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L-2000-242
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: 2000-004-00
Date of Event: October 21, 2000
Loss of Offsite Power and Safety Injection Actuation While in Mode 3

The attached Licensee Event Report 2000-004 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 contact us.

Very truly yours,

D. E. Jernigan For

R. J. Hovey
Vice President
Turkey Point Nuclear Plant

SM
Attachment

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

IE22

NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Turkey Point Unit 4	05000251	Page 1 of 7

TITLE (4)

Loss of Offsite Power and Actuation of Safety Injection While in Mode 3

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 NAME	DOCKET NUMBER
10	21	2000	2000	- 004 -	00	11	16	2000	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	3
POWER LEVEL (10)	0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
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	20.2203(a)(2)(ii)		20.2203(a)(4)	x	50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Stavroula Mihalakea	(305) 246 - 6454

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	FK	CBL	0040	N					

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	(If yes, complete EXPECTED SUBMISSION DATE).	x NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) **(16)**

On October 21, 2000, Turkey Point Unit 4 was in Mode 3 while restarting from the Cycle 19 refueling outage. The 4 kV vital buses were being powered from the startup transformer. At approximately 0425 hours, the startup transformer tripped causing a loss of offsite power (LOOP) to the 4 kV vital busses. The LOOP automatically started all Auxiliary Feedwater (AFW) pumps, the 4A and 4B Emergency Diesel Generators (EDGs), and the associated Emergency Load Sequencers. The 4A and 4B EDG's re-energized their respective 4 kV vital buses. An unusual event was declared at 0435 hours. As a result of the low decay heat and the loss of Reactor Coolant Pump (RCP) heat input, the steam demand from the 4B Steam Generator (S/G), supplying steam to steam driven AFW Pumps caused a safety injection actuation at 0557 hours due to differential pressure between the steam line and the 4B S/G. Safety injection was reset, offsite power was restored at 0616 hours, the EDGs were shutdown, and the plant was stabilized by restoring forced cooling using the RCPs. Turkey Point Unit 4 exited the unusual event at 0645 hours. The cause for the loss of the startup transformer was the internal failure of a control cable in the circuit for the string bus differential relays that provides the 4 kV breaker failure backup protection for the startup transformer. The faulted cable was removed from service.

EVENT DESCRIPTION

On 10/21/00 at approximately 0425 hours, a loss of the startup transformer [FK:xfmr] occurred on Turkey Point Unit 4 while in Mode 3 (Hot Standby) and restarting from the Cycle 19 refueling outage. Reactor Coolant System (RCS) [AB] temperature was at 530°F and RCS pressure was at 2285 psig. The plant conditions had been established as prerequisites for performing the Main Steam Safety Valve testing and the RCS overpressure leak inspection.

The resulting loss of offsite power (LOOP) to the 4 kv vital buses [EA:bu] automatically started all Auxiliary Feedwater (AFW) pumps [BA:p], the 4A and 4B Emergency Diesel Generators (EDG) [EK] and the associated Emergency Load Sequencers. The 4A and 4B EDG's re-energized their respective 4 kV vital buses. Operations personnel entered 4-ONOP-004, Loss of Offsite Power, to stabilize the plant and restore offsite power.

The LOOP caused automatic AFW system actuation. The AFW system had been previously realigned (as permitted by Technical Specifications) to facilitate maintenance on MOV-4-1405, 4C Steam Generator (S/G) [AB:sg] steam supply isolation valve [SJ:isv] to the AFW pumps. MOV-4-1405 was closed and its breaker open, preventing 4C S/G from supplying steam to the AFW pumps. The 4B S/G steam supply was aligned to Train 1, "A" AFW pump. The 4A S/G steam supply was aligned to Train 2, and the "B" and "C" AFW pumps. The AFW system performed as designed and caused a gradual decrease in S/G pressure and temperature, due to the minimal decay heat load present during Mode 3 operations following refueling. The 4C S/G remained stable during the event, since its steam supply valve, MOV-4-1405, was out of service (closed for maintenance).

Following the LOOP, Train 2 AFW was secured in accordance with procedures to minimize the cooldown and remain within the pressure/temperature operational limits. The 4B S/G continued to supply steam to Train 1, to "A" AFW pump, causing pressure in the 4B S/G to decrease. When pressure in the 4B S/G reached 485 psig, an automatic Safety Injection (SI) actuation [JE] occurred at 0557 hours, caused by steam line high differential pressure. Phase A containment isolation actuated as a result of the SI actuation. The Operations crew stabilized the plant using emergency operating procedures and then transitioned to normal operating procedures. SI was terminated at 0607 hours.

Station Area Operations (SAO) personnel performed troubleshooting and determined that the Unit 4 startup transformer primary string bus lockout relay 86/k had actuated with no targets. Relay 86/k actuation caused breakers 8W43, 8W90, 4AA05 and 4AB05 (startup transformer supply and load side breakers) to open, resulting in a loss of offsite power. The lockout relay was found to have a constant but false trip signal. The field cables terminated at the lockout relay in the switchyard were lifted to remove the signal and the lockout relay was reset.

The startup transformer was re-energized by offsite power at 0616 hours. One Reactor Coolant Pump (RCP) was started to restore forced flow RCS heat removal. The Operations crew transitioned back to 4-GOP-503, Cold Shutdown to Hot Standby. AFW was placed in standby. The Unusual Event was terminated at 0645 hours.

BACKGROUND

Turkey Point Units 3 and 4 are each provided with a startup transformer. Each transformer is connected to the 240 kV switchyard by two bus circuit breakers on the primary side, and has two secondary windings that connect to the plant 4 kV buses. The startup transformers are used to provide power during startup, shutdown, and after a reactor trip. The startup transformer also constitutes a standby source of power in the event of a loss of the auxiliary transformer during normal plant operation. The startup transformer can also provide a redundant source of emergency power for one bus on the opposite unit. The 86/k lockout relay is a device used to clear a startup transformer fault. It opens the 240 kV source breakers 8W43 and 8W90 in the switchyard along with 4 kV breakers 4AA05, 4AB05, 3AA22. This lockout relay actuates for a 240 kV string bus (240 kV transmission lines from the switchyard to the startup transformer) fault or for the 4 kV breaker trip failure.

EVENT ANALYSIS

Loss of Startup Transformer

On October 21, 2000 at approximately 0425 hours, Turkey Point Unit 4 experienced a LOOP due to the loss of its startup transformer. Switchyard breakers 8W43 and 8W90, and 4 kV bus breakers 4AA05 and 4AB05, tripped open, breaker 3AA22 is normally open and racked out. SAO personnel performed troubleshooting and determined that Unit 4 startup transformer primary string bus lockout relay 86/k had actuated with no targets on the fault sensing relays. Relay 86/k actuation had caused breakers 8W43, 8W90, 4AA05 and 4AB05 to open, resulting in a loss of offsite power. The lockout relay was found to have a constant trip signal. The field cables terminated at the lockout relay in the switchyard were lifted to remove the signal and the lockout relay was reset. Further troubleshooting identified that two conductors in cable F01/C1709-4C11/4 had become shorted, thus energizing the lockout relay. This cable provides a trip signal to the 86/k lockout relay in the event that a startup transformer 4 kV breaker fails to clear a bus fault on overcurrent. This cable runs from transformer protection panel 4C11T, in the cable spreading room, to protection panel C1709, in the switchyard. Megger test readings indicated that the short was internal to cable F01/C1709-4C11/4.

In order to identify the location of the faulted portion of the cable, a Time Domain Reflectometry (TDR) analysis was performed. The fault location was determined to be in underground conduit 4L198 between manholes 426 and 430 (see attached sketch), which are located on opposite sides of a bridge over the condenser discharge canal. In addition to the two cables associated with lockout relay 86/k, six other cables are routed through 4L198. All cables within this conduit were identified and evaluated for potential adverse effect on the Unit 4 startup transformer. It was determined that the failure of any of the other cables in 4L198 would not adversely affect operation of the Unit 4 startup transformer. Engineering identified nine other cables whose potential failure could separate the unit from offsite power while on the startup transformer, and determined that these cables are either not routed in any common raceways with the faulted cable (except for a short section at the switchyard control house) or are protected from physical damage associated with the faulted cable.

Additionally, the cables are not routed in any common ductbank conduits with the faulted cable. The cables in the short cable tray section at the control house were inspected and no physical damage to any cable was identified. Three cables associated with the 240 kV switchyard main generator differential and main generator breaker failure trip circuits were megger tested. Based on the test results, there was no insulation damage on these cables.

Based on the results of the above investigation, there was reasonable assurance that faulted cable F01/C1709-4C11/4 would not adversely affect other circuits associated with the operation of the Unit 4 startup transformer. Based on this conclusion, the faulted cable leads were left lifted and a redundant cable was utilized to restore the string bus protection to service.

LOOP Transient and Safety Injection Actuation

At the time of the event, the plant conditions had been established as prerequisites for performing the Main Steam Safety Valve testing and the RCS overpressure leak inspection. The RCS temperature was maintained by the RCP heat input and the atmospheric steam dump valves. The LOOP to the 4kV vital buses automatically started all AFW pumps and tripped all RCPs. The AFW system performed as designed and caused a gradual decrease in S/G pressure and temperature due to the main steam being supplied to the AFW pumps. Assessment of plant conditions required that AFW flowrate to each S/G be reduced to a minimum, since there was adequate heat sink (greater than 60% level in each S/G), with minimal heat input from the reactor core. Normal startup feedwater supply was also available from the two standby feedwater pumps. In accordance with procedure, Operations shut down (mechanically tripped) Train 2 AFW Pumps. This action stopped the slow depressurization of the 4A S/G. However, Train 1 AFW was required to remain operable due to Technical Specification requirements applicable to both Turkey Point Units 3 and 4 (AFW is a shared system for Turkey Point Units 3 and 4). Thus, the 4B S/G continued to slowly depressurize, since it continued to supply steam to the remaining "A" AFW pump. The AFW system could not be placed on standby due to the undervoltage start of the steam driven AFW pumps, which is designed to remain locked in until power is restored from the Startup Transformer. The Operating crew recognized that the continued slow depressurization of the 4B S/G would result in a SI. The steam line differential pressure of 100 psig, which protects against a steam line break upstream of the Main Steam Isolation Valves, would actuate once the 4B S/G decreased to 485 psig. This is 100 psig below the null setpoint, 585 psig, of the steam header pressure. The SI occurred on steam line differential pressure with no SI flow to RCS, since RCS pressure remained above the shutoff head of the SI pumps.

Because the LOOP had stopped the RCPs, a slow natural circulation cooldown was in progress. Since the newly refueled reactor core had minimal heat input to the RCS, the operating crew recognized that the cooldown would continue until RCP pump heat input could again be established. The cooldown gradually decreased Pressurizer (PZR) level. Charging was restored to control PZR level, prior to reaching the manual SI setpoint of 12%. PZR level was maintained above 12% throughout the event. Auxiliary Spray was used to maintain RCS pressure per procedure, since no RCPs were available

and RCS temperature was decreasing. Engineering evaluated the use of PRZ auxiliary spray during the event from the prospective of fatigue cycles on the PRZ nozzle and vessel wall. Although under normal cooldown conditions, procedures provide cautions to limit the effects of thermal cycling by controlling the number and duration of spray cycles, under the off normal conditions, these procedural limitations were not specified. The duration and magnitude of the cycles from auxiliary spray were evaluated by Engineering against the conditions originally assumed in the stress analysis for the PRZ. It was concluded that the event was not outside the analysis limits and that the overall impact on the usage factor was small.

During the safety injection, the Component Cooling Water (CCW) from the Excess Letdown Heat Exchanger containment isolation valve (CV-4-739) closed on the containment isolation phase A actuation. Approximately eight minutes later, the Excess Letdown Heat Exchanger CCW relief valve RV-4-715 lifted and did not fully reseat. The relief valve leakage was isolated after the SI event by manually closing the CCW inlet supply valve to the Excess Letdown Heat Exchanger. After CCW was reinitiated to the Excess Letdown Heat Exchanger, the relief valve had reseated. The relief valve will be replaced and tested when a replacement valve becomes available at the next opportunity.

CAUSE OF THE EVENT

The shorting of the two conductors in cable F01/C1709-4C11/4 is the root cause of this event. Based on TDR analysis, the fault location was determined to be in the underground conduit (4L198) between two manholes, (426 and 430), which are located on opposite sides of the bridge over the condenser discharge canal. The specific location of the fault in the cable could not be identified. It is conceivable that some relatively minor damage might have occurred at the time of cable installation while pulling the cable. The area of the faults was in one of the lowest elevation raceways outside the plant protected areas. There was ground water in the raceway as a result of a faulted manhole sump pump.

As part of this root cause evaluation, a TDR analysis for two previously reported failed cables was performed to determine the relative location of those faults. These cables had exhibited ground faults (conductor to ground) as well as internal faults (conductor to conductor). The results of this analysis indicate that these cables had faulted in the same general area as those that caused the loss of the startup transformer. This could indicate that there might have been some mechanistic stress imposed on these cables during initial installation, some 25-30 years ago. The stress coupled with the presence of ground water and debris introduced (because of conduit degradation), could explain the cable failures. However, absent the ability to actually inspect the faulted cables, this conclusion is based on engineering judgement and on the process of eliminating other causes. Since the actual location or condition of the two shorted conductors cannot be evaluated, a verifiable root cause is not possible. Therefore, based on an evaluation of cable routing conditions, the most probable root cause of the shorted conductors is initial cable pull damage coupled with cable degradation from water intrusion. The proposed corrective actions are based on this root cause and the contributing environmental conditions.

The cause for the automatic SI that occurred was the operating conditions that developed during the event. The newly refueled reactor core produced minimal decay heat; and, without the RCPs' heat input after the LOOP, S/G pressures decreased. The AFW could not be placed on standby due to the undervoltage start of the steam driven AFW pumps, which is designed to remain in, until power is restored from the Startup Transformer. The operating crew recognized that the continued slow depressurization of the 4B S/G would result in a SI. The operating conditions at the time of the event did not meet the entry conditions for the plant procedures that provided the steps for blocking SI during normal cooldown.

SAFETY SIGNIFICANCE

There was no effect on plant safety by this event. The event was initiated by a control cable failure in the 4 kV breaker failure backup protection circuit for the startup transformer. The reactor was subcritical and the plant was in Hot Standby. The core decay heat load was very low due to the event occurring at the end of the refueling outage. The plant responded as expected for the operating conditions that were present. Plant equipment responded as expected. Backup offsite power was available from the C bus transformer and the opposite unit's startup transformer, but was not required, as all EDGs responded as designed. The operating crew mitigated the event per plant procedures and there were no adverse consequences. Previous plant events and the Updated Safety Analysis Report (UFSAR) analyzed events were reviewed to determine if the results of this event were comparable. These previous plant events and the UFSAR analyzed events did not have initial conditions or results that were similar. This plant response was specific to the initial hot standby plant conditions. The health and safety of the public was not compromised nor adversely affected.

CORRECTIVE ACTIONS

The following corrective actions were completed:

1. Troubleshooting was performed and it was determined that Unit 4 Startup Transformer Primary String Bus Lockout relay 86/k had actuated with no targets. The lockout relay was found to have a constant trip signal. The faulted cable was identified and removed from service. The field cables, which terminated at the lockout relay in the switchyard, were lifted to remove the signal and the lockout relay was reset.
2. A walk-down of the cable route was performed to verify that there was no other visible physical damage.
3. Other cables that could cause a startup transformer loss for both Turkey Point Units 3 and 4 and cables associated with Turkey Point Unit 4 main transformer and generator were checked, and no problems were found.
4. A design package was issued to abandon the shorted conductors and to use the remaining two intact conductors from another cable for Turkey Point Unit 4 backup startup transformer protection.

5. Sump pumps and water level alarm lights were installed/repaired in switchyard manholes 427, 428, and 430. These manholes were also added to the plant's severe weather preparation procedure.

Long term corrective actions:

1. The Turkey Point Unit 3 main transformer and main generator control cables will be checked during the next Unit 3 refueling outage.
2. FPL Engineering will determine the feasibility of modifying the AFW actuation circuitry to allow AFW to be placed back into standby without having to open the steam supply motor operated valve breakers or mechanically trip the AFW pumps following a LOOP.
3. FPL Engineering will evaluate the long term reliability of other cables in the same raceways as the affected cables.
4. The Excess Letdown Heat Exchanger CCW relief valve RV-4-715 will be replaced and tested when a replacement valve becomes available at the next opportunity.

ADDITIONAL INFORMATION

There have been no other similar LERs issued for Turkey Point. EIIS Codes are shown in the format [EIIS SYSTEM:IEEE component function identifier, second component function identifier (if appropriate)].

PTN UNIT 4 STARTUP TRANSFORMER
PROTECTION CIRCUIT ROUTING