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10 CFR § 50.73
L-2006-005

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

Re: Turkey Point Unit 4
Docket No. 50-251
Reportable Event: 2005-006-00
Date of Event: November 11, 2005
Manual Reactor Trip due to Rod Control Urgent Failure Alarm

The attached Licensee Event Report 50-251 / 2005-006-00 is being submitted pursuant to the requirements of 10 CFR 50.73(a)(2)(iv)(A) to provide notification of the subject event.

If there are any questions, please call Mr. Walter Parker at (305) 246-6632.

Very truly yours,

Terry Jones

Terry O. Jones
Vice President
Turkey Point Nuclear Plant

OH
Attachment

cc: Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, Turkey Point Nuclear Plant

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NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Turkey Point Unit 4	05000251	1 OF 6

4. TITLE
Manual Reactor Trip Due To Rod Control Urgent Failure Alarm

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
11	11	2005	2005	- 006 -	00	01	10	2006	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE: 3

10. POWER LEVEL: 0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Olga Hanek - Licensing Engineer	305-246-6607

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	AA	RLY	C345	Y					

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

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On November 11, 2005 at approximately 1413 hours, Unit 4 was in Mode 3 hot standby, performing a normal reactor startup evolution, with Shutdown Bank A fully withdrawn and attempting to withdraw Shutdown Bank B, when a Rod Control Urgent Failure Alarm was actuated due to failure of the 2BD rod control power cabinet. After gathering data and indications for troubleshooting, a manual reactor trip was initiated on November 11, 2005 at approximately 1502 hours to determine the cause of the failure and effect the repairs. All rods fully inserted and the unit remained in Mode 3. There were no other required or actual Engineered Safety Features System actuations. The root cause was identified as failure of a C.P. Claire Mercury wetted multiplexing relay MXR2 in Power Cabinet 2BD. The relay was replaced and the system was returned to operable status. This event had no adverse effect on the operating crew's ability to safely shutdown the reactor; therefore, the health and safety of the public were not affected.

DESCRIPTION OF THE EVENT

On November 11, 2005 at approximately 1413 hours, Unit 4 was in Mode 3, hot standby, performing a normal reactor startup evolution, with Shutdown Bank A fully withdrawn and attempting to withdraw Shutdown Bank B, when a Rod Control Urgent Failure Alarm [AA:JA] was actuated. The urgent failure occurred during the first step of rod motion for Shutdown Bank B. Upon investigation, Power Cabinet 2BD [AA:CAB] was found with an Urgent Failure light. After gathering data and indications for troubleshooting, a manual reactor trip was initiated on November 11, 2005 at approximately 1502 hours to determine the cause of the failure and effect the repairs. All rods fully inserted and the unit remained in Mode 3. There were no other required or actual Engineered Safety Features System actuations. Therefore, this event did not challenge or adversely affect the health and safety of the public.

BACKGROUND

The rod control system controls the motion of the control rods within the core, in response to signals from the In-Hold-Out switch or the reactor control unit. The major components include the reactor control unit, logic cabinet, power cabinets, rod drive motor-generator sets, and the control rod drive mechanism.

The rod control system is a solid-state electronic control system that moves and holds the rod cluster control assembly (RCCA) according to input orders. The control rod drive mechanism is an electromagnetic stepping type with three actuating coils. To move the RCCA up or down one step at a time, the system sequentially energizes and de-energizes the three coils. To hold the RCCA in place, the system keeps a stationary gripper coil energized.

The system is controlled by either the In-Hold-Out switch (MANUAL/ INDIVIDUAL BANK SELECT) or the reactor control unit (AUTOMATIC). Both of the components generate a rod speed and direction signal which is used in the logic cabinet. When using MANUAL OR INDIVIDUAL BANK SELECT control, the direction signal is generated by the In-Hold-Out switch.

The logic cabinet generates current regulating signals for the power cabinets, based upon speed and direction control input signals. Two types of current regulating signals are transmitted to the power cabinets: 1) bank selection (multiplexing) signals which determine the group/groups to move, and 2) step sequencing signals which establish the direction and speed of the selected or programmed group/groups.

Each power cabinet contains rod motor power circuits to operate the moving and lift coils for each control rod. The power circuits in Power Cabinet 2BD are shared between three control rod groups, Group A, Group B, and Group C. The 2BD Power Cabinet Group A power circuits are used for Control Bank B Group 2 (CB-B) control rods; the 2BD Power Cabinet Group B power circuits are used for the Shutdown Bank B

Group 2 (SB-B) control rods. The Rod Control System Logic allows only one group of control rods within a power cabinet to be moved at any one time. Rod Control System multiplex signals are used to align the Power Cabinet power circuits to the group desired for control rod motion.

A Rod Control Urgent Failure occurs when the built-in diagnostics of the rod control system detect a condition that could result in improper rod motion. The multiplex error detection circuitry compares the multiplex demand signal, derived from the Logic Cabinet (Power Cabinet communication signal), against voltages measured on the actual power line (voltage applied to lift and move coils for the control rods). If voltage is detected on the power circuit for either of the two group control rods not selected for motion, a multiplex error signal is generated, resulting in a Rod Control System Urgent Failure. An Urgent Failure can be generated from any one of the Rod Control System Power Cabinets (1AC, 2AC, 1BD, 2BD) or from the system Logic Cabinet.

The Rod Control System Power Cabinet contains additional indicating lamps internal to the cabinet that can be used to diagnose failures in the cabinet. The Group Selection Indicating lamps provide a direct indication of which multiplex thyristors are supplied with a gate signal needed to fire the thyristors supplying power to the control rod lift and moving coils. The three group select lamps are operated by contacts on multiplex relays MXR1 and MXR2.

ANALYSIS OF THE EVENT

During this event, the Rod Control System Urgent Failure indicator lamp was illuminated for Power Cabinet 2BD. No other abnormal indications were noted on the other Power Cabinets or on the Logic Cabinet.

The diagnostic lamps provided in Power Cabinet 2BD indicated a multiplex error had occurred for Group B. This error indication showed that Power Cabinet 2BD Group B control rods (Control Bank D Group 2) attempted to move when the commanded multiplex signal was selected to a group other than Group B. At the time of the event, Shutdown Bank A was fully withdrawn and withdrawal of Shutdown Bank B was being initiated. Therefore, the commanded multiplex signal should have required motion of Power Cabinet 2BD Group C (Shutdown Bank B Group 2) control rods. Contrary to this, it was found that the group selection indicating lamps on the Power Cabinets indicated that Group C was selected on all cabinets except for Power Cabinet 2BD. Power Cabinet 2BD group selection indicating lamp showed that the Power Cabinet was selected to Group B (Control Bank D Group 2).

With the Control Room bank selector switch aligned for operation of Power Cabinet 2BD Group C (Shutdown Bank B, Group 2), the illumination of the Power Cabinet 2BD Group B group selection indicating lamp indicates that a multiplex error is in progress, in that motion is being attempted on the wrong group in the Power Cabinet. In order to have Group B group selection indicating lamp lit, Power Cabinet 2BD Group B relay MXR2 must be in its energized state and relay MXR1 must be in the de-energized state. For Power Cabinet 2BD Group C (Shutdown Bank B Group 2) group selection indicating lamp to be lit, both MXR1 and MXR2 must be in their de-energized state.

Troubleshooting activities determined that the cause of this event was that the Power Cabinet 2BD MXR2 relay did not change to the de-energized state when provided with the correct control signal for the Logic Cabinet. The C.P. Claire MXR2 Mercury wetted relay was "stuck" in its energized state, a known failure mode for these relays. As part of the troubleshooting effort using the Group B lamp as an indication (illuminated), the MXR2 relay was gently tapped. Immediately upon tapping the relay the Group B lamp extinguished and the Group C lamp illuminated, indicating that the Power Cabinet was now aligned as it should be based on the position of the Bank Selector switch in the Control Room.

The MXR2 relay was replaced and the system was returned to operable status.

CAUSE OF THE EVENT

The cause of the Rod Control Urgent Failure alarm actuation was the movement of Control Bank D Group 2 rods when the control system commanded that Shutdown Bank B Group 2 rods should have moved. The cause for this improper Rod Control System operation was the failure of Power Cabinet 2BD MXR2 C.P. Claire Mercury wetted multiplexing relay.

As noted above, the subject relay utilizes Mercury wetted contacts. A desirable feature of mercury contacts is that they have very low resistance and are not subject to wear like conventional contacts. However, industry operating experience has shown that the mercury will redistribute within the contact over time, resulting in unreliable operation.

At the time of the event, the Turkey Point Preventive Maintenance Basis document for periodic rod control maintenance required periodic maintenance of the Mercury wetted relays at intervals that are not consistent with industry practice. Industry recommendation is to perform periodic maintenance of the Mercury wetted relays every refueling outage. The periodic maintenance activity is to gently shake the relay, re-insert the relay into its base, and tap the relay to redistribute the mercury within the contact. The periodic maintenance was performed on the Mercury wetted relays for both Units 3 and 4 during the last refueling outage which was less than 18 months, therefore the periodic maintenance frequency did not contribute to this failure.

The Mercury wetted MXR2 multiplexing relay was replaced. Mercury wetted relays are considered highly reliable when periodically exercised. The observed failure is considered a low probability event and an outlier based on industry experience. Therefore, no other corrective actions are required.

Procedure 0-PMI-028.5, "Rod Control System Preventive Maintenance And Power Cabinet Functional Test," will be revised to include the industry recommended maintenance activities and frequency of every 18 months for the mercury relays in the rod control cabinets.

GENERIC IMPLICATIONS

The C.P. Claire Mercury wetted relays are only used in the Rod Control Power Cabinets in Units 3 and 4. The periodic relay maintenance required by plant procedures had been performed on both Units 3 and 4 during the 2004/2005 refueling outages. No other issues have occurred on Units 3 or 4 over the multiple startups and surveillance activities. The performance trend of Units 3 and 4 indicates that the condition of remaining power cabinet relays is acceptable.

REPORTABILITY

A review of the reporting requirements of 10 CFR 50.72 and 10 CFR 50.73 and NRC guidance provided in NUREG-1022, Revision 2, Event Reporting Guidelines 10 CFR 50.72 and 10 CFR 50.73, was performed for the subject condition. As a result of this review, the condition is reportable as described below.

This event is reportable in accordance with 10 CFR 50.73(a)(2)(iv)(A), due to the actuation of the reactor protection system and 10 CFR 50.73(a)(2)(iv)(B)(1) due to initiation of a manual reactor trip. In addition, this event was reported on November 11, 2005 in accordance with 10 CFR 50.72(b)(3)(iv)(A) for a valid reactor protection system actuation (Event Number 42137).

ANALYSIS OF SAFETY SIGNIFICANCE

The rod control system controls the motion of the control rods within the core, in response to signals from the In-Hold-Out switch or the reactor control unit. The failure of the multiplexing relay MXR2 did not affect the ability of the control rod system to insert rods. When the manual reactor trip was initiated to determine the cause of the failure and effect the repairs, all rods fully inserted and the unit remained in Mode 3.

This event had no adverse effect on the operating crew's ability to safely shutdown the reactor; therefore, the health and safety of the public were not affected.

CORRECTIVE ACTIONS

Immediate Actions

1. The C.P. Claire Mercury wetted multiplexing relay MXR2 was replaced.
2. The Rod Control System was returned to service.

Long Term Actions

1. Plant procedure 0-PMI-028.5, "Rod Control System Preventive Maintenance And Power Cabinet Functional Test," will be revised prior to the next Unit 3 Spring 2006 refueling outage, to incorporate the industry practice for maintenance activities and intervals of the Mercury wetted relays.

ADDITIONAL INFORMATION

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

SIMILAR EVENTS

No similar event related to Rod Control System malfunctions due to failure of C.P. Claire Mercury wetted relays has occurred at Turkey Point.