FPL

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L-2001-038
10 CFR § 50.73

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

Re: Turkey Point Unit 4
Docket No. 50-251
Reportable Event: 2001-001-00
Date of Event: January 25, 2001
Manual Reactor Trip due to Two Dropped Rods

The attached Licensee Event Report 2001-001 is being submitted pursuant to the requirements of 10 CFR § 50.73 to provide notification of the subject event.

If there are any questions, please call Olga Hanek at (305) 246-6607.

Very truly yours,

R. J. Hovey
Vice President
Turkey Point Nuclear Plant

OIH

Attachment

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

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NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	Estimated burden per response to comply with this mandatory information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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.

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TITLE (4)
Manual Reactor Trip due to Two Dropped Rods

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	25	2001	2001	- 01 -	00	03	12	2001	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)							
			20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)
POWER LEVEL (10)	045		20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)
			20.2203(a)(1)		50.36(c)(1)(i)(A)	x	50.73(a)(2)(iv)(A)		73.71(a)(4)
			20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)
			20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
			20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
			20.2203(a)(2)(v)	x	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
			20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
			20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

LICENSEE CONTACT FOR THIS LER (12)	
NAME	TELEPHONE NUMBER (Include Area Code)
Olga Hanek, Licensing Engineer	(305) 246-6607

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)									
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	AA	CON	W123	Y					

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 15 single-spaced typewritten lines) (16)

On January 25, 2001, Turkey Point Unit 4 was at 100% power performing periodic rod exercises. At 1535, while driving in Shutdown Bank B, rod H-6 of Shutdown Bank B partially dropped into the core to about 120 steps. At 1545, reactor power was reduced to less than 75% power, in accordance with Technical Specification 3.1.3.1. FPL decided to not recover the partially dropped rod or withdraw Shutdown Bank B, requiring shutdown of Unit 4. At 1950, rod H-4 in Control Bank D dropped to about 150 steps while Control Bank D was being inserted as part of the reactor shutdown. At 1951, the reactor operator manually tripped the reactor due to a single dropped rod in two different banks. All systems operated as designed and the plant was stabilized in Mode 3.

The root cause of the initial partially dropped rod was an open circuit in the Movable Gripper circuit caused by a dark green substance. The substance is being analyzed to determine its nature and origin. The root cause of the second dropped rod and the manual reactor trip is human error in communicating real time configuration while troubleshooting in-service equipment, due to weakness in the troubleshooting plan. Personnel involved in the event were counseled and training briefs were issued to all plant personnel. Procedures will be revised to enhance the communications during troubleshooting on in-service equipment.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

EVENT DESCRIPTION

On January 25, 2001, Turkey Point Unit 4 was at 100% power performing periodic rod exercises in accordance with 4-OSP-028.6, "RCCA Periodic Exercise," which requires that shutdown bank rods [AA] be stepped into the core approximately 10 to 20 steps. At 1535, while driving in Shutdown Bank B as part of the periodic exercise, rod H-6 of Shutdown Bank B partially dropped into the core to about 120 steps. The seven remaining control rods in Shutdown Bank B were at approximately 224 steps. At 1545, reactor power was reduced to less than 75% power (by boration), in accordance with Technical Specification (TS) 3.1.3.1. Reactor power was further reduced to less than 50% (by boration) in response to a quadrant power tilt ratio (QPTR) greater than 3%. A conservative decision was made to not withdraw the seven control rods in Shutdown Bank B or attempt to recover the partially dropped rod while the unit was online. Any rod motion would have resulted in control rod H-6 dropping to the bottom of the core exacerbating an already skewed power distribution. At 1915, it was determined that TS 3.1.3.5, which requires that all shutdown rods be fully withdrawn, could not be met and the exception for surveillance testing no longer applied; therefore TS 3.0.3 was applicable and a controlled shutdown of the plant was required. The time at which TS 3.0.3 was applicable was conservatively determined to be the initiating event time of 1535, the time when H-6 partially dropped into the core and was declared inoperable. At 1610, the Quadrant Power Tilt Ratio (QPTR) calculation was performed in accordance with plant procedures and was determined to be 1.03, which is greater than the TS 3.2.4 limit of 1.02. TS 3.2.4, Action 1 requires that a QPTR calculation be performed at least once per hour until either the QPTR is reduced to within its limit, or thermal power is reduced to less than 50%. Contrary to the above, the next QPTR calculation was completed at 1827 and the one hour requirement was not met. At 1856, thermal power was reduced to less than 50% (by boration) and the QPTR calculation was no longer required. At 1950, with Unit 4 in Mode 1 at about 45% power, operations personnel began a controlled reactor shutdown due to the first dropped rod H-6. When rod motion was resumed another rod in Control Bank D, rod H-4, dropped to about 150 steps. Control Bank D was being inserted at the time. At 1951, the RCO manually tripped the reactor due to a single dropped rod in two different banks. All rods inserted as expected when the reactor trip breakers were opened. The plant was stabilized in Mode 3. All systems operated as designed with the following exception: control rod H-8 rod bottom bistable light was energized, but the analog RPI indicator was observed to initially stick at midrange, and subsequently went to zero.

BACKGROUND

The Rod Cluster Control Assemblies (RCCAs or rods) are used to add negative reactivity to the reactor core. During reactor startup, RCCAs are withdrawn from the reactor core. To shut down the reactor, RCCAs are inserted into the core. There are forty-five RCCAs. In addition to the RCCAs, controlling boric acid concentration in the reactor coolant system also controls reactivity.

RCCA movement is effected through the use of a Control Rod Drive Mechanism (CRDM). Each RCCA has an associated CRDM, located on the reactor head. The CRDM is used to position the rod within the core. The CRDM uses magnetic forces to lift and hold the rod. To move the 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 low level current through the Stationary Gripper coil. Signals to the coils are provided from the rod control cabinet by a cable to the reactor head assembly. The cable is segmented at the reactor bulkhead to allow for head removal.

The Rod Control System is a solid state electronic control system consisting of four power cabinets, one logic cabinet, and the DC Hold Cabinet. The logic cabinet generates current regulating signals that are used by the power cabinets, based upon the speed, direction, and selected bank control input signals. The power cabinets generate and deliver power to the CRDM coils based upon the signals received from the logic cabinet. Power to the system is delivered via the Reactor Trip Breakers from two motor-generator sets.

The forty-five CRDMs are divided among the four power cabinets. Each cabinet supports three groups of approximately four CRDMs. Only one group may be moved at a particular time while the other groups are held stationary. For a control rod to fall, the Stationary Gripper mechanism and Moveable Gripper mechanism must simultaneously release their grip.

EVENT ANALYSIS

On January 25, 2001, operations personnel were exercising Shutdown Bank B rods in accordance with 4-OSP-028.6, "RCCA Periodic Exercise," when control rod H-6 dropped from about 224 steps to about 120 steps. Technical Specification (TS) 3.1.3.1 Action Statement d.3, requires that with one full length rod inoperable due to causes other than excessive friction or mechanical interference, power operation may continue provided thermal power is reduced to less than or equal to 75% and the Nuclear Instrumentation Setpoint (NIS) high flux trip setpoint is reduced to less than 85% power within 4 hours. Control rod H-6 was declared inoperable and reactor power was reduced to less than 70% by boration, in accordance with TS requirements.

At 1610, the Quadrant Power Tilt Ratio (QPTR) was determined to be 1.03, which is greater than the TS 3.2.4 limit of 1.02. TS 3.2.4, Action 1 requires that a QPTR calculation be performed at least once per hour until either the QPTR is reduced to within its limit, or thermal power is reduced to less than 50%. Contrary to the above, the next QPTR calculation was performed at 1827 and the one hour requirement was not met.

Troubleshooting was commenced to determine the cause of the dropped control rod H-6. Initial troubleshooting activities indicated several potential causes for the dropped control rod H-6: a diode failure, an open circuit, or a failed movable coil. Due to system design, a coil failure may be masked by diode failure symptoms. In order to confirm if coil failure was the cause of the dropped rod, removal of two fuses, FU49 and FU45, was required. With the fuses removed a continuity test was performed. The continuity test confirmed an open circuit in the Moveable Gripper circuit. The open circuit could be caused by a failed Moveable Gripper coil or a bad connection in the circuit somewhere between the cabinet and the reactor head. Further troubleshooting in the vicinity of the reactor head was needed to determine the exact cause of the failure. A conservative decision was made to not withdraw the seven control rods in Shutdown Bank B or attempt to recover the partially dropped rod while the unit was online. The decision was made

based on considerations regarding excessive radiation exposure to personnel and power distribution perturbations resulting from control rod H-6 dropping to the bottom of the core.

At 1950, when insertion of control rods was started, another rod (H-4) in Control Bank D dropped part way into the core. At 1951, the Unit 4 reactor was manually tripped due to a single dropped control rod in two different banks. All systems responded as designed and the plant was stabilized in Mode 3.

One anomaly was noted after the manual reactor trip. Although control rod H-8 rod bottom bistable light was energized, the analog RPI indicator malfunctioned, initially sticking at midrange and subsequently dropping to zero. Reactor operator response to the event was not affected by the RPI indicator malfunction; therefore it is not considered safety significant.

CAUSE OF THE EVENT

The immediate cause of the reactor trip was manual action taken by the RCO in response to indications of one control rod partially dropped in the core in two different banks. The cause of the reactor trip was the dropped control rod H-4 while commencing a controlled Unit 4 shutdown as a result of dropped control rod H-6, which was dropped during performance of the periodic control rod exercises.

Cause of Dropped Rod H-6

To move the 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. A stepping sequence (energizing and de-energizing the three coils) is completed in approximately 780 milliseconds.

Troubleshooting activities to determine the cause of the dropped control rod H-6 in Shutdown Bank B found an open circuit on the H-6 moveable gripper circuit. When rod H-6 was tasked to move, the stationary coil released as designed but the movable gripper coil failed to energize due to the open circuit and resulted in the rod dropping about 80 steps to 150 steps. The rest of the control rods in Shutdown Bank B were inserted 6 steps into the core at 224 steps. A visual inspection of the bulkhead cable connector [AA:CON] revealed a foreign, dark green substance which caused an open circuit on the movable gripper coil. At this time, the source and makeup of the dark green substance is unknown. The dark green substance is being analyzed to determine its nature and origin. All 45 CRDM cavity bulkhead connectors were inspected for foreign material. Several other connectors were found to have the dark green foreign substance. The connectors were cleaned and subsequently tested satisfactorily. One connector was replaced and the removed connector is being evaluated for degradation.

Cause of Dropped Rod H-4

Troubleshooting activities to determine the cause of dropped rod H-6 required removal of two fuses, FU49, and FU45. The Nuclear Plant Supervisor (NPS) (licensed senior operator in charge of the plant) was informed that two fuses were to be pulled for troubleshooting of the Moveable Gripper coil of rod H-6. The

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NPS was also erroneously informed that the pulled fuses only affected operation of rod H-6. Removal of fuse FU45 disabled the Movable Gripper in three rods: K-2 in Control Bank B, H-4 in Control Bank D, and H-6 in Shutdown Bank B.

After initially determining that an open circuit existed in the H-6 moveable gripper circuit, the troubleshooting activities were suspended temporarily for a planning meeting to determine the next course of action. The CRDM cabinet was shut and locked, but the fuses were not reinstalled since the team expected to return to troubleshooting after a brief meeting. The troubleshooting team discussed the impact of leaving the fuses out and concluded that reinstallation of the fuses was not necessary since troubleshooting activities were still underway. The troubleshooting team assumed that no rods would be moved without discussing it with the team and so that an action plan could be developed. There was no communication between the troubleshooting team and the control room personnel regarding the status of the rod control cabinet (fuses) and moving of control rods. Troubleshooting at the rod control power cabinet did not immediately resume.

After personnel adjourned from the planning meeting, the normal shift turnover meeting to the night shift operations personnel commenced in the control room. During the turnover meeting, it was identified that H-6 was inoperable but the information regarding the pulled fuses was not communicated to the night shift personnel. This information was not considered crucial since the dayshift operations personnel understood that the pulled fuses only affected rod H-6 in Shutdown Bank B.

A conservative decision was made to not withdraw the seven control rods in Shutdown Bank B or attempt to recover the partially dropped rod while the unit was online. When a controlled shutdown of Unit 4 was commenced by control rod insertion, rod H-4 of Control Bank D dropped part way into the core due to the absence fuse FU45.

The absence of fuse FU45 caused control rod H-4 to drop upon attempt to move Control Bank D. The root cause of this event was human error due to weakness in the troubleshooting plan with respect to communicating real time configuration while troubleshooting in-service equipment. Information important to the understanding of the equipment status was not adequately shared between the troubleshooting team and operations. Communications between the troubleshooting team and control room personnel did not include details or verification of information. The decision to leave the fuses out did not involve operations personnel and was not communicated to operations personnel.

Cause of Rod Position Indication Malfunction

After the manual reactor trip, the control rod H-8 bistable light was energized indicating the control rod was inserted in the core, however, the RPI for control rod H-8 malfunctioned, initially sticking at midrange and subsequently dropping to zero. The RPI malfunction was caused by mechanical binding of the RPI indicator. The RPI indicator was replaced and subsequently tested satisfactorily.

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Performance of QPTR

In accordance with 4-ONOP-028.3, "Dropped Rod," at 1610, the QPTR was determined to be 1.03, which is greater than the TS 3.2.4 limit of 1.02. TS 3.2.4, Action 1 requires that a QPTR calculation be performed at least once per hour until either the QPTR is reduced to within its limit, or thermal power is reduced to less than 50%. Contrary to the above, the next QPTR calculation was completed at 1827 and the one hour requirement was not met. The individual from the Reactor Engineering staff, given the responsibility to perform the QPTR calculation once per hour failed to perform the surveillance within the required time limit. The reactor engineer given the responsibility to perform the first QPTR calculation did not understand he was expected to repeat the QPTR calculation every hour. In addition, operations personnel did not verify completion of the QPTR calculation within the required time limit since the expectation was that the individual performing the first QPTR calculation would continue to perform the calculation every hour. As a result of the miscommunication between operations personnel and reactor engineering personnel, the surveillance was not performed within the required time limit.

SAFETY SIGNIFICANCE

RCCA drop is an Updated Final Safety Analysis Report (UFSAR) analyzed accident. The dropped rod event is a Condition II event that is assumed to be initiated by a single electrical or mechanical failure which causes any number and combination of rods from the same group of a given bank to drop to the bottom of the core. The resulting negative reactivity insertion causes nuclear power to decrease. An increase in the hot channel factor may occur due to the skewed power distribution representative of a dropped rod configuration. The RCCA rod drop design basis event is based on the worst credible asymmetric dropped rod configurations in the core intended to maximize the peaking factors and potential for cladding damage. The analysis for the Unit 4 core design verifies that the plant will return to a stabilized condition at less than or equal to its initial power level. In this case, the initiating event was the partial dropping into the core of control rod H-6 in Shutdown Bank B. Reactor power was reduced to less than 75% power (by boration) in response to the partially dropped rod. Therefore, the resulting peaking factors and the impact on the Departure from Nucleate Boiling Ratio (DNBR) are bounded by the results of the UFSAR analysis which assumes multiple control rods dropped to the bottom of the core from the same group at an initial reactor power level of 100%. The second partially dropped rod, H-4 in Control Bank D, occurred when reactor power was at about 45%. At this power level, the impact on DNBR will be less severe than the UFSAR analysis which assumes multiple control rods dropped to the bottom of the core and an initial power level of 100%. The reactor power and average Reactor Coolant System temperature were not allowed to stabilize at a lower value since the reactor was manually tripped in response to the second partially dropped rod.

TS 3.2.4, Action 1 requires that a QPTR calculation be performed at least once per hour until either the QPTR is reduced to within its limit, or thermal power is reduced to less than 50%. In addition, TS 3.2.4, Action 2 requires that within 2 hours either reduce the QPTR to within its limit, or reduce thermal power at least 3% from rated thermal power for each 1% of indicated QPTR in excess of 1.0. The two hour time allowance for operation with a tilt condition greater than 1.02 but less than 1.09 is provided to allow identification and correction of a dropped or misaligned control rod. The required reduction of thermal power by 3% for each percent of tilt in excess of 1.0 assures that the radial power distribution satisfies the design values. At 1545 reactor power reduction was commenced in

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accordance with TS 3.1.3.1. At 1610, the QPTR was calculated to be 1.03. At 1632 reactor power was reduced to less than 75% power. Although the QPTR calculation was not performed every hour as required by TS 3.2.4, Action 1, reactor power was much less than 91% power (the required 9% power reduction), in advance of the two hour time allowance provided by TS 3.2.4, Action 2. Therefore, the actual power distribution during this event remained within the design values assumed in the UFSAR.

Since the assumptions and results of the analysis in the UFSAR bound the conditions of the actual event, this event did not compromise the health or safety of plant personnel or the general public.

CORRECTIVE ACTIONS

The following immediate corrective actions have been completed:

1. Fuses FU45 and FU49 were reinstalled.
2. The degraded bulkhead connector that caused control rod H-6 to drop was cleaned and tested satisfactorily. All 45 CRDM bulkhead connectors were cleaned and inspected.
3. One CRDM bulkhead connector was replaced and the removed connector is being evaluated for degradation.
4. Control rod H-8 RPI indicator was replaced and tested satisfactorily.
5. Additional Operations Department oversight of maintenance activities has been implemented for troubleshooting activities involving in-service equipment.
6. Maintenance personnel involved in this event were counseled on the need to more effectively communicate with the control room operations personnel about activities that can affect in-service plant equipment.
7. Operations personnel involved in this event were counseled on the need for more effective communications with Maintenance personnel and for maintaining a clear understanding of the real time configuration of in-service equipment.
8. Operations personnel involved in this event were counseled on the need for maintaining awareness of ongoing time critical evolutions.
9. The individual who was given the responsibility of performing the QPTR calculation has been counseled on the need to perform time critical surveillances.
10. A training brief, addressed to the plant staff, was issued explaining the event and the need for more effective communications and an effective questioning attitude.

Long term corrective actions:

1. Maintenance procedures will be revised to explicitly detail cleanliness requirements for the CRDM bulkhead connectors prior to the next refueling outage.
2. The dark green substance found in the CRDM bulkhead connectors is being analyzed to determine its nature and origin.
3. The removed CRDM bulkhead connector is being analyzed for degradation.

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ADDITIONAL INFORMATION

A manual reactor trip was initiated on Unit 3 in 1999 based on multiple dropped rods due to a failure of a Stationary Gripper Regulating circuit card in the Rod Control System. This event was described in LER 250/1999-001.

Although there have been other trips due to dropped rods, e.g., LER 250/97-06 and LER 250/96-10, the root causes were not related.

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