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10 CFR § 50.73
L-2008-241
November 6, 2008

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555-0001

Re: Turkey Point Unit 4
Docket No. 50-251
Reportable Event: 2008-004-00
Date of Event: September 8, 2008
Undervoltage Trip Time Delay Relays Cause Loss of Function

The attached Licensee Event Report 05000251/2008-004-00 is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v), and 10 CFR 50.73(a)(2)(vii) to provide notification of the subject event.

If there are any questions, please call Mr. Robert Tomonto at 305-246-7327.

Very truly yours,

William Jefferson, Jr.
Vice President
Turkey Point Nuclear Plant

Attachment

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

JE22
NRR

NRC FORM 366 (9-2007)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104	EXPIRES: 08/31/2010
LICENSEE EVENT REPORT (LER)		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.	

1. FACILITY NAME Turkey Point Unit 4	2. DOCKET NUMBER 05000251	3. PAGE 1 of 7
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4. TITLE
Undervoltage Trip Time Delay Relays Cause Loss of Function

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
9	8	2008	2008	004	00	11	6	2008		
									FACILITY NAME	DOCKET NUMBER
									FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE 1	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: <i>(Check all that apply)</i>									
10. POWER LEVEL 100	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input checked="" type="checkbox"/> 50.73(a)(2)(vii)						
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)						
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)						
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)						
	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)						
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)						
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)						
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER							
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A							

12. LICENSEE CONTACT FOR THIS LER	
NAME Paul F. Czaya	TELEPHONE NUMBER (Include Area Code) 305-246-7150

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT									
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	JC	RLY, 2	T351	Y					

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE		
<input checked="" type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE)				<input type="checkbox"/> NO		
		MONTH	DAY	YEAR		
		1	30	2009		

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

On September 8, 2008, one of the Unit 4 undervoltage time delay (UVTD) relays (Agastat model E7024PB004) for Channel B of the Reactor Protection System failed during a surveillance test. Subsequent investigation revealed the cause to be the same for a failed test of the same channel on August 22, 2008 that was not repeatable from the initial failure at that time. In addition, the time delay requirements (less than 2 seconds for reactor trip) were determined to have not been met since July 14, 2008 for Channel B and August 22, 2008 for Channel A. Previously, timing was only checked during 18 month Channel Calibration. A root cause evaluation is currently underway. Preliminary indications point to relay manufacturing anomalies as the cause of the erratic response behavior. Corrective actions include: 1) Unit 3 UVTD relays were tested to ensure proper operation and timing. 2) One of each pair of Unit 4 Agastat model E7024PB004 UVTD relays was replaced with an Agastat model E7022 relay in the trip channel. The function of the other (E7024PB004) UVTD relay in each pair was revised to provide only annunciation. As a backup to the undervoltage trip, credit can be taken for reactor trip on 4.16 kV bus underfrequency for an event causing complete loss of reactor coolant system flow due to a loss of power. The reactor coolant pumps are tripped, which in turn trips the reactor, when the 4.16 kV bus frequency reaches 56.1 HZ or 93.5% of nominal 60 HZ. It would take approximately 1.25 seconds to release the control rods achieving the reactor protection function.

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DESCRIPTION OF THE EVENT

At approximately 1022 on September 8, 2008 with Unit 4 in Mode 1 at 100% power, one of the undervoltage time delay (UVTD) relays [JC, RLY, 2] for Channel B [JC, CHA] of the Reactor Protection System (RPS) [JC] failed during the monthly surveillance test. Turkey Point Unit 4 entered the 6-hour shutdown action of Technical Specification (TS) Table 3.3-1, Functional Unit 20, Action 8, for an inoperable Automatic Trip and Interlock logic channel. Troubleshooting found that relay UVTD-2B did not open contacts 3 and 5 as required when de-energized. For each RPS channel, UVTD-1 and UVTD-2 coils and contacts are arranged in parallel. In this arrangement, both relays are required to de-energize and change state in order to initiate a reactor [AC, RCT] trip. Since a replacement relay was not available, UVTD-2B contacts were removed from the reactor trip logic circuit as a compensatory measure. The surveillance test was performed again with satisfactory results. The unit exited the TS action at approximately 1349 hours on September 8, 2008. Condition Report (CR) 2008-28058 was initiated in response to this UVTD relay failure.

The test failure on September 8, 2008 was similar to a Unit 4 surveillance test failure that occurred on August 22, 2008. The unit at that time was in Mode 3 at 0% power. That failure was isolated to the Channel B UVTD relays as well; however, the symptoms could not be repeated. The failure was attributed to UVTD-1B after further troubleshooting found erratic resistance across contacts 3 and 5. Since there was only one spare relay available, UVTD-1B was replaced and the surveillance test performed successfully. That event was evaluated by CR 2008-26511. Subsequent investigation has revealed that the August 22, 2008 failure was caused by UVTD-2B and not UVTD-1B.

For the undervoltage trip, a delay time of 2.0 seconds is employed from the trip of the reactor coolant pumps (RCP) [AB, P] to prevent a spurious reactor scram caused by a momentary electrical power transient. This accounts for delays from EMF decay, the undervoltage trip circuitry (including delays to prevent spurious trips), trip breaker opening, rod cluster control assembly gripper release and logic delay times. On October 11, 2008 a test was performed to obtain as-found data prior to installation of a modification to the logic circuit. Review of the Channel A sequence of events (SOE) computer printouts found that the timing for the UVTD relays was 2.7 seconds. Unit 4 was in Mode 3 at 0% power on that date. UVTD-2A was replaced with a different model relay and UVTD-1A was disconnected from the reactor trip logic. Additional SOE reviews conducted at that time, found timing issues for Channel A as far back as August 22, 2008 (2.042 seconds) and for Channel B as far back as July 14, 2008 (5.024 seconds). CR 2008-31760 was initiated to address the circuit timing issue.

CAUSE OF THE EVENT

A root cause evaluation is currently underway. Preliminary indications point to relay manufacturing anomalies as the cause of the erratic response behavior. A supplement to this report will be submitted after receipt of the manufacturer's failure analysis report and completion of the root cause evaluation.

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ANALYSIS OF THE EVENT

UVTD-1 and UVTD-2 are Agastat model E7024PB004 relays. They are time delay (set to 0.9 – 1.0 second) to de-energize relays whose coils [JC, RLY, CL] are wired in parallel. Normally open (shelf state) contacts 3 and 5 on each relay are also wired in parallel. They provide a 2 out of 2 logic to trip upon an undervoltage event on the 4.16 kV buses. Failure of either relay to drop out would prevent the undervoltage trip function for that RPS channel. The UVTD relay coils are energized by contacts in the undervoltage relays [JC, RLY, 27] located in the A and B 4.16 kV buses.

UVTD-1B was first sent to an independent lab and then to the manufacturer for analysis. No problem was found with the relay. UVTD-2B was sent to the manufacturer (Tyco) for analysis. A preliminary report indicates that the relay had been assembled with an incorrect recycle spring. The spring was shorter than required. A final official report is expected.

Prior to shipment to the manufacturer, bench testing of UVTD-2B at Turkey Point found that the time delay period was not holding calibration. The time delay period would increase over the time that the relay remained energized. This undesirable characteristic was verified by the manufacturer. For the undervoltage trip, a delay time of 2.0 seconds is employed from the trip of the RCPs to prevent a spurious reactor scram caused by a momentary electrical power transient. This accounts for delays from EMF decay, the undervoltage trip circuitry (including delays to prevent spurious trips), trip breaker opening, rod cluster control assembly gripper release and logic delay times. On October 11, 2008 a test was performed to obtain as-found data prior to installation of a modification to replace the model E7024 relays from the trip portion of the logic circuit. Review of the Channel A SOE computer printouts from that test found that the timing for the UVTD relays was 2.7 seconds. Subsequent reviews found timing issues for Channel A as far back as August 22, 2008 (2.042 seconds) and for Channel B as far back as July 14, 2008 (5.024 seconds).

It can be concluded that the undervoltage trip function of Unit 4 Channel B was inoperable since July 14, 2008 and both channels of RPS were inoperable since August 22, 2008 until corrected on October 11, 2008, due to the timing being outside the design basis.

Calibration of UVTD relay timing is performed on an 18 month interval. The operability surveillance is performed monthly. Since the UVTD timing function is not a TS requirement, the monthly surveillance, which is designed to test TS operability, did not contain steps to verify the UVTD timing. Previously, the 18 month calibration was sufficient to ensure proper UVTD relay timing.

Reportability

TS Table 3.3-1, Functional Unit 20, provides the operability requirements for Automatic Trip and Interlock Logic. With an inoperable channel, Action 8 applies in Modes 1 and 2 and is as follows:

"Action 8 -With the number of OPERABLE channels one less than the Minimum Channels OPERABLE requirement, be in at least HOT STANDBY within 6 hours; however, one channel may be

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bypassed for up to 2 hours for surveillance testing per Specification 4.3.1.1, provided the other channel is OPERABLE."

TS Table 3.3-1, Functional Unit 20, Action 9, applies in Modes 3, 4 and 5 when the Reactor Trip System breakers [JC, BKR] are in the closed position and the Control Rod Drive System [AA] is capable of rod withdrawal. Action 9 is as follows:

"Action 9 - With the number of OPERABLE channels one less than the Minimum Channels OPERABLE requirement, restore the inoperable channel to OPERABLE status within 48 hours or open the Reactor Trip System breakers within the next hour."

Although not discovered until October 11, 2008, review of past surveillance SOE data found that from July 14, 2008 until August 22, 2008, Unit 4 did not comply with the action requirements of TS Table 3.3-1, Functional Unit 20 for the inoperability of RPS Channel B for the undervoltage trip function. From August 22, 2008 until October 11, 2008 both channels of RPS were inoperable for the undervoltage trip function. The TSs do not provide a specific action to take in the event both channels are inoperable. Therefore, TS 3.0.3 applies and is as follows:

"3.0.3 When a Limiting Condition for Operation is not met, except as provided in the associated ACTION requirements, within 1 hour action shall be initiated to place the unit, as applicable, in:

- a. At least HOT STANDBY within the next 6 hours,
- b. At least HOT SHUTDOWN within the following 6 hours, and
- c. At least COLD SHUTDOWN within the subsequent 24 hours.

Where corrective measures are completed that permit operation under the ACTION requirements, the action may be taken in accordance with the specified time limits as measured from the time of failure to meet the Limiting Condition for Operation. Exceptions to these requirements are stated in the individual specifications.

This specification is not applicable in MODES 5 or 6."

Unit 4 did not comply with TS 3.0.3 from August 22, 2008 until October 11, 2008 while both channels of RPS were inoperable for the undervoltage trip function.

TS 3.0.4 is as follows:

"3.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made when the conditions for the Limiting Conditions for Operation are not met and the associated ACTION requires a shutdown if they are not met within a specified time interval. Entry into an OPERATIONAL MODE or specified condition may be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time. This provision shall not

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prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual specifications."

Since both channels of RPS for the undervoltage trip function were inoperable since the first surveillance test failure on August 22, 2008, and since both the A and B channels of RPS were required to be operable by TS Table 3.3-1, Functional Unit 20, for the undervoltage trip, TS 3.0.4 was not complied with since Unit 4 entered Modes 2 and 1 on August 23, 2008 while not meeting the LCO.

Noncompliance with the actions of TS Table 3.3-1, Functional Unit 20, TS 3.0.3 and TS 3.0.4 are reportable to the NRC in accordance with 10 CFR 50.73(a)(2)(i)(B):

"Any operation or condition which was prohibited by the plant's Technical Specifications except when:

- (1) The Technical Specification is administrative in nature;
- (2) The event consisted solely of a case of a late surveillance test where the oversight was corrected, the test was performed, and the equipment was found to be capable of performing its specified safety functions; or
- (3) The Technical Specification was revised prior to discovery of the event such that the operation or condition was no longer prohibited at the time of discovery of the event."

As none of the three exceptions to 10 CFR 50.73(a)(2)(i)(B) apply in this case, the condition is reportable.

The loss of both channels of RPS for the undervoltage trip function is a loss of a reactor trip safety function reportable under 10 CFR 50.73(a)(2)(v):

"Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to:

- (A) Shut down the reactor and maintain it in a safe shutdown condition."

The common cause (relay unreliability) of the loss of reactor trip safety function is also reportable under 10 CFR 50.73(a)(2)(vii):

"Any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems or two independent trains or channels to become inoperable in a single system designed to:

- (A) Shut down the reactor and maintain it in a safe shutdown condition."

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ANALYSIS OF SAFETY SIGNIFICANCE

Reactor coolant flow is a monitored parameter used to initiate protective functions to protect the core against departure from nucleate boiling for loss of flow events. Three diverse and independent methods are used to detect a loss of coolant flow event.

- RCS flow instrumentation (Low RCS flow trip)
- 4.16 kV bus voltage (undervoltage trip)
- Underfrequency (RCP breaker open trip)

These methods are treated equally in the design bases and accident analysis, where they are often referred to as backups to each other.

Based upon reviews of SOE data from surveillance tests, it can be seen that as early as August 22, 2008, the undervoltage trip function for both Unit 4 RPS channels did not meet the less than 2.0 seconds assumption found in the design bases.

This is considered a worst case, in which both channels of RPS did not provide a timely response to an undervoltage condition. A loss of or degraded offsite power event would still result in a reactor trip due to the diverse and independent RCS low flow trip and RCP breakers open trip, which remained unaffected by the failed UVTD relays. For the underfrequency protection on the RCP breakers, the following analysis provides reasonable assurance that this back up to a loss of RCP power event would ensure core protection would be preserved.

With regards to safety significance, credit can be taken for reactor trip on 4.16 kV bus underfrequency on an event causing complete loss of RCS flow due to a loss of power. The RCPs are tripped, which in turn trips the reactor, when the 4.16 kV bus frequency reaches 56.1 HZ or 93.5% of nominal 60 HZ. It would take approximately 45 cycles or 0.75 seconds to reach the underfrequency setpoint and a total of approximately 1.25 seconds to release the control rods. Therefore, it is concluded that minimal safety consequence exists due to the timing failure of the UVTD relays.

CORRECTIVE ACTIONS

Corrective actions include the following:

1. Unit 3 UVTD relays were tested satisfactorily to ensure proper operation and timing, and past timing data was reviewed.
2. One of each pair of Unit 4 Agastat model E7024PB004 UVTD relays was replaced with a single Agastat model E7022 relay in the trip circuit. The function of the other (E7024PB004) UVTD relay in each pair was revised to provide only annunciation.

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3. The monthly surveillance test will be revised to also include review of the SOE printout for proper UVTD relay timing.
4. The UVTD-1B relay was first sent to an independent laboratory and then to the manufacturer for analysis. The UVTB-2B relay was tested in-house and sent to the manufacturer for analysis.

ADDITIONAL INFORMATION

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

FAILED COMPONENTS IDENTIFIED: Agastat model E7024PB004 time delay relay

PREVIOUS SIMILAR EVENTS: None