NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

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TITLE (4) Residual Heat Removal Shutdown Cooling Containment Isolation Valve Closures (ESF Actuations) Due to Procedure Inadequacies

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)
										0 5 0 0 0
0 5	2 7	8 9	8 9	0 2 0	0 0	0 6	2 6	8 9		0 5 0 0 0

OPERATING MODE (9)	5
POWER LEVEL (10)	0 0 0

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

	20.402(b)		20.405(c)	X	50.73(a)(2)(iv)
	20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)
	20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)
	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)(ii)		50.73(a)(2)(viii)(B)
	20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)

	73.71(b)	
	73.71(c)	
	OTHER (Specify in Abstract below and in Text, NRC Form 366A)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
J.D. Arbuckle, Compliance Engineer	AREA CODE 5 0 9 3 7 7 - 2 1 1 1 5

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

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

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

On the following dates, two related Engineered Safety Feature (ESF) isolations occurred involving the Residual Heat Removal (RHR) System:

(a) On May 27, 1989 an ESF isolation occurred when the Inboard RHR Shutdown Cooling Supply Valve (RHR-V-9) automatically isolated on a high flow signal during the performance of Local Leak Rate Testing (LLRT). During recovery efforts, Plant personnel were also unable to restore RHR Shutdown Cooling within the time frame required by the Plant Technical Specifications. The associated Limiting Condition for Operation (LCO) requires that with no shutdown cooling loop in operation, an alternate method of reactor coolant circulation and decay heat removal be established, and coolant temperatures be monitored at least once every hour. Contrary to that, from 0353 hours until 0400 hours (seven minutes beyond the 3-hour time limit imposed by the Technical Specifications), shutdown cooling remained inoperable and an alternate method of reactor coolant circulation and temperature monitoring was not established. The cause of the isolation was unanticipated system interaction during the testing of RHR Shutdown Cooling Supply Valve RHR-V-8 which closed RHR Shutdown Cooling Supply Valve RHR-V-9. During the test, RHR-V-9 was hydraulically locked shut by pressure inside the valve body and remained closed until the pressure differential was reduced. Valve RHR-V-9 was then opened and shutdown cooling restored at 0400 hours.

Abstract (continued)

(b) On June 5, 1989 while attempting to complete the same LLRT, RHR-V-9 automatically isolated when differential pressure switch RHR-DPIS-12B again actuated. However, in this event Residual Heat Removal Shutdown Cooling was not impacted, nor was there a hydraulic lock condition in the system. Although the isolation could not be immediately reset, Plant Operators were able to de-energize RHR-V-9, open it manually and successfully complete the test. During troubleshooting efforts to clear the isolation signal, Plant Operators discovered that RHR-DPIS-12A had been removed from service and RHR-DPIS-12B was reading 5.2 PSID and isolated with the equalizing valve shut. Accordingly, RHR-DPIS-12B was equalized and restored to service and RHR-V-9 was then opened by means of the motor operator.

The root cause of the first event is procedural inadequacy in that the RHR-V-9 actuation had not been anticipated during LLRT pressurization of the RHR Shutdown Cooling Supply line while testing RHR-V-8. The pressurization inadvertently actuated a differential pressure switch (RHR-DPIS-12B) designed to isolate the RHR system on excess flow. When RHR-V-9 closed on the high pressure line and the pipe was then depressurized, a high differential pressure between the inside of the valve and the RHR system hydraulically locked it shut.

The root causes of the second event are 1) procedural inadequacy and 2) inadequate corrective action following the first event.

Corrective action consists of 1) modifying the procedure to remove the correct DPIS from service when testing RHR-V-8, 2) performing a Category 1 Root Cause Analysis for both events, 3) performing an assessment of the RHR Shutdown Cooling isolations, and 4) addressing the hydraulic lock issue in a Monthly Operational Bulletin.

There is no safety significance associated with either event. At the time of both events the reactor vessel head was removed, the fuel pool gates were removed and reactor water level was greater than 22 feet above the reactor vessel flange. These conditions provided a large heat sink for core cooling.

Plant Conditions

a) Power Level - 0%
b) Plant Mode - 5 (Refueling)

Event Description

On the following dates, two related Engineered Safety Feature (ESF) isolations occurred involving the Residual Heat Removal (RHR) System:

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

(a) On May 27, 1989 an ESF isolation occurred when the Inboard RHR Shutdown Cooling Supply Valve (RHR-V-9) automatically isolated on a high flow signal during the performance of Local Leak Rate Testing (LLRT). During recovery efforts, Plant personnel were also unable to restore Residual Heat Removal (RHR) Shutdown Cooling within the time frame required by the Plant Technical Specifications. (The Technical Specifications allow shutdown cooling to be secured for 2 hours during an eight hour period). The Technical Specifications also require that, with no RHR Shutdown Cooling loop in operation, an alternate method of reactor coolant circulation and decay heat removal be established, and coolant temperatures be monitored at least once every hour. Due to unanticipated system interactions during the LLRT, RHR-V-9 could not be immediately re-opened to restore shutdown cooling.

In order to perform an LLRT on RHR-V-9, shutdown cooling was secured at 0053 hours with the intent of restoring shutdown cooling no later than 0253 hours and remaining within the bounds of the Limiting Condition for Operation (LCO). The LLRT on RHR-V-9 was done successfully with enough of the two hour interval left to expect to complete an LLRT on RHR-V-8. The LLRT is performed by closing manually-operated valve RHR-V-113 upstream of RHR-V-8 and RHR-V-9, and pressurizing the piping between RHR-V-113 and either RHR-V-8 or RHR-V-9 depending on which valve is to be tested (RHR-V-9 is between RHR-V-113 and RHR-V-8). In testing RHR-V-8, RHR-V-9 remains open and the piping between RHR-V-8 and RHR-V-9 is then pressurized with a test pump.

When RHR-V-9 received the auto-close signal, the bonnet area of the valve was pressurized to the same pressure as the line (approximately 1000 psig). In preparation for opening RHR-V-9 the operators conducting the LLRT depressurized the test assembly and the pressurized piping. However, the design of RHR-V-9 is such that when it closed the bonnet remained at the higher pressure. At 0234 hours the shutdown cooling isolation signal on RHR-V-9 was reset and an open signal was provided to the motor operator on RHR-V-9. Because the piping had been depressurized and the bonnet remained at higher pressure, the valve could not open across the resultant differential pressure and the motor operator fuses blew before efforts to open the valve were completed.

At 0300 hours, Fuel Pool Cooling Pump FPC-P-1B was started providing an alternate means of decay heat removal through the fuel pool. (It was recognized that this did not allow an exit from the LCO action statement because this did not establish sufficient circulation through the reactor core in accordance with the Technical Specification bases). At 0349 hours the fuses for the RHR-V-9 motor had been replaced and the operators recognized the hydraulic lock condition on RHR-V-9. Valve RHR-V-113 was then shut and the line pressurized to about 750 psig. This decreased the differential pressure between the valve body and the system and allowed the valve to be cracked manually off the seat. The valve was then opened by means of the motor operator.

(b) On June 5, 1989 while attempting to complete the same LLRT, Inboard Shutdown Cooling Supply Valve RHR-V-9 automatically isolated when differential pressure switch RHR-DPIS-12B again actuated. In this particular case, although the isolation could not immediately be reset, RHR Shutdown Cooling was not impacted as during the first event because the Reactor Recirculation (RRC) System was in service providing an alternate method of reactor coolant circulation. In addition, a hydraulic lock condition did not occur because Plant personnel maintained the system in a pressurized state. As a result, Plant Operators were able to de-energize RHR-V-9, open it manually to 25% and successfully complete the test on the still-pressurized piping.

Upon completion of the LLRT, Plant personnel began troubleshooting activities in an attempt to clear the isolation signal. During alignment of the system in accordance with Plant Procedure (PPM) 7.4.4.3.2.2, "High-Low Pressure Interface Valve Leak Test," a Plant Instrument and Control (I&C) Technician was directed to remove RHR-DPIS-12 from service in accordance with the procedural lineup. Further investigation found the instrument to be properly equalized and isolated, and labeled RHR-DPIS-12A. However, RHR-DPIS-12B was found to be reading 5.2 PSID and isolated with the equalizing valve shut. Accordingly, RHR-DPIS-12B was equalized and restored to service. Valve RHR-V-9 was then opened by means of the motor operator.

Immediate Corrective Action

(a) At 0400 hours, Plant operators started RHR Pump 2B (RHR-P-2B) and restored shutdown cooling (seven minutes beyond the three-hour time restriction imposed by the Technical Specifications).

(b) Following troubleshooting activities, RHR-V-9 was opened by means of the motor operator.

Further Evaluation and Corrective Action

A. Further Evaluation

1. The May 27, 1989 event is reportable under 10CFR50.73(a)(2)(i)(B), "a condition prohibited by the Plant's Technical Specifications," and 10CFR50.73(a)(2)(iv), "an event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF)."

2. The June 5, 1989 event is reportable under 10CFR50.73(a)(2)(iv), "an event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF).

3. There were no structures, components or systems that were inoperable at the start of the event that contributed to the event.

4. During the testing of RHR-V-8 it is believed that the test pump and pipe dynamics created sufficient pressure spikes in the pipe that differential pressure switch RHR-DPIS-12B actuated and closed RHR-V-9. The pressure switch is designed to sense high RHR flow rates which could indicate a pipe leak or break and isolate the RHR system, thereby, securing any potential leak.

5. The root causes of these two events are as follows:

   (a) May 27, 1989

   - Procedural inadequacy - the procedure (PPM 7.4.4.3.2.2) incorrectly required that the DPIS remain in service during the test. Following the event, Plant personnel recognized that the DPIS was within the test pressure boundary and modified the procedure accordingly to remove the DPIS from service during testing on RHR-V-8. In addition, Plant Management directed that a Category 1 (the highest level) Root Cause Analysis be performed on this event.

   (b) June 5, 1989

   - Procedural inadequacy - the procedure incorrectly identified RHR-DPIS-12B as RHR-DPIS-N012, and did not specifically identify either RHR-DPIS-12A or RHR-DPIS-12B. Due to the lack of "A" or "B" valve designation, and the absence of another flow element on RHR [RHR-DPIS-12A is on an RHR line and RHR-DPIS-12B is on a Reactor Recirculation (RRC) System line], it was assumed that RHR-DPIS-N012 contained the contacts for both logic trains. However, if the procedure had specifically identified RHR-DPIS-12B as the instrument to be removed from service, this event would not have occurred.

   - Inadequate corrective action following the first event - if it had been recognized following the first event that RHR-DPIS-N012 should have been RHR-DPIS-12B, the procedure would have been revised accordingly at that time. It should be noted that Root Cause Analysis efforts for the first event had not been completed by the time this event occurred. Followup efforts associated with this event discovered the discrepancy with the DPIS designation in the procedure. Plant Management directed that a Category 1 Root Cause Analysis also be performed on this event.

In addition, a contributing factor common to both events is system design. The system is designed as "one out of one" logic, which allows no margin for errors or problems during system operation and testing.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

B. Further Corrective Action

1. The LLRT procedure for testing RHR-V-8 was modified to require removal of RHR-DPIS-12B from service during testing on RHR-V-8.

2. An overall assessment of the RHR Shutdown Cooling isolations which have occurred is currently being performed by the Plant Technical and Nuclear Safety Assurance Groups.

3. The Nuclear Safety Assurance Group has addressed the hydraulic lock issue in a Monthly Operational Bulletin. The Monthly Operational Bulletin is required reading for Operations and Maintenance personnel.

4. An evaluation will be performed to consider the feasibility of a design change to incorporate a redundant trip system logic scheme for RHR isolation actuation.

Safety Significance

There is no safety significance associated with these events. At the time of both events, the reactor vessel head was removed and reactor water level was greater than 22 feet above the reactor vessel flange. These conditions provided a large heat sink for core cooling.

In the first event, the allowed interval for restoration of shutdown cooling was exceeded by seven minutes. Fuel pool cooling was operable providing a natural circulation method of core cooling (although not considered to have been proven to provide adequate assurance of core mixing). When RHR shutdown cooling was restored, temperatures in the RHR system had increased only 11° (from 73° to 84°F). This provides adequate assurance that temperatures in the core remained well below 140°F.

In the second event, the Reactor Recirculation (RRC) System was in service providing an alternate method of reactor coolant circulation.

Accordingly, these events posed no threat to the health and safety of either the public or Plant personnel.

Similar Events

There have been several LERs associated with the loss of Shutdown Cooling; however, none with the same root causes.

EIIS Information

Text Reference	EIIS Reference System	EIIS Reference Component
Residual Heat Removal (RHR) System	BO	---
Residual Heat Removal Shutdown Cooling Supply Valve (RHR-V-9)	BO	ISV

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

EIIS Information

Text Reference	EIIS Reference	
	System	Component
Valve RHR-V-8	BO	ISV
RHR-DPIS-12B	BO	PDIS
RHR-DPIS-12A	BO	PDIS
RHR-DPIS-N012	BO	PDIS
FPC-P-1B	DA	P
RHR-P-2B	BO	P
Fuel Pool Cooling (FPC) System	DA	---
Reactor Recirculation (RRC) System	AD	---