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DUKE POWER

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
Licensee Event Report 370/91-12, Revision 1

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report 370/91-12 (Revision 1, concerning an automatic reactor trip. This report is being submitted in accordance with 10 CFR 50.73 (a) (2) (iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

T.C. McMeekin

TLP/bcb

Attachment

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IE22
1/1

LICENSEE EVENT REPORT (LER)

FACILITY NAME(1)	DOCKET NUMBER(2)	PAGE(3)
McGuire Nuclear Station, Unit 2	05000 370	1 OF 10

TITLE(4) **An Automatic Reactor Trip Was Initiated Due To A Control Rod Failure Caused By An Equipment Failure**

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)
										05000
11	8	91	91	12	1	12	9	91		05000

OPERATING MODE(9)	1	THIS REPORT IS SUBMITTED PURSUANT TO REQUIREMENTS OF 10CFR (Check one or more of the following)(11)							
POWER LEVEL(10)	100%		20.402(b)		20.405(c)	X	50.73(a)(2)(iv)		73.71(b)
			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)
			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	
Terry L. Pedersen, Manager, Safety Review Group	704	875-4487

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	
AW	RBK	IWPSUP	W120	YES							

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 November 8, 1991, at approximately 1142, Operations (OPS) Control Room personnel were performing the monthly procedure PT/2/A/4600/01, Rod Cluster Control Assembly Movement Test. Shutdown Banks A and B moved properly. However, Shutdown Bank C dropped into the core as the Reactor Operator at the controls attempted to step this bank in. The Solid State Protection System subsequently generated a Negative Flux Rate Trip signal which automatically tripped the Reactor. OPS Control Room personnel also initiated a Manual Reactor Trip as required by the Reactor Trip procedure. Diesel Generator 2B was running at the time and the emergency breaker for Diesel Generator 2B opened due to an overload when a low-low level in Steam Generator A caused the Auxiliary Feedwater and Nuclear Service Water Pumps to start. Unit 2 was in Mode 1 (Power Operation) at 100 percent power prior to the trip. The Unit performed as expected during the transient and there were no nuclear safety significant problems. An investigation was performed and it was determined that an electronic equipment failure within the Shutdown Bank C input logic circuit had caused the stationary rod gripper coils to stay de-energized too long. An independent safety review was performed and it was determined that it was safe and prudent to restart the Reactor. Unit 2 was returned to Mode 1 on November 9, 1991, at 0510. This event is assigned a cause of Equipment Failure due to an electronic failure in the Rod Control system circuitry.

EVALUATION:

Background

The Full Length Rod Control system [EIIS:JL] is used for Reactor [EIIS:RCT] Control, Startup, and Shutdown to compensate for short term reactivity changes. Every 31 days, each Control Rod [EIIS:ROD] Drive is determined operable by movement of at least 10 steps in any one direction. This operability determination is accomplished by procedures PT/1 and 2/A/4600/01, Rod Cluster Control Assembly (RCCA) Movement Test.

Each RCCA has a Digital Rod Position Indicator (DRPI) [EIIS:AA] channel [EIIS:CHA] which displays the position of each group of control rods [EIIS:ROD]. Movements of each bank of rods can be made manually as necessary and monitored using the DRPI and Rod Step Demand Counter positions displayed in the Control Room [EIIS:NA]. The Rod Step Demand Counter indicates the demand position which has been entered by OPS personnel to the Rod Control system.

Technical Specification (TS) 3/4.8.1.1.d requires that with the unit in Modes 1 (Power Operation), 2 (Startup), or 3 (Hot Standby) and with steam pressure greater than 900 psig and one diesel generator [EIIS:DG] inoperable, demonstrate the operability of the remaining diesel generator by performing a 1 hour run at 4000 kw within 24 hours or be in at least Hot Standby within the next 6 hours and in Mode 4 (Hot Shutdown) within the following 30 hours.

Description of Event

On November 8, 1991, at approximately 1142, Operations (OPS) Control Room personnel were performing the monthly RCCA movement test as directed by procedure PT/2/A/4600/01. Shutdown Banks A and B moved properly. However, Shutdown Bank C control rods dropped into the core as the Reactor Operator at the Controls (ROATC) attempted to step this bank in. The Solid State Protection System (SSPS) [EIIS:JC] subsequently generated a High Negative Flux Rate Trip signal which automatically tripped the Reactor. OPS personnel initiated standard Reactor Trip procedures EP/2/A/5000/01, Reactor Trip or Safety Injection, and EP/2/A/5000/1.3, Reactor Trip. The ROATC observed indication of the rod drop on the DRPI and immediately initiated a manual Reactor Trip as required by these procedures. Unit 2 was in Mode 1 at 100 percent power prior to the trip. OPS personnel observed that the first out annunciator panel [EIIS:AN] did not respond as expected. The "P/R Hi Flux Rate Rx Trip" light was illuminated but not the "Reactor Trip" light as expected. It was also determined by Instrument and Electrical (IAE) and Maintenance Engineering Services (MES) personnel that the first out annunciator failure was due to an electronic failure on a memory circuit card, a non-safety related portion of the SSPS. An investigation of the trip was immediately performed by appropriate McGuire Nuclear Station (MNS) personnel and it was determined that

an equipment failure within the Control Rod Shutdown Bank C input logic circuit in the Rod Control system had inadvertently de-energized the control rod stationary and movable gripper coils [EIIS:CL] simultaneously. This caused the control rods to fall. The protection circuitry was also evaluated and it was determined that the protection portion of the SSPS performed as designed.

At the time, Diesel Generator 2B was fully loaded and in the middle of a 1 hour run to satisfy TS surveillance requirements due to a Diesel Generator Cooling Water (KD) system [EIIS:LB] leak on Diesel Generator 2A which occurred on November 7, 1991. Diesel Generator 2A was operable, but not running at the time. OPS personnel were in the process of re-establishing normal feedwater flow on Unit 2 when the motor [EIIS:MO] driven Auxiliary Feedwater (CA) [EIIS:BA] and Nuclear Service Water (RN) system [EIIS:BI] pumps [EIIS:P] automatically started on low-low Steam Generator [EIIS:SG] A level. This introduced a momentary voltage drop in Essential Bus [EIIS:EB] 2ETB which caused Relay [EIIS:RLY] 50DGT [EIIS:50], Diesel Generator 2B Instantaneous Overcurrent, to actuate and open the emergency breaker for Diesel Generator 2B.

On November 8, 1991, the root cause of the trip could not be determined, therefore, at 1600, an independent safety review was subsequently performed by OPS Management personnel, the Station Manager, Integrated Scheduling (IS) personnel, Performance (PRF) personnel, IAE personnel, MES personnel and McGuire Engineering Management. It was determined during this review that it was safe and prudent to restart the Reactor. Unit 2 was returned to Mode 1 on November 9, 1991, at 0510.

Conclusion

This event is assigned a cause of Equipment Failure due to a circuit card failure in the Rod Control system, which resulted in Shutdown Bank C falling into the core. The activities in progress at the time of the event were routine. Prior to the event, there were no alarms [EIIS:ALM] or abnormal indications associated with rod control. The OPS personnel involved felt very comfortable performing procedure PT/2/A/4600/01 and there were no procedure discrepancies noted.

Extensive and thorough troubleshooting by IAE, MES, PRF, and OPS personnel narrowed the cause of the rods dropping into the core to an intermittent failure within the logic cabinet [EIIS:CAB] of the Rod Control system. This was established because monitoring equipment had previously been attached to the logic and power cabinets on Shutdown Bank C of the Rod Control system. This equipment was connected to collect data for analysis due to previous intermittent failures within the rod control circuitry. The exact cause of failure within the control circuitry has not been determined. Prior to this event, because of the previous failures in this system, all known avenues of investigation and analysis were ongoing and are

being thoroughly evaluated and are continuing to be vigorously pursued. McGuire Management and Engineering staff have considered many options, and will continue to evaluate other options when they become known or available.

Diesel Generator 2B was being run as required by TS 3/4.8.1.1.d because of a valid failure on Diesel Generator 2A from the previous day, November 7, 1991. The valid failure of Diesel Generator 2A is documented in Diesel Generator 2A Special Report, Docket 300, dated December 6, 1991, and will be submitted to the NRC.

The emergency breaker for Diesel Generator 2B opened when the motor driven CA and RN system pumps automatically started, as designed, to provide assured cooling water to the steam generators. Diesel Generator 2B and the off site power source were aligned to Essential Bus 2ETB. Diesel Generator 2B was under full load conditions prior to the CA and RN system pump motors starting. This simultaneous starting of two large motors introduced a momentary voltage drop in Essential Bus 2ETB which caused Instantaneous Overcurrent Relay 50DGT to actuate. Relay 50DGT is provided to protect the diesel generator from overcurrent caused by a Normal Auxiliary Power (EPB) system [EIIS:EA] Blackout or fault occurring while the off site power system and diesel generator are paralleled. Subsequently, Relay 50DGT opened the emergency breaker for Diesel Generator 2B. This response was evaluated by McGuire Engineering staff and it was determined that the diesel generator control circuitry performed as designed. If a Blackout condition had existed, the emergency bus would have been cleared, then the CA and RN motor loads, along with other Blackout loads would have been sequenced on by the Diesel Generator Load Sequencer and the emergency breaker for Diesel Generator 2B would not have opened.

OPS personnel responded to the transient in a timely manner to stabilize Unit 2. With the exception of the diesel generator trip and annunciator first out problem, there were no anomalies noted during the Reactor Trip. All other equipment and systems operated within specifications and as expected during this Reactor Trip.

A review of the Operating Experience Program Database for the 24 months prior to this event revealed 4 Reactor Trip events in which the root cause was Equipment Failure or Possible Equipment Failure. The previous events were documented on Licensee Event Reports (LERs) 369/90-23, 369/90-25, 370/90-07, 370/91-08. LERs 370/90-08 and 370/91-07 also involved a failure of the Rod Control system; therefore, this problem is considered recurring. LER 370/90-08 involved Shutdown Bank E falling into the core for unknown reasons and the cause was never found. As a result of that event, an ongoing electronic monitoring program was established to identify the root cause of erratic failures within the Rod Control system. Prior to this event, there had been no additional failures detected by this equipment. However, MES and IAE personnel were continuing to research in an attempt to identify the cause of the previous intermittent failures. LER 370/91-07 involved a Reactor quadrant power

tilt ratio problem. This event was caused by control rods being mispositioned greater than TS limits of +/- 12 steps. No corrective actions for that event would have prevented this event from occurring.

This event is Nuclear Plant Reliability Data System (NPRDS) reportable. A search of the NPRDS database revealed numerous failures of rod control systems. Apparently, this appears to be an industry concern.

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive material as a result of this event.

CORRECTIVE ACTIONS:

Immediate: OPS personnel implemented procedures EP/2/A/5000/01, Reactor Trip or Safety Injection and EP/2/A/5000/1.3, Reactor Trip.

Subsequent: 1) IAE personnel tested, then replaced two circuit cards in the logic and power cabinets for Shutdown Bank C control rods, as directed by Work Request 146129.

2) IAE and MES personnel verified the SSPS protection circuits performed as required, as directed by Work Request 146127.

3) IAE personnel downloaded traces of electronic circuit performance within the stationary gripper circuit during the control rod failure.

4) MES personnel took the failed decoder and firing circuit cards to the Westinghouse test facility in Pittsburgh, Pa. and tested them. The test did not identify why the cards failed while installed in the MNS rod control equipment.

5) A telephone survey of the industry was conducted by MES personnel which focused on rod control problems. A large number of utilities were identified that have had rod control equipment problems.

6) MES personnel performed an NPRDS data search which focused on rod control failures. The database search revealed numerous failures related to rod control equipment.

7) MES and IAE personnel investigated the use of DC rod control hold

circuitry to test timing circuit cards prior to actually moving the cards. The initial test was inconclusive, however, MES and IAE personnel have planned additional testing of this feature.

8) A conference call was held between Duke personnel, Duke assigned Westinghouse Engineering personnel and Westinghouse Field Services Group personnel to discuss the MNS rod control equipment. No definite conclusion of what caused the failures of the MNS rod control equipment were found.

9) An independent safety review meeting was held with OPS Management personnel, the Station Manager, IS personnel, PRF personnel, IAE personnel, MES personnel and McGuire Engineering Management in attendance. It was decided that it was safe and prudent to restart the Reactor.

10) MES and IAE personnel corrected the first out annunciator problem as directed by Work Request 146020

Planned:

1) IAE and MES personnel will continue analysis of the Rod Control system and verify proper operation.

2) MES and IAE personnel will add forced ventilation to the Unit 1 and Unit 2 rod control cabinets.

3) Additional telephone surveys of industry rod control problems will be conducted by MES personnel.

4) MES personnel will update the Rod Control system report originally written June, 1991.

5) MES and IAE personnel will pull Unit 1 and Unit 2 rod control cards, including warehouse inventory, to obtain date codes, if available, and serial numbers.

6) IAE personnel will wire wrap connector position pins for circuit cards in the Unit 2 rod control shutdown bank C, D, and E logic cabinets.

7) This item was deleted.

8) IAE personnel will ohm and megger test the wiring between the Unit 2 rod

control logic cabinet and the remaining power cabinets and take corrective action if necessary.

9) MES personnel will evaluate the existing Unit 2 rod control equipment grounding arrangement and determine if additional grounding cables are needed.

10) MES and IAE personnel will replace transistors Q7, Q8, and Q11 on the Unit 2 rod control circuit firing cards.

11) MES and IAE personnel will continue to inspect capacitors within the Unit 2 rod control circuitry.

12) MES personnel will coordinate bringing the Westinghouse Rod Control Expert person on site during a portion of the next Unit 2 refueling outage to perform additional troubleshooting.

13) MES personnel will evaluate bringing the Westinghouse Nuclear Steam Supply System Training trailer on site during the next Unit 2 refueling outage. The unit simulation equipment within the trailer will be used to continue troubleshooting the MNS Rod Control system electronic cards.

SAFETY ANALYSIS:

The Reactor trip occurred while moving Control Rod Shutdown Bank C. The Turbine Generator [EIIS:TG] automatically tripped because of the Reactor trip. This Reactor trip initiating transient is bounded by the "Rod Cluster Control Assembly Misoperation" and the "Turbine Trip" events of the McGuire Final Safety Analysis Report Accident Analysis, Chapter 15. Single or multiple dropped RCCAs within the same group result in a negative reactivity insertion. A High Negative Flux Rate signal was generated which initiated a Reactor trip and placed the Reactor in a safe condition.

Following the Reactor trip, OPS personnel followed normal Reactor trip procedures. No abnormalities, other than the emergency breaker for Diesel Generator 2B opening and the failure of the first out annunciator panel response were noted. OPS personnel were attempting to re-establish Main Feedwater [EIIS:SJ] when Steam Generator A reached the low-low level setpoint. The RN and CA system pumps automatically started to provide feedwater to the Steam Generators to maintain a heat sink. Diesel Generator 2B was already fully loaded and subsequently opened the emergency breaker for Diesel Generator 2B on current overload due to the inrush of current when the RN and CA system pump motors started.

Other emergency core cooling and emergency electrical power systems were available, but not required to operate and were not actuated. The event presented no hazard to the integrity of the Reactor Coolant (NC) [EIIS:AB] or Main Steam (SM) systems [EIIS:SB]. There were no radiological consequences as a result of this event.

This event is considered to be of no significance with respect to the health and safety of the public.

ADDITIONAL INFORMATION

Sequence of Events:

TR-Reactor Trip Investigation Report
SRO-Senior Reactor Operators Logbook
PR-Personnel Recollection
RO-Reactor Operators Logbook

Date	Time	Event
11/07/91	1300	Diesel Generator 2A was declared inoperable due to a KD system leak. (SRO)
11/08/91	0200	The KD system leak repair work was completed on Diesel Generator 2A. (PR)
	0400	Procedure PT/2/A/4350/02A, Diesel Generator 2A Operability Test, was performed, which proved that Diesel Generator 2A was functional. (PR)
	0730	IAE personnel started work to replace a failed thermocouple on Diesel Generator 2A. (PR)
	A.M.	Unit 2 was operating at 100 percent power. (TR)
	1030	IAE personnel completed the thermocouple replacement on Diesel Generator 2A. (PR)
		OPS personnel performed procedure OP/2/A/6350/02, Diesel Generator, to verify the operability of Diesel Generator 2A. (PR)
	1100	Diesel Generator 2B started a 1 hour run to meet TS surveillience requirements. (PR)

1117 Diesel Generator 2A was declared operable. (PR)

A.M. OPS personnel initiated procedure PT/2/A/4600/01, RCCA Movement Test, for the monthly RCCA movement test. (TR)

A.M. Shutdown Banks A and B operated properly. (TR)

1142 The ROATC began to insert Shutdown Bank C control rods. (TR)

1143 The entire Shutdown Bank C control rods dropped into the core. (TR)

1143:25 The SSPS generated an automatic Reactor Trip signal due to high negative flux rate. (TR)

1143:29 The ROATC observed the control rods drop on the DRPI and manually opened the Reactor Trip breakers. (TR)

OPS personnel observed the "manual reactor trip" window in alarm, which is on first out annunciator panel 1F01. (PR)

1149:25 RN pump 2B and CA pump 2B automatically started. (TR)

Relay 50DGT actuated due to a high inrush of current on Essential Bus 2ETB, which opened the emergency breaker for Diesel Generator 2B on an overcurrent signal. (TR)

1258 OPS personnel realized that the Limiting Condition of Operation (LCO) statement for Diesel Generator 2B would not be met by 1300 due to Unit 2 trip. (TR)

The Diesel Generator 2B 1 hour run was started over. (SRO)

1303 The NRC was notified per procedure RP/0/A/5700/10, NRC Immediate Notification Requirements. (SRO)

1304 The CA and RN system pumps were secured. (RO)

1423 The First out annunciator problem was repaired. (RO)

1600 OPS Management, the Station Manager, IS, PRF, IAE, and MES personnel met to perform an independent review. (TR)

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	1600	The independent review group determined that it was safe and prudent to restart the Reactor. (TR)
		NRC resident personnel were contacted and they were informed of the restart decision. The NRC Resident person raised no additional questions or concerns. (TR)
11/09/91	0510	Unit 2 was returned to Mode 1. (SRO)