

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Shearon Harris Unit 1		DOCKET NUMBER (2) 050004100	PAGE (3) 1 OF 6
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TITLE (4)  
AFW Pump Inoperable/Shutdown to Mode 4

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 NAMES		DOCKET NUMBER(S)
01	13	87	87	003	00	02	12	87			050000
THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §. (Check one or more of the following) (11)											

OPERATING MODE (9) 3	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10) 0100	20.405(a)(1)(i)	50.36(e)(1)	50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(e)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(iii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)		TELEPHONE NUMBER	
NAME O. N. Hudson, Senior Engineer - Regulatory Compliance		AREA CODE 9119	NUMBER 3612121363

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	BJA	111P	1101715	N					

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
<input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO						

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

On January 13, 1987, the Shearon Harris Nuclear Power Plant, Unit 1, was operating in Mode 3. A cooldown from Mode 3 to Mode 4 was initiated at 1645 because of inoperable motor-driven 1A-SA Auxiliary Feedwater Pump (1A AFW Pump). The 1A AFW Pump had been declared inoperable on January 12, 1987, based on the review of an Operational Surveillance Test (OST-1087, "Motor-Driven Auxiliary Feedwater Pumps Full Flow Test") performed on December 31, 1986. The plant cooldown to Mode 4 was completed on January 13, 1987. After corrective actions were taken to repair the pump, OST-1087 was successfully completed and AFW Pump 1A was declared operational at 0833 on January 17, 1987.

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TEXT (If more space is required, use additional NRC Form 388A's) (17)

Background

On January 13, 1987 the Shearon Harris Nuclear Power Plant, Unit 1 was operating in Mode 3. A cooldown from Mode 3 to Mode 4 was initiated at 1645 because of inoperable motor-driven 1A-SA Auxiliary Feedwater Pump (1A AFW Pump). The 1A AFW Pump had been declared inoperable on January 12, 1987 based on the review of an Operational Surveillance Test (OST-1087, "Motor-Driven Auxiliary Feedwater Pumps Full Flow Test") performed on December 31, 1986. The plant cooldown to Mode 4 was completed on January 13, 1987. The following sections address the description of the Auxiliary Feedwater System at SHNPP, the history of testing and maintenance on the 1A AFW Pump, and the corrective actions taken to repair the 1A AFW Pump.

System Description and Design Bases

The SHNPP design includes three Auxiliary Feedwater Pumps. Two of the pumps (1A-SA and 1B-SB) are motor driven and each one is designed to provide at least 475 gpm at a steam generator pressure of 1217 psig. The third Auxiliary Feedwater Pump (1C-SAB) has a capacity of 900 gpm with a steam supply pressure of 1110 psig. All three pumps are manufactured by Ingersoll-Rand. Each pump is a multi-stage centrifugal pump. The total AFW flow required by safety analysis is dependent upon the specific accident. The largest flow rate required for the Auxiliary Feedwater System is a total of 475 gpm for the Loss of Main Feedwater with Offsite Power Available. The other required total system flow rates are provided in FSAR Section 10.4.9.1. The Technical Specifications for SHNPP require all three AFW Pumps to be operable in Modes 1, 2, and 3. With one AFW Pump inoperable, the required Action is to restore the inoperable pump within 72 hours or be in Mode 3 within 6 hours and be in Mode 4 within the following 6 hours.

Performance of the Auxiliary Feedwater Pumps was initially demonstrated by verifying the design pump head curve during preoperational testing. Preoperational test data was taken on December 9, 1985 by procedure 1/2-9003-M-01. This testing demonstrated that both 1A and 1B AFW Pumps performed as required by the vendor's pump flow curve. After preoperational test data was taken, the 1A AFW pump assembly was removed for the purpose of hydrostatically testing the pump casing and suction piping. This occurred in November 1986. The initial assembly of the impeller assembly was performed on site under the supervision of vendor personnel (Ingersoll-Rand) and the initial assembly settings and adjustments were not disturbed by any subsequent pump disassembly for hydrostatic testing purposes. Both motor-driven AFW pumps were periodically operated for the purpose of filling the steam generators since early 1986 and for the purpose of integrated Engineered Safety Features testing.

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Prior to entry into each operational mode specified by Technical Specifications, the applicable surveillance tests for required systems were completed. For the motor-driven AFW pumps, three different surveillance tests are used to verify operability. Two of the surveillance tests for the 1A AFW Pump operate the pump on mini-flow recirculation in accordance with Technical Specification Surveillance Requirement 4.7.1.2.1.a.1. These tests are OST-1011 and OST-1211. The acceptance criteria specify a discharge pressure of 1590 psig at a flow of 50 gpm. Tests on recirculation flow were performed successfully on the following dates: September 25, December 23, January 7. The plant entered Mode 3 for the first time on December 25, 1986.

The third test (OST-1087) is performed per the Inservice Inspection Program (Technical Specification 4.0.5) and requires that the pump performance be verified under full flow conditions. The first performance of this test was to provide the baseline data to be used for the trending of pump performance. OST-1087 was attempted during operations in Mode 4, but the test did not result in useful data because of the low Steam Generator pressures (approximately 100 psig) which exist with the Reactor Coolant System less than 350°F. The motor-driven pumps include a hydraulically actuated pressure control valve at the pump discharge to prevent pump runout. At the low Steam Generator pressures, this valve oscillated to a degree that prevented the collection of meaningful data. As a result, the pre-op test program data was used to verify proper pump performance and justify entry into Mode 3. While the pre-op data was used to justify entry into Mode 3, it was not used to establish acceptance criteria for OST-1087. OST-1087 was run for the first time on December 31, 1986 in Mode 3 at normal operating temperature and normal operating pressure for the purpose of establishing baseline data. The results of the testing were that the 1B AFW Pump delivered 606.3 gpm at 1142 psid for the pump. The corresponding data for the 1A AFW Pump was 430.19 gpm at 1183 psid. The onshift Operations personnel performing the test did not recognize these raw data results as unacceptable primarily because the procedure was being run to establish baseline acceptance criteria and therefore, did not yet have definitive acceptance criteria. Additionally, the OST was being performed for baseline data and not operability determination. The results of the test were provided to the onsite Inservice Inspection (ISI) group on January 5, 1987. Due to the apparent routine nature of the OST and other commitments of ISI personnel, the results were not reviewed until January 12, 1987.

The successful completion of OST-1011 on January 7, 1987 provided additional apparently conflicting information. OST-1011 provided satisfactory performance because it was run on recirculation flow only and not full flow. However, the ISI personnel, based on plotting the OST-1087 results on a pump curve, concluded that the data indicated unacceptable performance for the 1A AFW Pump. The pump was subsequently declared inoperable and the test rerun to verify that the problem was not due to instrumentation problems or some other error. This additional testing performed on January 12 & 13, 1987 included obtaining data to replot a head curve. The new data showed a definite loss of performance at flow rates above 400 gpm.

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Corrective Actions to Repair Pump

In the subsequent four days, the 1A AFW Pump was disassembled three times in an effort to identify and correct the root cause. A review of the flow data suggested that bypass flow from discharge to suction was a possible cause. Therefore, the pump impeller assembly was removed and the casing-to-rotating element assembly 'O' rings were replaced on January 14. There was no significant change in pump performance following the 'O' ring replacement.

At this point, the probable cause was determined to be internal to the pump. Therefore, the second disassembly involved the replacement of the impeller assembly. The intent was to examine the removed assembly for a failure analysis after returning the AFW Pump to an operable status. A satisfactory pump performance curve was obtained about 2100 on January 15. However, when OST-1087 was performed immediately thereafter, the results were unsatisfactory. Subsequently, data was retaken for a pump performance curve at 0300 on January 16. Severe degradation in pump performance was observed.

Vendor technical and engineering representatives arrived on site January 16 and their examinations (which included disassembly and inspection of both impeller assemblies) and analysis led to the following conclusions and recommendations:

1. Failure of the "spare internals assembly" was due to the fact that the key fastening the 9th stage impeller to the shaft was omitted during assembly at the factory. It was concluded that shaft-to-stage friction probably held the 9th stage impeller in place long enough to obtain the initial satisfactory pump flow data. Once the impeller loosened, performance rapidly degraded.
2. The vendor's inspection of the "initial impeller assembly" revealed: (1) improper clearance between the 9th stage impeller and the balance piston apparently caused by an error in initial assembly in measuring and setting pump clearances, (2) mild but acceptable wear of the balancing piston assembly and (3) minor acceptable cavitation. Condition (1) resulted in 9th stage-to-volute misalignment such that under load the 9th stage impeller was essentially closed off. The vendor concluded that this accounted for degraded high flow performance observed on December 31, 1986, and reproduced on January 12 and 13, 1987. It is surmised that the successful pre-operational test data and earlier satisfactory data on this pump was due to the difference in the manner of performing the pump tests. Pump performance curves (pre-op test) are generally performed by starting at mini-flow head and slowly increasing flow to the limits of the pump curve. Under these conditions the thrust on the 9th stage impeller was apparently not enough to cause it to move axially and pinch off flow. On the other hand, OST-1087 starts

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the pump at full flow. The sudden thrusting of the pump apparently did cause axial movement of the 9th stage impeller and "pinching off" of flow.

- The vendor recommended a modification that would provide assurance of proper thrust bearing adjustment. This modification, removal of thrust bearing coil springs, was accomplished prior to restoring the 1A AFW Pump to service.

The inspections did not reveal any other reason for the pump performance degradation. As noted above, work on the impeller was performed under the guidance of a vendor representative.

AFW Pump 1A-SA was completely reassembled (including detaching the rotor to verify proper key placement) using the original components. Work was accomplished under direct supervision of vendor personnel using a new balancing drum assembly. The 1A AFW Pump was run at various flow rates to establish that the pump performed per design. OST-1087 was successfully completed on January 17 and the pump declared operational at 0833.

Further testing of 1A AFW Pump has included the completion of the 48 hour endurance run required by the FSAR. The endurance testing was completed as part of the 30% power plateau test program on February 4, 1987.

Cause

As discussed in #2 above, the cause of the degraded high flow performance of motor-driven AFW Pump 1A was 9th stage-to-volute misalignment caused by assembly error during initial installation.

It should be noted that the conclusions made by the vendor were preliminary and made verbally. If the vendor's final written report significantly changes these conclusions, a supplemental LER will be submitted.

Analysis

There was no safety consequence from this event. At the time the problem was discovered, the other two AFW pumps were operable and capable, even assuming a single failure, of providing sufficient auxiliary feedwater flow to protect the plant from design basis events.

This event is being reported in accordance with 10CFR50.73(a)(2)(i)(A) since the plant was required to be shutdown per Technical Specifications.

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Action to Prevent Recurrence

1. OST-1087, "Motor-Driven AFW Pumps Full Flow Test," has been changed from an 18-month frequency. It is now required to be performed when in cold shutdown if it has not been performed within the past quarter. Therefore, any future problems with AFW full flow will be detected in a more timely manner.
2. All operational surveillance tests either include acceptance criteria or will be reviewed for acceptability by the Inservice Inspection group immediately after completion of test performance. Acceptance criteria will be incorporated into the remaining OSTs by March 2, 1987.



Carolina Power & Light Company

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FEB 12 1987

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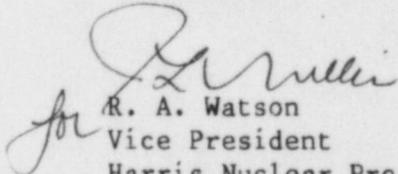
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SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1  
DOCKET NO. 50-400  
LICENSE NO. NPF-63  
LICENSEE EVENT REPORT 87-003

Gentlemen:

In accordance with Title 10 to the Code of Federal Regulations, the enclosed Licensee Event Report is submitted. This report fulfills the requirement for a written report within thirty (30) days of a reportable occurrence and is in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,

  
R. A. Watson  
Vice President  
Harris Nuclear Project

RAW:sdg

Enclosure

cc: Dr. J. N. Grace (NRC - RII)  
Mr. B. Buckley (NRR)  
Mr. G. Maxwell (NRC - SHNPP)

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