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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit - 1
Docket No. 50-313
License No. DPR-51
Licensee Event Report 50-313/2000-002-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(i)(B), enclosed is the subject report concerning the Low Pressure Injection/Decay Heat Removal pumps.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/rhs

enclosure

IE22

cc: Mr. Ellis W. Merschoff
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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Arkansas Nuclear One - Unit 1	05000313	1 of 5

TITLE (4) Both Low Pressure Injection/Decay Heat Removal Pumps Potentially Rendered Inoperable As A Result Of An Inadequate Design Which Failed To Consider Critical Cooling Water Parameters and Bearing Tolerances

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
02	05	2000	2000	002	00	03	06	2000	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11)							
POWER LEVEL (10)	0.00		20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)
			20.405(a)(1)(i)		50.36(c)(1)	X	50.73(a)(2)(v)		73.71(c)
			20.405(a)(1)(ii)		50.36(c)(2)	X	50.73(a)(2)(vii)		OTHER
			20.405(a)(1)(iii)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		Specify in
			20.405(a)(1)(iv)	X	50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)		Abstract Below
			20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)		and in Text

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Richard H. Scheide, Nuclear Safety and Licensing Specialist	501-858-4618

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
B	BP	P	B010	Y						

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED	MONTH	DAY	YEAR
	YES		NO	SUBMISSION			
X	(If yes, complete EXPECTED SUBMISSION DATE)			DATE (15)	05	15	2000

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

On February 5, 2000, during a normal reactor shutdown, Low Pressure Injection/Decay Heat Removal pump P-34A was started in anticipation of placing the Reactor Coolant System (RCS) on shutdown cooling to allow securing the Reactor Coolant Pumps (RCPs) and proceeding to cold shutdown. Approximately one hour later, P-34A was secured and declared inoperable due to high inboard bearing temperature. P-34B was started and subsequently secured when it too experienced high inboard bearing temperature. Core cooling was maintained using an RCS loop and associated steam generators and RCPs. The root cause of this event has not yet been conclusively determined; however, preliminary results indicate that the pumps' design failed to consider the wide range of cooling water temperatures that the bearings would encounter and the impact of the temperature range on the critical clearances between the inboard bearing and housing. Temporary alterations were completed to restore the pumps to operable status for shutdown cooling purposes. Permanent modifications will be completed prior to restart from the current outage.

A. Plant Status

At the time this condition was discovered, Arkansas Nuclear One Unit 1 (ANO-1) Reactor Coolant System (RCS)[AB] temperature was 280 degrees and pressure was approximately 240 psig. Reactor Coolant Pumps (RCPs) P-32A and P-32B were running. The unit was proceeding to Cold Shutdown for a maintenance outage.

B. Event Description

On February 5, 2000, at approximately 1138, Low Pressure Injection/Decay Heat Removal (LPI/DHR)[BP] pump P-34A was started in anticipation of placing the RCS on shutdown cooling to allow securing the running RCPs. At 1230, P-34A was secured and declared inoperable due to high inboard bearing temperature (approximately 160 degrees). LPI/DHR pump P-34B was started at 1250; however, it was also secured at 1306 and declared inoperable due to high inboard bearing temperature.

The LPI/DHR system is designed to remove decay heat from the core and sensible heat from the RCS during the last stages of cooldown. It also provides a means of automatically injecting borated water into the reactor vessel for cooling the core in the event of a Loss of Coolant Accident during power operation. During operation, the LPI system maintains core cooling for large breaks and operates independent of, and in addition to, the High Pressure Injection System (HPI)[BG]. Normal suction for LPI is from the Borated Water Storage Tank (BWST) with an alternate suction from the Reactor Building sump. This gives the system the ability to provide long-term core cooling after the BWST has been emptied.

ANO Technical Specification (TS) 3.3.1(D) requires that two LPI pumps be operable whenever containment integrity is established as required by TS 3.6.1. TS 3.6.1 requires the reactor building to be operable whenever all three of the following conditions exist: a) Reactor coolant pressure is 300 psig or greater, b) Reactor coolant temperature is 200 degrees or greater, and c) Nuclear fuel is in the core. TS 3.1.1.6 requires that, with the average reactor coolant temperature at or below 280 degrees, but the reactor above the refueling shutdown condition, at least two of the coolant loops listed below must be operable: 1) Reactor coolant loop "A" and its associated steam generator and at least one associated RCP. 2) Reactor coolant loop "B" and its associated steam generator and at least one associated RCP. 3) Decay Heat Removal Loop "A". 4) Decay Heat Removal Loop "B".

At the time this event occurred, RCS pressure was approximately 240 psig; therefore, LPI was not required to be operable. Additionally, since both Reactor coolant loops and their associated steam generators and at least one RCP in each loop were operable, the provisions of TS 3.1.1.6 were met even though both LPI/DHR pumps were declared inoperable.

After being declared inoperable, both pumps were aligned to the BWST and run with acceptable bearing temperatures. Subsequent troubleshooting efforts identified that an oil type change which was implemented during the previous refueling outage may have contributed to the high bearing temperature problems. The oil in both LPI/DHR pumps was changed back to the original type and testing was conducted to verify operability. P-34A ran with acceptable operating temperatures with suction taken from the RCS; however, P-34B again exhibited high bearing temperature when its suction was taken from the RCS. At 0119 On February 7, P-34A was declared operable.

At 0052 on February 8, P-34A was aligned for decay heat operation and RCS cooldown to Cold Shutdown was commenced. At 0232, the running RCPs were secured. At 0435 on February 8, the unit reached cold shutdown (RCS temperature less than 200 degrees). The reactor coolant loops were maintained operable while repair efforts continued on P-34B.

C. Root Cause

Extensive investigation into the cause of this event determined that the design of the pumps was inadequate in that it did not consider the wide range of cooling water temperatures that would be supplied to the bearing housings for cooling and the impact of the temperature range on the critical clearances between the inboard radial bearing and bearing housing. These deficiencies resulted in binding between the inboard bearings and bearing housings during operation with cooling water temperature at approximately 42 degrees.

Starting the pumps with RCS water temperatures greater than ambient results in differential axial movement between the shaft and casing. The clearances at the inboard bearing must be adequate to allow axial movement between the outer bearing race and bearing housing without excessive axial load being applied to the bearing. They must also be such that the outer race does not spin in the housing.

In 1992, to address cooling water corrosion of the bearing housings, ANO replaced the original cast iron inboard and outboard bearing housings with stainless steel housings which have a higher thermal coefficient of expansion than cast iron. This change also failed to consider the wide range of cooling water temperatures that would be supplied to the bearing housings.

Changing to a heavier weight oil in the LPI/DHR pumps during the last outage is considered to be a minor contributor to this event. The heavier weight oil resulted in greater heat generation within the bearings which caused greater thermal expansion of the outer bearing race. The oil viscosity change was in compliance with the pump vendor's recommendations and would not have caused a problem with pump operation in the absence of the design problem with the bearing clearances.

The root cause evaluation of this event is ongoing. This report will be supplemented to include the results of the evaluation after its completion.

D. Corrective Actions

Corrective actions completed to date include:

- A Temporary Alteration was installed to provide a manual valve to control service water cooling to each pumps' inboard bearings.

- Procedures were revised to provide instructions for maintaining acceptable inboard bearing and bearing housing temperatures by manually controlling cooling water flow to the bearing housings with the Temporary Alteration installed. Operations crews were briefed on the Temporary Alteration and associated procedure changes.

- P-34B was completely disassembled to evaluate all possible causal factors and verify condition and tolerances of the pump's sub-components.

- The inboard bearing on P-34B was replaced, establishing acceptable tolerances between the outer race and the bearing housing.

- Calculations were developed using the actual as-left measured values of the P-34B inboard bearing and housing to demonstrate that acceptable clearances will be maintained under the conditions established by the Temporary Alteration.

- The type and quantity of oil utilized in the pump bearings was evaluated. The oil was changed back to a lower viscosity. Existing oil levels were determined to be adequate.

Additionally, a modification will be installed on both LPI/DHR pumps to restore the inboard bearing housings to their original cast iron configuration with bearing and housing fits verified to be acceptable. The modification will also change the inboard bearing from a 'C3' fit bearing to a 'C4' fit bearing. The 'C4' fit bearing has a slightly looser internal fit between the ball bearings and the races. This modification and extensive post-installation testing will be completed prior to restart from the current outage.

Any additional corrective actions determined to be necessary during completion of the root cause evaluation will be reported in a supplement to this report.

E. Safety Significance

The significance of this event has not yet been conclusively determined since an evaluation of the full impact of the reported condition on the ability of the LPI/DHR pumps to perform their specified functions has not yet been completed. The results of that determination will be included in a supplement to this report.

F. Basis for Reportability

Since inadequate design considerations resulted in both LPI/DHR pumps being potentially incapable of performing their design function of providing cooling to the core post-LOCA following emptying of the BWST, this condition is considered reportable pursuant to 10CFR50.73(a)(2)(v), 10CFR50.73(a)2)(vii), and 10CFR50.73(a)(2)(ii)(B). Since one or both trains of LPI may have been inoperable longer than allowed by Technical Specifications, this condition is also reportable in accordance with 10CFR50.73(a)(2)(i)(B).

This condition was also reported to the NRC Operations Center at 1730 EST on February 5, 2000, in accordance with 10CFR50.72(b)(2)(i).

G. Additional Information

A review to determine if there have been any previous similar events at ANO will be conducted after completion of the root cause analysis. The results of that review will be included in the supplement to this report which is expected to be submitted by May 15, 2000.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].