CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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FACIL:50-250 Turkey Point Plant, Unit 3, Florida Power and Light C 05000250

AUTH.NAME	AUTHOR AFFILIATION
KNORR,J.E.	Florida Power & Light Co.
HOVEY,R.J.	Florida Power & Light Co.
RECIP.NAME	RECIPIENT AFFILIATION

SUBJECT: LER 97-002-00:on 970303,manual reactor trip following rod control urgent failure alarm occurred.Caused by phase failure detection on stationary A circuits of 2BD rod control cabinet.Air conditioning replaced.W/970328 ltr.

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L-97-83
10 CFR §50.73

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

Re: Turkey Point Unit 3
Docket No. 50-250
Reportable Event: 97-002-00
Manual Reactor Trip Following a
Rod Control Urgent Failure Alarm

The attached Licensee Event Report, 250/97-002-00, is being provided in accordance with 10 CFR 50.73(a)(2)(iv).

If there are any questions, please contact us.

Very truly yours,

R. J. Hovey
Vice President
Turkey Point Plant

JEK

attachment

cc: Luis A. Reyes, Regional Administrator, Region II, USNRC
Thomas P. Johnson, Senior Resident Inspector, USNRC, Turkey Point Plant

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PDR ADOCK 05000250
S PDR

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)		
TURKEY POINT UNIT 3	05000250	1	OF	7

TITLE Manual Reactor Trip Following a Rod Control Urgent Failure Alarm

EVENT DATE (5)			LER NUMBER(6)			RPT DATE (7)			OTHER FACILITIES INV. (8)	
MON	DAY	YR	YR	SEQ #	R#	MON	DAY	YR	FACILITY NAMES	DOCKET # (S)
3	3	97	97	002	00	3	28	97		

OPERATING MODE (9)	3	10 CFR 50.73(a)(2)(iv)
POWER LEVEL (10)	1292 cpm	

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER
J. E. Knorr, Regulation and Compliance Specialist	305-246-6757

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS?	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS?

SUPPLEMENTAL REPORT EXPECTED (14) NO ☒ YES ☐	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
(if yes, complete EXPECTED SUBMISSION DATE)				

ABSTRACT (16)

On March 3, 1997, Florida Power & Light Company's Turkey Point Unit 3 was subcritical in Mode 3 proceeding toward a shutdown to begin a refueling outage.

At 0012 hours a Rod Control Urgent Failure alarm was received. Off Normal Operating Procedure 3-ONOP-028 "Reactor Control System Malfunction," was implemented to assure steady state conditions. After an attempt to troubleshoot, a reset of the alarm, and another attempt to move control rods, the reactor was manually tripped at 0041 hours.

A post-trip review established that pertinent plant parameters responded as expected. Other than the manual reactor trip, there were no reactor protection system or engineered safety feature actuations.

The cause of the urgent failure alarm was a phase failure detection on stationary A circuits of the 2BD rod control power cabinet.

The NRC operations center was notified at 0124 in accordance with 10 CFR §50.72(b)(2)(ii), Reactor Protection System Actuation.

I. DESCRIPTION OF THE EVENT

On March 3, 1997, Florida Power & Light Company's (FPL) Turkey Point Unit 3 was subcritical in Mode 3. Operations personnel were stepping control rods into the core.

With bank C control rods at 100 steps the control bank B rods began to step in from 227 steps. When the first demand to step the control bank B rods occurred, at 0012 hours, a Rod Control Urgent Failure alarm [AA:JA] was received. Off Normal Operating Procedure 3-ONOP-028 "Reactor Control System Malfunction," was implemented. After no obvious problems were identified, the urgent failure alarm was reset and a second attempt was made to insert control rods [AA:ROD]. This resulted in a single control bank B insertion step and a re-actuation of an urgent failure alarm. A "Stationary A Phase Failure," error light in power cabinet 2BD [JD:CAB,JC] was found. As a result, a decision was made to manually trip the reactor at 0041 hours and enter Emergency Operating Procedure, 3-EOP-E-0, "Reactor Trip or Safety Injection." All rods inserted as expected after the manual reactor trip.

The NRC operations center was notified at 0124 in accordance with 10 CFR §50.72(b)(2)(ii), Reactor Protection System Actuation.

II. SYSTEM DESCRIPTION

The Rod Control System controls the motion of Rod Cluster Control Assemblies (RCCAs) or control rods within the reactor by manipulating magnetic jacking mechanisms, called Control Rod Drive Mechanisms (CRDM). Control rods may be used to add positive or negative reactivity to the reactor core during reactor startups, shutdowns and normal operation. There are 45 Control Rods.

A CRDM uses magnetic forces to lift and hold an RCCA. To move an RCCA up or down, one step at a time, the rod control system sequentially energizes and de-energizes three coils in the CRDM. The three coils are the stationary gripper, the moveable gripper and the lift coil. To hold the RCCA in place, the system maintains a current through the stationary gripper coil.

The RCCAs are divided into six banks of five or eight RCCAs. These bank divisions are referred to as shutdown banks (SBA and SDB) and control banks (CBA, CBB, CBC and CBD). The positioning of each bank is established and maintained by signals developed

within the rod control system.

The rod control system is a solid-state electronic control system that moves and/or holds each RCCA according to input orders. The system is controlled by either a manual control switch or the automatic reactor control unit. Both the manual and automatic input orders control the direction and speed of the rods. This information is used by the logic cabinet to develop rod motion signals. There are two types of output signals from the logic cabinets, (1) multiplexed bank selection signals that determine which banks will move and (2) step sequencing signals which determine the direction and speed of the selected or programmed groups of control rods. The multiplexing and step sequencing signals are used by the power cabinets to govern how long each power thyristor bridge will conduct, which governs the current sent to CRDM coils.

The power cabinets each contain five bridge control circuits (one circuit for movable coils, one for lift coils and three for stationary coils) to convert 3-phase, ac input power into a sequenced dc current. Each bridge circuit contains three printed circuit cards which receive, process, and output the gating signals to the silicon-controlled rectifiers (SCRs). The cards that control the SCRs are the firing, phase and regulation cards. The sequenced firing of the SCRs control the current supplied to the stationary, lift and movable coils. Additional circuit cards within each power cabinet provide failure detection and alarming.

The rod control system has a number of alarms that can be annunciated. The one which occurred in this case was a "Rod Control System Urgent Failure." The Annunciator Response Procedure for this alarm, 3-ARP-097.CR, "Control Room Annunciator Response," provides that the trouble lights in the rod control logic and power cabinets be checked. This alarm indicates that an internal failure has occurred in the rod control equipment that has in turn limited the ability of the rod control system to move rods. When this alarm is received, automatic and manual rod motion is prevented. The trouble in this case was indicated by the failure detector lamp for the "stationary A phase control" card (a card used to control the rectification of the A phase of a three phase AC supply for the stationary coils) in the 2BD rod control power cabinet.

III. CAUSE OF THE EVENT

The reactor trip was a manual reactor trip in order to complete the planned plant shutdown that was in progress. The cause of the inability to drive the Control Bank B control rods was a phase failure detection in the 2BD rod control power cabinet. The cause of the phase failure is being investigated by thorough testing associated with the current system refueling outage scheduled work activities.

Contributing Causes:

During the Unit 3 shutdown for refueling cycle 16, a rod control system urgent failure alarm occurred when inward motion was demanded for the control bank B control rods. The trouble was localized to the 2BD rod control power cabinet based on the installed system fault lights. Specifically, the "Stationary A Phase Failure" detector light on the failure detection card was lit. According to the vendor technical manual, this failure light is an indication of loss of an AC power phase or a faulty control card in the power cabinet. The phase, regulation, and firing cards were removed and tested by the vendor at elevated temperatures. No faults were identified on the phase card. The firing and regulation cards had minor test deficiencies identified which are not believed to have caused the indicated phase failure. The failure detection card was also tested, and with the exception of a loose light socket, no faults were found. To date it is not believed that the individual or combined effects of the card deficiencies were the cause of the phase failure detection on this power cabinet. Additional testing is proceeding as the plant and equipment conditions permit during the current refueling outage.

Additional Information:

In October 1995, several rods in the 2BD power cabinet dropped due to water intrusion from an overflowing air conditioner drip pan (LER 250/95-007). The other components in the 2BD power cabinet were inspected for water damage and tested to assure continued operability and reliability of the rod control system. Other cabinets in the area of the water leakage were also inspected. Water intrusion or damage from the previous water intrusion event is not a factor in this event.

In February 1996, during a Unit 3 startup, a Rod Control Urgent Failure Alarm occurred in the 1BD and 2BD power cabinets. After

initial investigation the alarm was reset and a normal shutdown was performed to further investigate and correct the problem. After shutdown, testing revealed one failed circuit card and a bad card edge connector.

Several other cards were replaced, as a preventive measure, when the faulty card in control group B and C could not be positively identified. Vendor analysis of the six suspect cards revealed that only one card, the group C regulation card, failed initial cabinet testing. Testing of this card identified a bad zener diode (CR12) within the auctioneering amplifier.

In September 1996, two control rods in control bank C dropped. The cause of the problem was found to be a failed regulation card in the stationary control circuits of the 2AC rod control power cabinet. Vendor testing of the regulation card at elevated temperatures revealed several discrepancies centered around the inability of the V_{err} signal to achieve its maximum output voltage value. A single component failure could not be identified on the card and the vendor recommended that the card not be returned to service. A thorough review of system failures and operating conditions, during and prior to this event, identified a room air conditioner that had been operating at reduced capacity for a period of time. This may have caused some accelerated aging of the cards in the power cabinets. Corrective actions were put in place to replace the degraded room air conditioner, test the cards in the rod control cabinets during the refueling, and add additional forced cooling to the rod control power cabinets.

In January of 1997, during routine control rod testing one control rod in the 1BD power cabinet was dropped into the core. A reactor shutdown was performed to perform troubleshooting and testing. The failure was isolated to a faulty AC amplifier card in the rod control logic cabinet. This failure does not appear to be related to this or other previous events.

No conclusive determination can be made whether the number of failures are related to age or accelerated aging as a result of the malfunctioning room air conditioning unit. Phase cards have been dynamically tested and minor deficiencies (solder joint anomalies) have been found and corrected. The Unit 4 system, which has cards of similar age, has not been experiencing the problems seen on the Unit 3 system. Corrective actions in this LER are intended to address both potential problems.

IV. ANALYSIS OF THE EVENT

A manual reactor trip is an expected corrective action for conditions such as are described in this event report. Plant procedures provide operator guidance in responding to the transient conditions, and assure that the plant is stabilized in a safe condition in accordance with the plant Technical Specifications. The unit was stabilized in Mode 3 in accordance with approved plant procedures.

A post-trip review was conducted to assess the proper operation of safety related equipment. This review established that plant parameters responded as expected. Other than the manual initiation of the reactor trip, there were no manual or automatic reactor protection system or engineered safety feature actuations.

Based on the above, the health and safety of the public were not adversely affected.

V. CORRECTIVE ACTIONS

1) An inspection of the Unit 3 2BD power cabinet is being performed as part of the refueling activities in order to establish the root cause of this event.

2) Dynamic testing of Unit 3 rod control cards that are related to this or the previous events is being performed during the refueling outage.

3) The firing cards in the power cabinet card cage, which are the main heat producing source in the card cage area, have been replaced with newer low heat producing cards during the current Unit 3 refueling outage.

4) Two zener diodes on each regulation card, located in the area where heat from the firing cards can impact the regulation card components, have been replaced.

5) A review of the phase card circuits did not reveal any zener diodes in heat affected areas in the vicinity of the firing cards. All phase cards have been dynamically tested. Minor deficiencies were found and corrected.

6) The degraded room air conditioning air handler has been replaced.

7) Additional forced air cooling fans have been added to the rod control power cabinets to enhance the cooling in the cabinets and prolong the life of the cabinet components.

VI. ADDITIONAL INFORMATION

EIIS Codes are shown in the format [EIIS SYSTEM: IEEE component function identifier, second component function identifier (if appropriate)].

A) A manual trip was initiated due to a failure in a power supply in a similar cabinet in 1995. This event was described in LER 250/95-004. These power supplies have been replaced with a new model.

B) LER 250/95-007 describes a number of dropped control rods which occurred as a result of water intrusion into the power control cabinet described in this LER.