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January 28, 1991

10 CFR Part 50
Section 50.73

U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Unit 2 Reactor Trip as a Result of Rod Control System Failures

The Licensee Event Report for this occurrence is attached.

This event was reported via the Emergency Notification System in accordance with 10 CFR Part 50, Section 50.72, on December 29, 1990. Please contact us if you require additional information related to this event.

Thomas M Parker
Manager
Nuclear Support Services

c: Regional Administrator - Region III, NRC
NRR Project Manager, NRC
Senior Resident Inspector, NRC
MPCA
Attn: Dr J W Ferman

Attachment

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NRC FORM 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, 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)
PRAIRIE ISLAND NUCLEAR GENERATING PLANT UNIT 2	0 5 0 0 0 3 0 6	1 OF 0 5

TITLE (4)

UNIT 2 REACTOR TRIP AS A RESULT OF ROD CONTROL SYSTEM FAILURES

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
1 2	2 9	9 0	9 0	0 1 2	0 0	0 1	2 8	9 1		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
	N	20.402(b)	20.405(c)	XX 50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	1 0 0	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	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)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
	AREA CODE
Arne A Hunstad, Staff Engineer	6 1 2 3 8 8 - 1 1 1 2 1

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	
X	A I A		W 1 1 2 1 0	Yes							

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

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

On December 29, 1990, Unit 2 was at 100% power. At 2234, Unit 2 tripped. Control room annunciators, and the sequence of events generated by the plant process computer, indicated that the cause of the reactor trip was a negative flux rate trip from the reactor protection system.

An investigation into the cause of the negative flux rate trip revealed that two circuit cards in the rod control system power cabinet 1BD had failed. The first failure was of a transistor in the urgent failure alarm circuit. The second failure was the opening of a solder connection on the stationary gripper regulation card, causing the reference voltage to go to zero. In response to the reference voltage going to zero, the urgent failure alarm circuit should have generated an urgent failure alarm and a "hold" current that would be applied to the stationary grippers for all the rods supplied by that power cabinet. This hold current would have prevented the rods from dropping into the reactor. But since the Urgent Failure alarm circuit had also failed, no current was supplied to the stationary grippers in control rod Bank D and they fell into the core, causing the negative flux rate trip.

The failed cards in the rod control system were replaced. Unit 2 was returned to service at 1330 on December 30, 1990.

EVENT DESCRIPTION

On December 29, 1990, Unit 2 was at 100% power. At 2234, the Unit 2 control room operators received annunciation of a reactor trip. The operators verified the reactor trip using control room indication and stabilized the unit in the hot shutdown condition in accordance with plant procedures. Except as noted below, plant systems and components responded to the reactor trip as designed. Control room annunciators (EIIS Component Identifier ANN), and the sequence of events generated by the plant process computer indicated that the cause of the reactor trip was a negative flux rate trip from the reactor protection system. A negative flux rate trip is consistent with a dropped rod or rods.

An investigation into the cause of the negative flux rate trip was initiated following stabilization of the unit. The investigation initially centered on possible blown fuses in the rod control system. However, no blown fuses were found. Further investigation revealed that two circuit cards in the rod control system (EIIS System Identifier AA) power cabinet 1BD had failed.

The first failure was of a transistor in the urgent failure alarm circuit. Because there are no alarms or annunciation associated with the failure of an urgent failure alarm circuit, the control room operators were unaware of the failure.

The second failure was the opening of a solder connection on the stationary gripper regulation card, causing the reference voltage to go to zero. In response to the reference voltage going to zero, the urgent failure alarm circuit should have generated an urgent failure alarm and a "hold" current that would be applied to the stationary grippers for all the rods supplied by that power cabinet. This hold current would have prevented the rods from dropping into the reactor. But since the urgent failure alarm circuit had also failed, no current was supplied to the stationary grippers in control rod Bank D and they fell into the core, causing the negative flux rate trip as they left their withdrawn position.

There were several secondary effects of the unit trip:

- A control rod drive mechanism fan, a spent fuel pool cooling pump, and an auxiliary building normal ventilation supply fan tripped as a result of the automatic transfer of the power sources supplying the nonsafeguards 4160 volt buses. The equipment that tripped was restarted.

- Some turbine drain valves indicated that they were not fully open. A work request was initiated to correct the malfunctions.

- The nuclear instrumentation source range channels had to be manually re-energized because the intermediate range channels were undercompensated. This undercompensation prevented the intermediate range detector output from dropping below the level where the source range detectors would be automatically re-energized. (This is an expected condition after a long period of operation at high power.) The intermediate range channels were recalibrated.

The failed cards in the rod control system were replaced. Unit 2 was returned to service at 1330 on December 30, 1990.

CAUSE OF THE EVENT

A study of the rod position history performed after the unit restart, which utilized data from the plant process computer, indicated that the control rod Bank D rods began to drop before the remainder of the rods. The results of this study confirmed the cause of this trip to be a negative flux rate trip caused by the unannunciated failure of the urgent failure alarm circuitry, followed by a failure on the stationary gripper regulation card, which allowed control rod Bank D rods to drop into the core.

ANALYSIS OF THE EVENT

This event is reportable pursuant to 10CFR50.73(a)(2)(iv) since it involved an unplanned actuation of the reactor protection system. The health and safety of the public were unaffected by this event. The reactor protection system responded as designed to the negative flux rate caused by the dropped rods and the plant was stabilized in the hot shutdown condition in accordance with plant procedures following the reactor trip.

CORRECTIVE ACTION

An investigation into the cause of the negative flux rate trip was initiated following stabilization of the unit. The investigation initially centered on possible blown fuses in the rod control system. However, no blown fuses were found. Further investigation revealed that two circuit cards in the rod control system power cabinet 1BD had failed. The first failure was of a transistor in the Urgent Failure alarm circuit. The second failure was the opening of a solder connection on the stationary gripper regulation card, causing the reference voltage to go to zero. The two failed rod control system circuit cards were replaced. The two failed circuit cards were repaired. The cause of the transistor and solder connection failures will be addressed through the followup system assessment studies described below.

Increased maintenance has been done during recent outages in response to rod control system malfunctions that resulted in Unit 2 trips in December 1989. Specifically, the Unit 2 rod control system was inspected, repaired and tested by the vendor during the September 1990 refueling outage; the failed cards that caused this event were included in that activity. Based on this event, the Westinghouse maintenance organization will be contacted and the adequacy and quality of their maintenance program will be evaluated.

The problems resulting from secondary effects of the trip were corrected before restart as described above.

Several other corrective actions have been taken or are under consideration. These actions are designed to either minimize the potential for further rod control system component failures or to improve the ability to identify failures before they result in operational problems. These corrective actions include:

- A periodic walkdown inspection of both units' rod control systems has been instituted in an effort to determine the condition of rod control system circuit cards and fuses at power.

- Thermal monitoring of components in the rod control cabinets is being done to establish baseline information. This information will be used to periodically determine if components in the rod control system power cabinets are operating at elevated temperatures. Elevated component temperatures could be indicative of a component failure.

- Replacement of old or repaired alarm cards is being considered.

- The establishment of baseline test point measurements for an operating rod control system is being evaluated. This would provide baseline data for the rod control system cards. A deviation from the baseline data would indicate a change in operating characteristics of the card, which would be indicative of a card component failure.

- Online monitoring of alarm card functionality by the plant process computer is also under consideration.

- A study has been initiated for the assessment of system lifetime and failure modes, and to ensure appropriate maintenance practices. Study results will be used in the determination of the need for system upgrades or replacement.

FAILED COMPONENT IDENTIFICATION

Failures occurred on an Urgent Failure alarm circuit card and a stationary gripper regulation card in a Westinghouse Full Length Rod Control System.

PREVIOUS SIMILAR EVENTS

Previous similar events were reported in Unit 2 LER 89-004. The transistor that failed during this event was not the same transistor that failed during the events described in Unit 2 LER 89-004.