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10 CFR § 50.73
L-2009-226
October 13, 2009

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: 2009-001-00
Date of Event: August 11, 2009
4B Emergency Diesel Generator Inoperable Due to Air-bound Main Fuel Pump

The attached Licensee Event Report 05000251/2009-001-00 is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) to provide notification of the subject event.

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

Very truly yours,

Michael Kiley
Vice President
Turkey Point Nuclear Plant

Attachment

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

IE22

NRR

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2010

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)

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4. TITLE

4B Emergency Diesel Generator Inoperable Due to Air-bound Main Fuel Pump

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
8	11	2009	2009	- 001 -	00	10	13	2009	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

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

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☒ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Paul F. Czaya	305-246-7150

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

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On August 11, 2009 during a surveillance test, erratic fuel pressure indications were observed by an operator at the 4B Emergency Diesel Generator (EDG). The DC priming pump remained running beyond the point when it normally would shut off. The diesel was secured for troubleshooting and repairs. Subsequent investigation determined that the 4B EDG was inoperable for about 14.3 days, in excess of the allowed outage time of 14 days. The cause of the inoperability was an air bound engine driven fuel pump due to air in-leakage at a suction strainer. Corrective actions include replacement of the suction strainer, and revision of the maintenance procedure to ensure proper installation and gasket seating during fuel suction strainer housing reassembly. The DC priming pump would have been able to provide sufficient fuel for the 4B EDG to respond to loss of offsite power and loss of coolant accident loads while load management would have been necessary for station blackout loads. The risk impact associated with the approximate 14.3 days the 4B EDG was considered inoperable results in an ICCDP (Incremental Conditional Core Damage Probability) of 5.4E-08 and an ICLERP (Incremental Conditional Large Early Release Probability) of 2.6E-10, well below NRC thresholds. Therefore, safety significance is considered to be very low.

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NARRATIVE

DESCRIPTION OF THE EVENT

During a normal start of the 4B Emergency Diesel Generator (EDG) [EK, DG] on August 11, 2009 at approximately 1100 hours for a surveillance test, erratic fuel pressure indications were observed by an operator at the EDG. The following alarms were received at the 4B EDG Control Panel [EK, PL]: Degraded EDG, Fuel Oil Low Pressure, and Fuel Oil Priming Pump Timer Timed Out. Also, the 4B EDG Trouble annunciator alarmed in the Control Room [NA]. The DC priming pump [DC, P] remained running beyond the point when it normally would shut off. It was concluded that the engine driven fuel pump [DC, P] was air bound. The diesel was secured for troubleshooting and repairs. Condition Report (CR) 2009-22839 was initiated in response to the event.

Troubleshooting identified the most likely cause of the air binding was air in-leakage at the fuel suction strainer [DC, STR]. Re-aligning the dual suction strainer from the south strainer to the north strainer allowed a successful prime and surveillance test, after which the 4B EDG was returned to service on August 12, 2009. The suction strainer was replaced on August 19, 2009. The removed strainer assembly was vacuum-tested and confirmed to be the source of significant air in-leakage.

There had been evidence of air in the EDG fuel system during and following maintenance in January 2009. The issue was identified in several CRs but not corrected prior to the August 11, 2009 event.

Subsequent investigation determined that the 4B EDG should be considered inoperable from July 29, 2009 until the fuel system air in-leakage problem was corrected on August 12, 2009.

This event is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B).

CAUSE OF THE EVENT

The apparent causes of this event are:

1. The air in-leakage path from the deformed fuel suction strainer.
2. Untimely implementation of corrective actions.
3. Inadequate post maintenance test (PMT) during Critical Mechanical Maintenance (CMM) strainer troubleshooting, and no requirement of a formal troubleshooting plan to correctly assess the situation.

ANALYSIS OF THE EVENT

Background

Each Turkey Point unit has two associated EDGs. Technical Specification (TS) Limiting Condition for Operation 3.8.1.1.b requires a unit's two EDGs and one of the opposite unit's EDGs to be operable to

provide standby electrical power for required equipment in support of plant operation in Modes 1-4. TS Surveillance Requirement (SR) 4.8.1.1.2.a.5 requires the Unit 4 EDGs to be loaded to 2650-2850 KW for at least 60 minutes at least once per 31 days. The safety related function of the EDGs is to automatically start and provide power to required safety related loads during a loss of offsite power (LOOP) in order to achieve and maintain safe shutdown of the reactor [AC, RCT].

The EDG engine fuel oil system consists of fuel injectors, engine driven fuel oil pump, fuel oil filter [DC, FLT], and fuel oil supply and return manifolds, all located on or within the engine. Components of the fuel oil system include the duplex fuel oil suction strainer, DC priming pump, duplex fuel oil filter, engine driven fuel oil pump, check valves [DC, V] and associated piping [DC, PSP].

The engine driven fuel oil pump, an internal gear, positive displacement type pump, is mounted to and directly driven by the lubricating oil scavenging pump. Fuel oil is drawn into the inlet port filling the space created by the gear teeth coming out of mesh. The fuel oil is then trapped in the space between the gear teeth and carried to the outlet side of the pump. The fuel oil is forced from the gear teeth when they mesh and flows out through the pump outlet port under pressure. The DC priming pump is also an internal gear, positive displacement type pump. It is DC powered and operates during system priming and engine starting. It is started when the fuel oil prime pushbutton on the Engine Control Panel is pressed or when the engine is started. Once the engine driven fuel oil pump's discharge pressure is adequate (greater than or equal to 15 psig) the DC priming pump turns off. It will also auto start if the engine driven fuel oil pump's discharge pressure is too low (less than or equal to 10 psig). If the DC priming pump runs for longer than 10 seconds, an alarm will result (Fuel Oil Priming Pump Timer Timed Out). The DC priming pump is used to initially supply fuel oil to the EDG upon starting until the engine-driven pump can take over.

Analysis

Air in-leakage was first identified following 4B EDG CMM in January 2009. CR 2009-2308 documents air leaking into the south fuel oil suction strainer preventing successful venting of fuel oil piping. Disassembly of the strainer identified a mispositioned gasket. The strainer was reassembled and the fuel system successfully vented. A visual inspection of the strainer following reassembly identified deformation of the housing that may have contributed to the air in-leakage. A work request was initiated to replace the suction strainer housing during the next opportunity, which was considered to be the next 4B EDG CMM. At this point, the strainer housing deformation was not recognized as an active air leak that could impact fuel system function.

The priming button is depressed daily and the DC priming pump discharge pressure is recorded during operator rounds. On February 4, 2009, unsteady manifold pressure was found during fuel priming. CR 2009-3150 was written. A Prompt Operability Determination (POD) was performed, which attributed the cause of the unsteady pressure to air trapped in the pressure transmitter sensing line introduced during the January 2009 CMM. The POD concluded that the condition affected indication only, and that the EDG was capable of starting and loading as required, and meeting all of its design basis functions.

NARRATIVE

The 4B EDG started as required during a monthly surveillance test on February 24, 2009. The 4B EDG Trouble annunciator alarmed and cleared. CR 2009-5487 was generated and trended to CR 2009-3150. The alarm was due to low fuel oil pressure. However, the recorded fuel oil pressure was 32 psig at 1000 KW, 28 psig at 2000 KW, and 24 psig at 2750 KW – normal pressures during a run, therefore, the 4B EDG was considered operable. No other issues were noted during the run. This start was used as a basis to conclude that the observed pressure indicator fluctuation was an indication deficiency only, with no adverse impact on the EDG start capability. The sensing line was vented on February 24, 2009 prior to the 4B EDG run. Trends of nightly priming pressure readings made an immediate step change improvement. The 4B EDG fuel priming pressures were then closely mirroring that of the 4A EDG. It was concluded that venting the sense line corrected the indication deficiency. The 4B EDG was considered operable and fully qualified.

On July 20, 2009, pressure indications during priming were again unsteady. CR 2009-20451 identified air in-leakage via the suction strainer as the reason for the erratic response. A work request was initiated to vent the sensing lines. Pressure fluctuations during priming continued; however, they were within specifications (12-40 psig) and not considered to affect EDG operability but only affect pressure indication based on the earlier POD results. Erratic priming pressures continued to be logged with the daily priming pressure check in the operator logs.

On August 11, 2009, after a normal start of the 4B EDG for a monthly surveillance run, the fuel manifold pressure pegged low for approximately 10 seconds, then steadily rose to a running pressure of 22 psig (well below the normal running pressure of about 35 psig at 900 rpm, no load). In addition, the DC priming pump remained running instead of automatically shutting down a few seconds after the engine started. Those conditions resulted in a number of annunciator alarms for EDG and EDG fuel system trouble. The engine ran for approximately 2 hours at 900 rpm in the unloaded condition during the initial troubleshooting effort. A thermography inspection of the running pumps confirmed the main fuel pump to be significantly warmer than the DC priming pump which indicated an air bound main fuel pump based on past experience. The 4B EDG was then secured for troubleshooting without completing the surveillance run. During a normal shutdown, the EDG is brought to idle (450 rpm) for about 20 minutes before stopping, and it was noted that the DC priming pump stopped running, yet the pressure remained at about 20 psig (the engine-driven fuel pump seemed to have primed itself). This is a normal pressure value when the engine is idling at 450 rpm.

The EDG normally starts using the DC priming pump, but switches to the higher capacity engine driven fuel pump for normal operation. These pumps are small gear positive displacement pumps with a limited ability to self-prime. During the August 11, 2009 run, the engine driven fuel pump did not initially prime, leaving only the DC priming pump to supply fuel oil pressure. Troubleshooting identified an air leak into the fuel line caused by a leak in the fuel oil suction strainer. Long term, low level leakage during the nightly priming pump runs eventually accumulated sufficient air to bind the engine driven fuel oil pump but not the DC priming pump due to differences in the configuration of the suction piping. The strainer in use was switched from the south (originally thought as source of leakage) to the north. The DC priming pump primed adequately, and the 4B EDG was run for its surveillance with the engine driven pump providing the expected fuel system pressures. The test was completed satisfactorily on August 12, 2009 at approximately 0815. Subsequent vacuum bench testing of the strainer revealed that the leak existed independent of the

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strainer in service. The likely reason for the successful prime and subsequent surveillance was due to the engine driven fuel pump finally clearing the majority of the accumulated air as the 4B EDG was secured during the original run.

The strainer was replaced on August 19, 2009. Both sides of the new strainer were tested during the maintenance and operability runs of the 4B EDG. All indications were satisfactory.

Past Operability Assessment

Operator logs recorded lower than normal fuel manifold pressures (about 12 psig) during nightly rounds indicating air in-leakage had increased and conditions degraded further beginning July 20, 2009. However, two days later the pressures were back up to 16-18 psig. The pressures remained in this range up until July 28, 2009 where the pressure degraded to 14 psig, then to 12 psig on July 29, 2009. The pressures remained mostly at 12 psig from that point up until the 4B EDG run on August 11, 2009 – the last reading of 12 psig recorded at midnight on the day of the 4B EDG run. The consistent, recurring values of 12 psig or less during priming evolutions has been determined to be indicative of the cumulative effects of entrained air in the fuel pump suction. While there is no direct indication of either condition or air entrainment effects in the suction lines, the repetitive low priming pressure readings are interpreted as the point at which air binding seems most likely to have occurred.

A past operability assessment was performed. Based on the review of field observations, it is not likely the engine driven fuel pump would have responded during the August 11, 2009 4B EDG run and provided adequate fuel manifold pressure to meet the fuel supply requirements for the most demanding load as defined by the TS SRs. Although there is no firm evidence indicating when air binding may have occurred, insufficient data exists to provide reasonable assurance of diesel operability for the timeframe from July 29, 2009 at 0117 to August 11, 2009 at 1331 when consistent operator round readings of 12 psig were recorded for the 4B EDG fuel manifold pressure. As such, the 4B EDG is considered inoperable during that approximately 13.5 day period. Since the 4B EDG was not returned to service after the August 11, 2009 surveillance test until August 12, 2009 at approximately 0815, the total period of inoperability is 14.3 days.

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.

The 4B EDG is considered inoperable from July 29, 2009 at 0117 to August 12, 2009 at approximately 0815 due to fuel system air binding. The condition placed Unit 4 in TS Actions 3.8.1.1.b and 3.8.1.1.d for the 4B EDG.

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TS Action 3.8.1.1.b requires startup transformer [EB, XFMR] and associated circuit operability to be verified within one hour. This action was not met since Operations personnel were not aware that the 4B EDG was inoperable on July 29, 2009.

TS Action 3.8.1.1.b requires restoration of "...the inoperable diesel generator to OPERABLE status within 14 days** or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours." This action was not met since Operations personnel were not aware that the 4B EDG was inoperable prior to August 11, 2009.

TS Action 3.8.1.1.d.1 requires a cross-train operability verification for required equipment powered by the remaining required operable EDGs to be completed within two hours. This action was not satisfied for the 4B EDG.

TS Action 3.8.1.1.d.2 requires at least two high head safety injection (HHSI) pumps [BQ, P] to be verified operable and capable of being powered from their associated operable EDGs within 2 hours. This action was not satisfied for the 4B EDG. At least two HHSI pumps were operable during the period of 4B EDG inoperability.

10 CFR 50.73(a)(2)(i)(B) requires the reporting of :
"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."

The following conditions are reportable in accordance with 10 CFR 50.73(a)(2)(i)(B):

1. Non-compliance with TS Action 3.8.1.1.b requiring startup transformer and associated circuit operability to be verified within one hour of inoperability of the 4B EDG.
2. Non-compliance with TS Action 3.8.1.1.b requiring the 4B EDG to be restored to operable status within 14 days.
3. Non-compliance with TS Action 3.8.1.1.d.1 requiring cross-train operability verification for required equipment powered by the remaining required operable EDGs completed within two hours of the inoperability of the 4B EDG.
4. Non-compliance with TS Action 3.8.1.1.d.2 requiring at least two HHSI pumps to be verified operable and capable of being powered from their associated operable EDGs within 2 hours of inoperability of the 4B EDG.

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

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ANALYSIS OF SAFETY SIGNIFICANCE

The approximate 14.3 days the 4B EDG is considered inoperable has minimal safety significance.

The DC priming pump, although not completely redundant to the engine driven fuel pump, would supply fuel manifold pressure to support EDG loading as follows:

The maximum LOOP/loss of coolant accident load is 2117 KW and the maximum LOOP load is 1693 KW. This is within the capability of the priming pump to provide sufficient fuel for design basis event conditions.

Based on the above, it is reasonable to conclude that with the engine driven pump not providing fuel to the engine, the priming pump would provide sufficient fuel for the engine to power design basis loads for a mission time of 24 hours.

Under station blackout conditions, the maximum load expected is 2854 KW. Under these conditions, the priming pump would not provide sufficient fuel to power the loads. The loads consist of 1101 KW Unit 4 auto-connect loads, 1211 KW Unit 3 blackout loads and 562 KW of Unit 4 manual loads. Load management would be required under these conditions.

The risk impact associated with the approximate 14.3 days the 4B EDG was considered inoperable results in an ICCDP (Incremental Conditional Core Damage Probability) of 5.4E-08 and an ICLERP (Incremental Conditional Large Early Release Probability) of 2.6E-10, well below NRC thresholds.

In conclusion, the 4B EDG being inoperable from July 29, 2009 at 0117 to August 12, 2009 at approximately 0815, as a singular event, has minimal safety significance.

CORRECTIVE ACTIONS

Corrective actions include the following:

1. The 4B EDG fuel supply strainer was replaced.
2. The maintenance procedure was revised to ensure proper installation and gasket seating during fuel suction strainer housing reassembly.
3. A case study was presented to Turkey Point Engineering and other departments and distributed to the FPL fleet.
4. A training brief will be developed concerning this event for key members of the corrective action process team.

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ADDITIONAL INFORMATION

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

FAILED COMPONENTS IDENTIFIED: None

PREVIOUS SIMILAR EVENTS: None