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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 95-002-00:on 950215,inadequate definition of "Loops Filled" resulted in units in condition prohibited by TS. Issued TS position statement to define term "loops filled" as used in TS 6.4.1.1.4.W/950313 ltr.

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MAR 13 1995

L-95-080
10 CFR 50.73

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

Gentlemen:

Re: Turkey Point Units 3 and 4
Docket No. 50-250, 50-251
Reportable Event: 95-002
Inadequate Definition of "Loops Filled" Results in Units in Condition Prohibited by Technical Specifications

The enclosed Licensee Event Report 250/95-002 is being provided in accordance with 10 CFR 50.73(a)(2)(i).

If there are any questions, please contact us.

Very truly yours,

T. F. Plunkett
Vice President
Turkey Point Plant

TFP/CLM/cm

enclosure

cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC
Thomas P. Johnson, Senior Resident Inspector, Turkey Point Plant, USNRC

210070

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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
TURKEY POINT UNIT 3	05000250	1 OF 8

TITLE (4) Inadequate Definition of "Loops Filled" Results in Units in Condition Prohibited by Technical Specifications

EVENT DATE (5)			LER NUMBER(6)			RPT DATE (7)			OTHER FACILITIES INV. (8)	
MON	DAY	YR	YR	SEQ #	R#	MON	DAY	YR	FACILITY NAMES	DOCKET # (S)
02	15	95	95	002	00	03	13	95	Turkey Point Unit 4	05000251

OPERATING MODE (9)	1/1	10 CFR 50.73(a)(2)(i)(B)
POWER LEVEL (10)	100/100	

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER
C. L. Mowrey, Regulation Compliance Specialist	305-246-6204

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS?	CAUSE	SYSTEM	COMPONENT	MAN'FACTURER	NPRDS?

SUPPLEMENTAL REPORT EXPECTED (14)	NO ☒	YES ☐	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
(if yes, complete EXPECTED SUBMISSION DATE)						

ABSTRACT (16)

Florida Power & Light Company (FPL) determined that both units had been in a condition prohibited by Technical Specification 3.4.1.4.1, during previous refueling outages. With loops filled, only one Residual Heat Removal (RHR) train is required to be operable. "Loops filled" is not a defined phrase, but implies decay heat removal capability of the Steam Generators (SGs). Credit was taken for "loops filled," at times when the SGs may not have been able to provide decay heat removal.

FPL failed to recognize the potential for gas to come out of solution and void portions of the SG U-tubes, preventing the establishment of natural circulation. Draining the pressurizer below 100% level exacerbates the condition.

The condition occurred only during Integrated Safeguards Testing, when one train of RHR was administratively declared inoperable. Since that train was still functional, the health and safety of the public was not impacted.

FPL has defined "loops filled" to require the Reactor Coolant System to remain pressurized after fill and venting. Procedures are being revised to reflect the definition. A more exact determination of prerequisites to natural circulation is being evaluated.

I. DESCRIPTION OF THE EVENT

On February 15, 1995, with both units in Mode 1 at approximately 100% power, Florida Power & Light Company (FPL) determined that both units had been in a condition prohibited by Technical Specification 3.4.1.4.1, during previous refueling outages. Technical Specification 3.4.1.4.1 reads as follows:

> At least one Residual Heat Removal (RHR) [BP] loop shall be OPERABLE and in operation, and either:
> a. One additional RHR loop shall be OPERABLE, or
> b. The secondary side water level of at least two steam generators [SB:sg] shall be greater than 10%.
>
> APPLICABILITY: MODE 5 with reactor coolant loops filled.

Note that the Specification uses the phrase "loops filled" as one of its applicability criteria. FPL has not been able to find a rigorous definition of this phrase. Recent understanding of steam generator gas voiding phenomena indicates that the "loops filled" criterion may have been misapplied during previous plant operations in Mode 5. At certain times, the steam generators could have been unavailable for decay heat removal by natural circulation, even though credit could procedurally have been taken for the Reactor Coolant System (RCS) [AB] loops being "filled".

During the 1994 Unit 4 refueling outage, FPL investigated the basis for Turkey Point's current criteria for taking credit for the RCS loops being filled. These criteria are specified in procedure 0-ADM-051, Shutdown Risk Assessment and Control, Section 5.1.1.2:

> "Whenever the RCS is depressurized and drained below 10 percent level in the Pressurizer [AB;pzr] the Steam Generators shall be considered as ineffective for purposes of Decay Heat Removal. This remains in effect until Fill and Vent of the Reactor Coolant System is subsequently performed."

The intent is implied by the immediately preceding caution statement:

> "The ability to achieve natural circulation cooling may or may not be compromised by partial draindown of the RCS. Natural Circulation cooling following loss of RHR cooling should be evaluated using the available instrumentation for each individual set of circumstances."

The term "partial draindown" as used above is defined in section 4.10.1 of 0-ADM-051:

> "The Reactor Coolant System level is lower than 10 percent in the Pressurizer."

Based on the foregoing, it is clear that the intent is to maintain the ability to establish natural circulation decay heat removal through the steam generators, and that the existing criteria were considered adequate to ensure this. While no explicit basis for the current criteria could be determined, it appears that the basis is to prevent introducing air into the steam generators ("burping") by maintaining the RCS level above the steam generator tube sheets.

II. CAUSE OF THE EVENT

In considering the ability to establish natural circulation decay heat removal, FPL performed a preliminary calculation of the potential for gas voiding of the steam generator U-tubes. Voiding is caused by dissolved gas coming out of solution when the RCS is depressurized. The results of the preliminary calculation indicated that substantial gas voiding (sufficient to prevent natural circulation) exists after depressurization of the RCS following performance of procedure 3/4-OP-041.8, Filling and Venting the Reactor Coolant System. While not as severe as the post fill and vent voiding, similar voiding is expected after any depressurization of the RCS, even with relatively low initial dissolved gas inventories. All voiding is compounded by subsequent draining of the RCS to reduced pressurizer levels.

The following information was taken from the results of the preliminary calculation cited above. Two general plant conditions were evaluated; (1) fill and vent following core reload, and (2) RCS degasification following shutdown, but prior to core offload.

(1) Under ideal fill and vent conditions, RCS pressure is raised, Reactor Coolant Pumps (RCPs)[AB:p] are bumped and run, then RCS pressure reduced to 150 psig during the venting process. The voided length in each U-tube, when the RCS pressure is reduced to atmospheric and the pressurizer is full, is approximately 92 inches (46 inches on each side from the top of the U-tube bend). The void length increases to approximately 198 inches if the pressurizer is drained to 10% level.

(2) Under ideal conditions (where RCS gas concentrations have been reduced to very low levels by degasification), the U-tube gas void lengths created by depressurization following a shutdown and transition to Mode 5 may be as small as 5 inches with the pressurizer full. Under realistic conditions however, the initial void will be somewhat larger (depending upon the effectiveness of RCS degasification), and will be enlarged further by any subsequent reduction in pressurizer level below 100%.

As long as the RCS is vented to atmosphere, the maximum hot leg temperature achievable while maintaining natural circulation is 212° F. In actuality, this temperature would be dependent upon the RCS (pressurizer) level: if drained below the top of the steam generator U-tubes, the partial vacuum will cause vapor voiding at lower temperatures. Natural circulation will accordingly be prevented or halted at even lower differential temperatures.

Assuming that a feed and bleed of the steam generator secondary side could be established to limit the RCS cold legs to 112° F, and the RCS hot legs reach atmospheric saturation conditions (212° F), the available thermal driving head would be approximately 7-9 inches of water (depending on the effective elevation difference between the core and the steam generator). This is inadequate to overcome all but the smallest gas voids described above.

FPL has concluded that the RCS cannot support subcooled natural circulation decay heat removal through the steam generators while the RCS is vented. The term "vented" is subjective: a sufficiently small vent could permit the RCS to pressurize as it heats up. However, the maximum size of a vent path that causes repressurization is highly dependent upon the decay heat load, which in turn is dependent on time after shutdown and the pre-shutdown power history of the core. Due to the wide range of decay heat loads during a refueling outage, FPL conservatively considers the RCS to be "vented" and incapable of repressurization from decay heat accumulation at any time a path larger than the installed head vent orifice line [AB:or] is open.

The preliminary calculation and conclusions were provided to Turkey Point's Nuclear Steam Supply System vendor, Westinghouse, for review and comment. Westinghouse has indicated that they are in general agreement with the methodology, results, and overall conclusions of the preliminary calculation.

Based on the above, a vented RCS will prevent the steam generators from providing subcooled natural circulation decay heat removal. Repressurization of the RCS to collapse gas voids is a natural requirement to establish natural circulation.

III. ANALYSIS OF THE EVENT

Technical Specification compliance depends on two issues:

1) The basis and/or intent of "loops filled" as used in the Technical Specifications; and

2) Whether or not Turkey Point was ever in a situation when the RCS loops were required to be filled, but in fact were not.

With respect to issue #1, apparently no analytical basis exists, and various plants (and versions of Technical Specifications) have interpreted the requirement differently. No instance of explicitly stating "natural circulation" within Technical Specifications or their bases could be located. However, it is the opinion of FPL and Westinghouse that this is the intent.

The No Significant Hazards Determination for Amendments 137 and 132 of the Turkey Point Units 3 and 4 Technical Specifications, respectively, states:

> "The Standard Technical Specification allows use of a steam generator for backup residual heat removal. It has been shown generically by the core designer that with some inventory in the secondary side of the steam generator natural circulation will develop and a steam generator with the prescribed secondary water level can be used to dissipate decay heat in place of an RHR loop..."

Further, the Federal Register Notice (Vol. 48, No. 144 dated Tuesday July 26, 1983) concerning voiding and its applicability to design basis and reportability states:

> "However, the accumulation of voids that could inhibit the ability to adequately remove heat from the reactor core, particularly under natural circulation conditions, would constitute an unanalyzed condition and must be reported..."

Based on the above, the first issue that must be addressed to determine Technical Specification compliance is resolved. The intent of the "loops filled" phrasing of Technical Specification 3.4.1.4.1 is to ensure the steam generators are capable of supporting natural circulation decay heat removal.

The second issue is whether Turkey Point has been in violation of the requirement determined above. Prior to January 1, 1991, Turkey Point Technical Specifications did not consider passive decay heat removal through the steam generators. The requirements prior to that time (prior to Amendments 137/132) were limited to two active coolant loops in Mode 5 with the loops filled (one loop of RHR, and either the other loop of RHR, or at least one RCS loop with an OPERABLE RCP). For an RCP to be operable, the RCS must be pressurized, which in turn prevents gas voiding and suppresses boiling in the reactor core. Based on the above, prior to January 1 1991, gas voiding of the U-tubes and venting of the RCS while taking credit for an RCS loop as a heat sink was prohibited by the Turkey Point Technical Specifications.

It is standard practice during a refueling outage at Turkey Point to perform Integrated Safeguards Testing in Mode 5 after core reload. Prior to Integrated Safeguards Testing, a fill and vent of the RCS is performed. During Integrated Safeguards Testing, the RHR loop associated with the train of Safeguards being tested has been considered inoperable for the duration of the test, and credit was taken for the steam generators being available to remove decay heat. The reason for declaring the RHR loop under test inoperable was the use of non-safety grade test connections in the actuation signal path for purposes of monitoring the test progress. The basis for declaring the loop under test inoperable has been evaluated.

FPL has concluded that consideration of the loop under test as inoperable has been in some cases more conservative than required. During the testing, the RCS is normally vented and the pressurizer level lowered to approximately 80% to accommodate any volume transients that may occur. Under these conditions the steam generators may not have been capable of supporting decay heat removal by natural circulation, and the unit would have been in violation of Technical Specification 3.4.1.4.1.

In evaluating whether the Turkey Point plant was capable of initiating natural circulation when it was required to be available, it is important to note that the heat up experienced due to a loss of RHR in Mode 5 is a relatively slow transient. Two days after shutdown, the time to boiling in the core is estimated to be approximately 2 hours, with an additional hour until the RCS inventory is boiled down to the top of the core. The vented conditions when a loop of RHR was administratively declared inoperable normally occurred late in the outage, after core reload. The decay heat load was therefore substantially less, with an attendant increase in the time to core boiling. Credit may reasonably be taken for proceduralized manual operator actions to close any openings in the RCS pressure boundary upon the occurrence of such an event. It can be shown that the RCS pressure boundary would have been restored in a timely manner, and the subsequent RCS repressurization would have led to natural circulation decay heat removal.

Turkey Point operating procedures 3/4-ONOP-050, 3/4-ONOP-41.7, and 3/4-ONOP-41.8, provide direction to close all RCS openings under the subject conditions. These procedures were established in their current form in October 1994. Prior to October 1994, 3/4-ONOP-050 (Loss of RHR) were the only applicable procedures. A review of versions of 3/4-ONOP-050 predating October 1994 found that they did not provide for closing RCS openings at any time during a loss of RHR.

During the period from January, 1991 to October 1994, multiple refueling outages have occurred on both units. FPL has determined that both units have been in violation of Technical Specification 3.4.1.4.1 during routine performance of Integrated Safeguards Testing when the train of RHR being tested was declared inoperable.

SAFETY SIGNIFICANCE DETERMINATION

The only time that an RHR train is routinely declared inoperable at Turkey Point during Mode 5 is to support Integrated Safeguards Testing (3/4-OSP-203.1 and 203.2). During Integrated Safeguards Testing the RCS boundary is intact as a matter of plant policy, i.e., the only vent paths open are through open valves; no portion of the system pressure boundary has been removed. While the head and pressurizer vent paths are maintained open, they are isolable by manual valves.

The Integrated Safeguards Testing procedures come under the guidance of administrative procedure 0-ADM-217, Conduct of Infrequently Performed Tests or Evolutions. 0-ADM-217 is replete with Cautions and Notes informing personnel performing and supervising the testing that the highest margin of safety shall be maintained, and specifically states the authority of both the Nuclear Plant Supervisor and the Assistant Nuclear Plant Supervisor to terminate any test or evolution that either will place, or has placed the plant in an unacceptable condition of operation.

Although administratively declared inoperable, the RHR loop under test during Integrated Safeguards Testing was and is intact and capable of functioning (and does so repeatedly throughout the test). Should the other (operating) loop of RHR fail, the guidance and directions contained in current procedures would direct the suspension of all testing, and the rapid restoration of the loop of RHR under test. Therefore, although declared inoperable, experience has shown that the loop of RHR under test is available and capable of functioning.

An additional consideration is that all versions of applicable operating procedures reviewed contained explicit directions to establish makeup water to the RCS in the event of a loss of RHR. This action alone would ensure decay heat removal for a period long enough to restore at least one train of RHR to service. By keeping the core covered, integrity of the fuel cladding is assured, decay heat would be removed by steaming the RCS through the open vent path, and no significant safety hazard would have been developed by the inability to establish natural circulation decay heat removal.

Based on the above, if a loss of RHR had been experienced during Integrated Safeguards Testing, the loop under test would have been available to provide decay heat removal. Even in the unlikely event that attempts to start the RHR loop under test had failed, the RCS would be intact and capable of being repressurized by isolating the vent paths manually. It is therefore concluded that while the steam generators may have been unavailable for natural circulation decay heat removal, no hazard to the health and safety of the public resulted.

IV. CORRECTIVE ACTIONS

1. A Technical Specification Position Statement has been issued to define the term "loops filled" as used in Technical Specification 3.4.1.4.1: "loops filled" will mean that the reactor coolant system has been filled and vented, and is still pressurized to at least 100 psig. If the RCS is depressurized to less than 100 psig, loops are not filled, and two RHR loops must be OPERABLE in accordance with Technical Specification 3.4.1.4.2.

2. Procedure 0-ADM-051 will be revised to incorporate the definition of "loops filled" by April 10, 1995.

3. Other operating procedures will be revised to incorporate the restricted definition by May 1, 1995.

4. The issue of "loops filled" will be investigated further to determine if there is a pressurizer level above which natural circulation can reasonably be expected to initiate. If so, our definition of "loops filled" and our applications of Technical Specification 3.4.1.4.1 will be revised accordingly. The investigation is expected to be completed by June 2, 1995.

V. ADDITIONAL INFORMATION

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

No similar Licensee Event Reports have been submitted as a result of less than adequate definitions or interpretations of Technical Specifications.