FPL

November 7, 2007
10 CFR § 50.73
L-2007-173

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

Re: Turkey Point Unit 3
Docket No. 50-250
Reportable Event: 2007-004-00
Date of Event: September 8, 2007
Reactor Coolant System Boundary Leakage

The attached Licensee Event Report 05000250/2007-004-00 is being submitted pursuant to the requirements of 10 CFR 50.73(a)(2)(i)(B) to provide notification of the subject event.

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

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

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: 80 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)

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

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4. TITLE

Reactor Coolant System Boundary Leakage

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
										05000
9	08	2007	2007	- 004 -	00	11	8	2007	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE

6

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)
Ronald L. Everett – Licensing Engineer	305-246-6190

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
X	AB	TE	C515	Y					

14. SUPPLEMENTAL REPORT EXPECTED

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

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
01	30	2008

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

During a Unit 3 Turkey Point Refueling Outage (PT3-23), water was found inside the Resistance Temperature Detector (RTD) enclosures for TE-3-420A/B and TE-3-422B2. The source of leakage into the enclosures is unknown. Evaluations of past moisture intrusion into TE-3-420A/B concluded that leakage was not from the thermowell and was not Reactor Coolant System (RCS) water; however, water samples found in the RTD enclosures this outage showed some constituents of RCS water. This indicated the potential for through-wall pressure boundary leakage from the thermowell or external leakage of RCS water into the RTD enclosure through seals, o-rings or threaded joints. Moisture inside the RTD enclosure resulted in shunts-to-ground and low-megger readings, which can affect instrument response. The TE-3-420A/B RTD is designed to be installed in a normal-response thermowell to detect changes in primary coolant loop temperature for input to the plant's accident monitoring system. The TE-3-422B2 RTD is designed to be installed in a fast-response thermowell for rapid detection of changes in coolant loop temperature for input to the plant's Reactor Protection System (RPS).

The RTD thermowells are part of the RCS pressure boundary and pressure boundary leakage is not permitted by Technical Specifications 3.4.6.2.a. RTD housings are designed as leak-tight environmental enclosures to assure RTD functions are met as required by Technical Specifications for the reactor protection or accident monitoring functions. The root cause is still being evaluated.

DESCRIPTION OF THE EVENT

On September 7, 2007, a small amount of water was discovered in the environmental qualification (EQ) boundary of the 3B Reactor Coolant System (RCS) Tcold RTD enclosure (TE-3-420) [AB,TE] during troubleshooting for low megger readings. At the time of discovery, Turkey Point Unit 3 was in Operational Mode 6 (refueling). Subsequent mass spectroscopy analysis indicated small levels of lithium, boron, strontium, and bromine indicating the source of the water intrusion into the RTD enclosure was likely RCS fluid. Turkey Point Unit 3 Technical Specifications (TS) Limiting Condition for Operation (LCO) 3.4.6.2.a permits no RCS pressure boundary leakage in modes 1 thru 4. As a result of the chemical analysis and indication of RCS fluid in the RTD enclosure, this condition was reported to the NRC pursuant to the requirements of 10 CFR 50.72(b)(3)(ii)(A) as a degraded condition.

An investigation into the source of the water intrusion into RTD TE-3-420A/B is ongoing. Leakage into the RTD enclosure was previously noted during the last refueling outage for Unit 3 in March, 2006 and a Short Notice Outage (SNO) conducted in June, 2007. On August 7, 2007, the RTD was declared inoperable due to degraded insulation resistance. Inspections and sampling performed during these events did not indicate the presence of boron or activity levels that were consistent with RCS water.

During the extent of condition reviews, another RCS RTD (TE-3-422B2) was found with water in its EQ enclosure on 9/13/2007 after low megger readings were identified pre-outage. The fluid sample from TE-3-422B2 was analyzed and had chemistry similar to RCS, however it indicated the RCS water was several years old. The NRC was notified on 9/14/2007. In 2004, this RTD and nearby piping and supports was exposed to an active RCS leak from a valve directly above TE-3-422B2 that caused a substantial buildup of boric acid on the RTD housing and surrounding area as documented in a past inspection report. This past event could have contributed to the TE-3-422B2 water intrusion. Outage PT3-23 Mode 6 Holds were placed on both Condition Reports related to the RTD/thermowell [AB,TW] leakage.

EXTENT OF CONDITION

As a result of finding the water intrusion in the two RTDs, a Project Team was assembled to investigate the causes of both events and implement the necessary repair plan and address the extent of condition for the PT3-23 outage. The team directed several actions to restore RTD functions. Both of the above RTD enclosures (with moisture) were pressure and vacuum tested, and no leak paths were identified. Both thermowells were visually inspected and welds to the RCS piping boss and RTD fittings were penetrant tested (PT). No cracks or indications were found. Both thermowells were removed and sent to an independent lab for forensic testing, and no leaks or cracks were found.

The team also directed several actions to address extent of condition for the mode hold release in Outage PT3-23. RTD megger readings were reviewed for adverse trends for the related population of RTDs on Unit 3. Eighteen (18) dual-element RTDs in the RCS were in the related population. If megger trends were inconclusive or adverse trends were identified, then visual inspections of the enclosures for moisture were performed. Only two RTDs (identified above) had moisture or indications of past moisture in their enclosures. No additional RTD thermowells on Unit 3 needed to be replaced.

RTD history megger readings were reviewed for adverse trends for the related population on Unit 4. No adverse trends were found indicating that no moisture was likely present in the RTD enclosures. As such, no inspections were required for the Unit 4 RTDs.

CORRECTIVE ACTIONS

The Thermowell Project Team has completed the following Actions to Date to investigate TE-3-420A/B:

- Pressurized the RTD enclosure to 100 psig and inspected for leaks. The enclosure was also vacuum tested. No leaks were identified.
- Performed visual inspection (VT) of thermowell boss and surrounding area, and no indications or through-wall cracks were observed.
- Performed dye penetrant tests (PTs) of the following welds: (a) pipe boss-to-RCS full penetration weld, (b) thermowell-to-pipe boss seal weld, and.(c) thermowell-to-adapter weld. No indications or cracks were found.
- Removed thermowell and shipped to independent laboratory for forensic analysis and testing.
- Thermowell was pressure tested with helium at 2400 psig for 2 hours, and no leaks were found.
- Performed metallurgical analysis on thermowell, and no flaws or defects were identified in the microstructure that would have caused a leak.
- Reviewed historical megger test data for the same type RTD enclosures on Unit 3, and the megger checks were satisfactory (with no decreasing trends) for the other RCS Cold Leg RTDs (TE-3-410A/B and TE-3-430A/B) and RCS Hot Leg RTDs (TE-3-413A/B, TE-3-423A/B and TE-3-433A/B). Good megger readings indicate that moisture is not likely present in any of the remaining Unit 3 RTDs of this type.
- Reviewed past megger test results for the same type RTDs on Unit 4, and all readings were in the megohm range with no adverse trends identified on any of the RCS Cold or Hot Leg RTDs (TE-4-410A/B, TE-4-420A/B, TE-4-430A/B, TE-4-413A/B, TE-4-423A/B and TE-4-433A/B). Good megger readings indicated that moisture is not likely present in any of the Unit 4 RTDs of this type.
- Performed history search using Operating Experience (OE), Condition Report, and work order databases, and no failures of this type of thermowell were found.
- Replaced the thermowell and temperature detector (including enclosure) with new components. Leakage inspections performed during overpressure tests subsequent to the Unit 3's return to service identified no leaks from new thermowells/detectors or in the surrounding area.

Second Event: TE-3-422B2

On 8/28/07, just days prior to the recent Unit 3 PT3-23 outage, a scheduled Preventive Maintenance for time response testing of the protection channel RTDs was performed. During the PM, a low (but still within acceptance criteria) megger reading was identified on RTD element TE-3-422B2. The thermowell/RTD assembly for TE-3-422B2 is a different type and different design than the one used for TE-3-420A/B. The assembly uses a fast-response dual-element RTD in conjunction with a tapered-wall thermowell design.

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There are twelve (12) of these dual-element RTDs in the RCS loops that provide temperature inputs to the Reactor Protection System Tavg and Delta T channels. There are three (3) Hot Leg RTDs and one (1) Cold Leg RTD per loop for each of the A, B and C Loops. On 9/13/07, the Hot Leg "B" RTD housing, TE-3-422B2, was inspected per the troubleshooting work order and a small amount of water (~5 to 10 ml) was found in the head assembly. A small sample was collected and taken to Chemistry for analysis. Results of the chemical analysis concluded that the water sample contained constituents of RCS fluid. The action plan to address leakage at the second location on thermowell TE-3-422B2 was very similar to the previously established plan for TE-3-420. Several additional inspections were recommended by the team, and those additional actions taken to this point are summarized below.

TE-3-422B2 Actions to Date:

- Pressurized the RTD enclosure to 100 psig and inspected for leaks. The enclosure was also vacuum tested. No leaks were identified.
- Performed visual inspection (VT) of thermowell boss and surrounding area, and no indications or through-wall cracks were observed.
- Performed PT of thermowell-to-pipe boss weld area. There were no indications and no evidence of degradation or past leakage around the pipe boss location.
- Removed thermowell and shipped to an independent laboratory for forensic analysis and testing.
- Pressure tested the thermowell with helium to 3200 psig for 2 hours and no leaks were found.
- PT inspected thermowell using fluorescent penetrant with an extended hold time of 1 hour, and no cracks or other indications were found.
- Performed a review of historical megger data for twelve (12) RCS temperature detectors having similar thermowell designs on Unit 3. Those temperature detectors with negative data trends were opened and internally inspected for moisture or evidence of past moisture. Those Temperature detectors lacking recent (i.e., 2007) hot megger readings were also inspected. As such, the eight (8) "A" and "C" Loop RTD housings were opened and inspected, and no moisture was found in any of these. For the "B" Loop, two (2) RTDs had satisfactory historical megger readings and two (2) RTDs had unsatisfactory historical readings, one being the subject RTD (TE-3-422B2 that has been replaced. The other remaining "B" Loop RTD with unsatisfactory readings (TE-3-422C/D) was opened and inspected, and no moisture (or sign of past moisture) was found.
- Reviewed past history of megger test results for all twelve (12) of the same type RTDs on Unit 4, and no adverse trends were identified on any of the three (3) RCS Cold Leg or nine (9) Hot Leg RTDs for the reactor protection system. Good megger readings(and no adverse trends) indicated that moisture is not likely present in any of the Unit 4 RTDs of this type. No further action is required for this population on Unit 4
- Replaced the thermowell and temperature detector (including enclosure) with new components. Leakage inspections performed during overpressure tests subsequent to the Unit 3's return to service identified no leaks from new thermowells/detectors or in the surrounding area.

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CAUSE OF THE EVENT

The root cause analysis is still in progress. Based on the results of the extensive NDE and destructive examinations performed and the robust design, it can be concluded that it is unlikely that a failure of the thermowell pressure boundary was the source of the water in the RTD housing. Nonetheless, the thermowells were replaced and the RCS system pressure boundary restored per the original design. As such, the focus of the continuing investigation is associated with the breach of the environmental qualification boundary of the RTD enclosures and potential sources of water intrusion. Although the field performed leak tests of the enclosures did not identify any leak path, further inspections and testing are planned on the RTDs which were replaced.

ANALYSIS OF THE EVENT

The thermowells and associated RTDs are safety related. The RCS TE-422B2 RTD provides input to the Reactor Protection System for RCS temperature monitoring. The RCS TE-420 A/B RTDs provide input to the Subcooled Margin Monitoring System and provide input to the Qualified Safety Parameter Display System. The thermowells are considered part of the Reactor Coolant System Pressure Boundary. In both cases, the instrumentation design provides redundancy so that failure of one Temperature Element does not result in loss of the required safety function. As a result of the extensive tests performed on the thermowells, there is no reason to suspect RCS pressure boundary leakage from the thermowells/RTDs. However, the root cause of this event is ongoing and any resulting additional measures determined to be required will be identified and implemented.

REPORTABILITY

Turkey Point Unit 3 Technical Specifications (TS) Limiting Condition for Operation (LCO) 3.4.6.2.a permits no RCS pressure boundary leakage in modes 1 thru 4. As a result of the chemical analysis indicating the water found had RCS constituents and indication of fluid in the thermowell, this condition was reported to the NRC pursuant to the requirements of 10 CFR 50.72(b)(3)(ii)(A) as a degraded condition. As a result of the on-going root cause analysis, it is conservatively being considered reportable under 50.73(a)(2)(i)(B) for operation in a condition prohibited by technical specifications.

APPLICABILITY: MODES 1-4

ANALYSIS OF SAFETY SIGNIFICANCE

TE-3-420A/B is a dual element RTD installed in Loop B Cold Leg. Different channels of QSPDS (Channel A and Channel B) utilize each element. Identical detectors are installed in Loops A and C. For a channel of Qualified Safety Parameter Display System (QSPDS) [IP] cold leg temperature to be considered OPERABLE, it must have at least two of its three detectors operable. This removed operating margin which would not allow for failure of any additional RTDs. The MINIMUM CHANNELS OPERABLE is one (with two of the three detectors.) To call a channel operable, it must have at least two of its three

detectors operable. Therefore, even with TE-3-420A/B inoperable, the technical specifications would be met and there would be no safety concern.

TE-3-422B2 is one of three Hot Leg RTDs located in reactor vessel output loop "B". The three RTD outputs are averaged and provide inputs to control circuits, reactor delta T, and reactor T_{ave}. T_{ave} is utilized in the overpower set point calculations and over-temperature set point calculations of Eagle 21 (Reactor Protection System) [JC]. Reactor delta T is compared against these two calculated set points and provides output trips when the set points are exceeded.

Three hot leg RTDs are not required for channel operation. If an RTD does not meet tested acceptance criteria, it is removed from scan. The channel is still operable but a trouble alarm is generated to alert the operators of the RTD failure.

TE-3-422B2 remained operable. Insulation resistance of this RTD had decreased from 80 MΩ to 10 MΩ. The 10 MΩ reading met procedural acceptance criteria. Continued operation with this degrading trend would not have affected the Eagle 21 safety margin. An RTD that for some reason drifts out of the required accuracy limits set into Eagle 21 algorithms is automatically removed from scan and is no longer included in the RTD average. For this reason the difference in T_{hot} average would be minimal.

No adverse safety issues were associated with the 10 MΩ readings of TE-3-422B2.

ADDITIONAL INFORMATION / SIMILAR EVENTS

Engineering reviewed the event history, OE, CR and work history databases for failures of fast-response RTD thermowells. Two (2) failures of the fast-response thermowells were identified in the nuclear industry, one at Palo Verde and one at the Robinson Plant.

- The Palo Verde failure occurred in the late 1980's when a thermowell broke off in the flow stream during startup testing due to excess flow vibration. The thermowell was a very different design and much less robust than the PTN design. They replaced the thermowells with a more robust design and have not indicated any problems since.

- The Robinson failure was caused by "field machining" performed on the thermowell at the site to accommodate fit-up issues into RCS piping. Their thermowell design was later updated to a more robust design that is "slightly different" (except at the tip) than the PTN design. Again, Turkey Point's design is more robust than the Robinson design.

A similar history/Operating Experience search for the normal-response RTD thermowell revealed no failures in the industry.

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

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FAILED COMPONENTS IDENTIFIED:

The fluid found inside the EQ enclosure for TE-3-422B2 and TE-3-420A/B did not cause a failure or loss of function of the associated channels of QSPDS or RPS. Although the fluid had some constituents of RCS, no cracks or flaws were found in either of the thermowells. No further tests will be performed on the thermowells for RCS pressure boundary leakage paths since no defects were discovered in the tests performed to date. However, based on the RTD TE-3-420A/B being declared inoperable, this would be considered a failure of the RTD. The operability of RTD TE-3-422B2 was never in question, so it is not considered a failure of the RTD. Based on the current information from the ongoing investigation, the source of leakage was not RCS pressure boundary leakage, but the most probable leakage path was through threads, seals or mechanical joints in the RTD enclosures.