in 1998 fully opened the "A" Train RHRSW motor cooler valves.

Erosion was again identified as causing leaks in the connecting nipples of the cooling coils in 2003 when the "C" pump had emulsified oil in the upper bearing reservoir. All nipples were subsequently replaced but the high flow condition went unaddressed.

In 2005, a root cause evaluation (RCE 1029) did address high flow through copper heat exchangers following a leak in 1VAC021, a condenser bay air conditioning unit. RCE 1029, as part of extent of condition review, evaluated all coolers in the General Service Water, ESW, & Well Water systems, with the exception of the RHRSW pump and Core Spray pump motor coolers. This omission was presumably due to the evaluation's emphasis on room coolers and because the motor coolers are integral to their motors and do not have separate equipment designations.

In May of 2006, the apparent cause evaluation (ACE 1627) of a leak in the "D" RHRSW pump motor cooler did identify the high flow condition through the copper cooling coils of these particular heat exchangers, but was not completed in time to initiate actions to prevent the subsequent leak in the "A" RHRSW pump motor cooler.

This current root cause evaluation identified the latent error of fully opening the discharge valves on the coolers, which has allowed accelerated erosion in the coolers for years.

Conclusions:

The excessive ESW flow through the RHRSW pump motor coolers caused the degradation and subsequent leaks in the coolers. This high flow was the cause in 1997 when the "B" motor cooler first exhibited a leak, it was the case with a leak in a nipple on "C" motor cooler in 2003, and was again the case in 2006 with "D" and "A" motor coolers.

As stated above, the root cause of the cooling coil failures is erosion due to high ESW flow through the copper coil. Three causal factors allowed this to occur:

1) Lack of rigor in procedure changes in 1995 & 1998 allowed flow in excess of the manufacturer's recommendations. These changes of coil flow from an outlet valve position of "throttled" to "open" was made without reference to vendor's recommendation of 2 gpm maximum.

2) Inherent weakness of copper cooling coil design with river water as cooling medium. The copper coil would fail at some point even without flow as high as was present in the RHRSW pump motor coolers.

3) Past failure analysis failed to identify and correct the high flow conditions in these coolers.

IV. Corrective Actions:

Event Report # 42680 was generated based on 3 out of 4 RHRSW pumps being inoperable, which represented a condition that could have prevented fulfillment of a safety function. This was an 8 hour reportable event per 10CFR50.72(b)(3)(v)(B).

On July 1, 2006, 1P-22C was declared operable after completion of repairs under Work Order A79319.

On July 1, 2006, 1P-22B was declared operable after completion of repairs under Work Order A79320.

On July 7, 2006, 1P-22A was declared operable after completion of repairs under Work Orders A79240 and A79007.

Completed RCE 1053, RHRSW Pump Motor Cooler Inoperabilities, on August 18, 2006. As part of this RCE, an extent of condition assessment was performed. This assessment determined that copper cooling coils at DAEC for systems other than RHRSW and Core Spray had previously been addressed by the 2005 RCE (RCE 1029). Core Spray motor coolers were determined to be potentially subject to the same failure mechanism as the RHRSW motor coolers, however, no current operability concerns exist due to the following:

1. The supply to the Core Spray motor coolers is substantially downstream and the return is to the ESW return line. This arrangement provides for significantly less flow, due to the length of the pipe runs involved and the low differential pressure across the cooler.

2. The ESW supply line flow sight glass to the Core Spray pump motors indicates relatively low flow conditions.

Causal Factor Corrective Action:

The first and third causal factors are being addressed by ongoing actions within engineering and the Corrective Action Program (CAP) at DAEC. Root cause training has been improved and Performance Assessment Review Board (PARB) review added to the RCE process within the CAP. Additionally, engineering has implemented programs and guidelines such as pre-job briefs, Quality Review Teams, peer reviews, and product quality reviews, to improve human performance. These actions help ensure the quality of both the corrective action and engineering processes.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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

Other Causal Factor Corrective Actions:

Causal Factor 1: The Action Request (AR) procedure is also being revised to require the writing of an AR to evaluate differences between vendor recommendations and operating practices when they are identified (CA 43836, Due 9/22/06).

Causal Factor 2: The RHRSW pump motor coolers are being redesigned with controlled flow and stronger material (CA 43569 to develop a modification, Due 10/06/06). As an interim corrective action, the flow through the existing coolers will be throttled (CA 43798, Due 10/18/06). The Core Spray pump motor coolers are also being replaced and evaluated for erosion (CA 43837, Due 04/30/07).

V. Additional Information:

Previous Similar Occurrences:

A review of LERs at the DAEC over the last 3 years identified no LERs with similar events.

EIIS System and Component Codes:

BI - Essential Service Water System

Reporting Requirements:

This report is being submitted under 10 CFR 50.73(a)(2)(v)(B).