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FACIL:50-250 Turkey Point Plant, Unit 3, Florida Power and Light C 05000250

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SUBJECT: LER 93-005-00:on 930325,discovered that setpoint for overpressure mitigating sys outside limiting design & licensing bases when RCS is water solid.Caused by erroneous pressure differential.Controls instituted.W/930426 ltr.

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L-93-105
10 CFR 50.73
10 CFR 50.4

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

Gentlemen:

Re: Turkey Point Units 3 & 4
Docket Nos. 50-250 and 50-251
Reportable Event: 93-005-00
Setpoint for Overpressure Mitigating System Found
Non-conservative with Respect to 10 CFR 50 Appendix G

The attached Licensee Event Report 250/93-005-00 is being provided in accordance with 10 CFR 50.73 (a)(2)(ii)(B) and 10 CFR 50.4(d).

If there are any questions, please contact us.

Very truly yours,

T. F. Plunkett
Vice President
Turkey Point Nuclear

TFP/JEK/jk

enclosure

cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC
Ross C. Butcher, Senior Resident Inspector, USNRC, Turkey Point Plant

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IE22

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)		
TURKEY POINT UNITS 3 AND 4	05000250	1	OF	8

TITLE (4) SETPOINT FOR OVERPRESSURE MITIGATING SYSTEM FOUND NON-CONSERVATIVE WITH RESPECT TO 10 CFR 50 APPENDIX G.

EVENT DATE (5)			LER NUMBER(6)			RPT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MON	DAY	YR	YR	SEQ #	R#	MON	DAY	YR	FACILITY NAMES	DOCKET # (S)
03	25	93	93	005	00	04	26	93	Turkey Point Unit 4	05000251

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

LICENSEE CONTACT FOR THIS LER (12)

J. E. Knorr, Regulation and Compliance Analyst	TELEPHONE NUMBER 305-246-6757

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS?	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS?

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

ABSTRACT (16)

On March 25, 1993, Turkey Point Units 3 and 4 were in Mode 1 at 100% power. On that date, Florida Power & Light (FPL) received information from its Nuclear Steam Supply System vendor that the setpoint for the Overpressure Mitigating System (OMS) is non-conservative with respect to 10 CFR 50 Appendix G. FPL therefore determined that the overpressure mitigating system on both Units 3 and 4 is placed outside the limiting design and licensing bases OMS analysis under the following conditions:

1. Reactor Coolant System (RCS) temperature less than 105 °F,
2. RCS is water solid, and
3. Three Reactor Coolant Pumps (RCPs) are running.

The acceptance criteria for the setpoint assumes a mass addition produced by the start of a Safety Injection (SI) pump. Technical Specification requirements and administrative controls prevent the injection of water into the RCS due to a start of an SI pump. Additional administrative controls have been instituted to limit the number of RCPs running at low RCS temperatures.

I. DESCRIPTION OF THE EVENT

On March 25, 1993, Turkey Point Units 3 and 4 were in Mode 1 at 100% power. That same day, Florida Power & Light (FPL) received information from its Nuclear Steam Supply System (NSSS) vendor that the setpoint for the Overpressure Mitigating System (OMS) is non-conservative with respect to 10 CFR 50 Appendix G at the current 13.1 effective full power years (EFPY) of operation of Turkey Point Unit 3. FPL therefore determined that the OMS on both Units 3 and 4 would be placed outside the limiting design and licensing basis OMS analysis under the following conditions:

1. Reactor Coolant System (RCS) temperature less than 105 °F,
2. RCS water solid, and
3. Three Reactor Coolant Pumps (RCPs) running.

The acceptance criteria for the OMS setpoint assumes a mass addition event produced by the start of a Safety Injection (SI) pump. Given the above conditions and the mass addition event, the OMS setpoint of 415 psig could result in a short term pressure excursion in the RCS to 560 psig. The 10 CFR 50 Appendix G limit for Turkey Point based upon calculations assuming 85 °F RCS temperature for the current time in reactor vessel life, is 507.56 psig at 13.1 EFPY.

Technical Specification requirements and administrative controls prevent the injection of water into the RCS due to the start of an SI pump. Nonetheless, additional administrative controls have been instituted to limit the number of RCPs running at low RCS temperatures.

II. CAUSE OF THE EVENT

The pressure difference between the wide-range pressure transmitter and the reactor vessel belt-line (where the Appendix G limit is defined) including the core differential pressure resulting from three RCPs in operation had not been considered in the original setpoint analysis for OMS performed by the NSSS vendor.

III. ANALYSIS OF THE EVENT

System Description

The OMS is designed to mitigate heat input and mass input induced pressure transients during water solid cold shutdown transient and steady-state conditions. The OMS uses the Power Operated Relief Valves (PORVs), with a 415 ± 15 psig setpoint, as the pressure relief path. The OMS pressure transmitter design employs two separate RCS hot leg mounted pressure transmitters, PT-*-403 and 405, for initiation of PORV opening under cold overpressure scenarios.

The OMS was designed to provide overpressure protection for the following cases:

1) The start of an idle RCP with the secondary water temperature of the steam generators 50 °F above the RCS cold leg temperature.

2) The inadvertent start of two charging pumps with a loss of letdown (which is analytically enveloped by item 3); or

3) The start of an SI pump and its injection of water into a water solid RCS.

Cases #1 and #3 are stated in the basis for Technical Specification 3.4.9.3. All three cases were addressed in the original generic NSSS vendor analysis.

Issue Analysis

Recently, the NSSS vendor investigated the relationship between PORV settings, pressure sensing location and the actual corresponding pressure within the reactor vessel belt line region. The NSSS vendor determined that the pressure difference, during RCP operation, between wide range pressure indication location and the vessel belt line region had not been explicitly considered in the OMS setpoint calculations. The pressure differential is the result of core pressure drop, and line losses with one or more RCPs in operation, and elevation differences between the area of interest in the reactor vessel and the hot leg location of the pressure transmitter taps. The consequence of this bias is most significant at low temperatures, while water solid with three RCPs in operation. Therefore, mass or thermal input transients under these conditions represent the most limiting events.

A plant specific review conducted by the NSSS vendor has determined that the identified calculational issues exist as part of the original Units 3 and 4 OMS designs. Discussions with the NSSS vendor (the OMS designer) confirm that the bias associated with core pressure drop (dynamic head) and elevation differences (static head) were not considered in the original Turkey Point Units 3 and 4 OMS design. Also, PORV setpoint tolerance (±15 psig) was not explicitly considered under the original Turkey Point Units 3 and 4 OMS design.

NSSS vendor letter FPL-88-844, Heatup and Cooldown Curves and OMS Setpoint Instrument Uncertainties, dated September 13, 1988, and FPL Engineering Evaluations for pressure transmitter static head correction have dealt with the issues of static head and PORV setpoint tolerance. In both instances, the amount of error introduced into the setpoint calculations (static head and setpoint tolerances) was determined to be insignificant and bounded by the conservatism contained in the formulation of the Appendix G curves. Therefore, these sources of bias do not pose a potential analytical overpressure concern.

A plant specific calculation has been completed by the NSSS vendor which indicates the differential pressure between the vessel belt line and the RCS hot leg resulting from running all three RCPs at Turkey Point is 57 psid at 85°F. The 20 effective full power years' Appendix G pressure limit at 85°F (the coldest temperature for which the Turkey Point reactor vessels are analyzed) is 503 psig. One heat injection and two mass injection scenarios are considered that may challenge this limit.

HEAT INJECTION

The heat injection scenario arises when one or more steam generators are warmer than the stagnant, water solid RCS. This is postulated to occur when a cooldown has been performed using natural circulation and/or residual heat removal. In these cases, one or more steam generators may have been permitted to stagnate, remaining warmer than the bulk RCS temperature. When the first RCP is started, heat is transferred into the RCS causing a pressure increase.

Using the Cold Overpressure Mitigating System Setpoint Evaluation completed by the NSSS vendor, a conservative estimate of the pressure overshoot due to the heat input transient is 22 psig. This calculation assumes a PORV opening time of 3.2 seconds.

Because the initial conditions needed to cause this transient are no longer present after the first RCP is started (since RCS and Steam Generator temperatures quickly equalize), only the core differential pressure due to one RCP running is applicable. The core differential pressure caused by a single running RCP is 25 psid (as shown by an NSSS vendor calculation at 85 °F) after it has attained full speed. This differential pressure is then added to the pressure transient caused by the heat injection:

OMS setpoint	415 psig
The potential pressure overshoot above the PORV setpoint	22 psig
Estimated vessel core differential pressure	25 psid
Total possible reactor vessel actual pressure . . .	462 psig

Therefore, heat injection from an RCP start does not pose a potential overpressure concern.

MASS INJECTION

MAXIMUM CHARGING WITH LETDOWN ISOLATED

The first potential mass input transient considered in the OMS design is charging pump water injection with letdown isolated. A calculation has been performed by FPL to determine the pressure overshoot for the cases of two and three running charging pumps as a function of PORV stroke time. For three charging pumps running at full speed with letdown isolated and a PORV stroke time of 3.2 seconds, the pressure overshoot is 30 psig.

Thus the worst case reactor vessel pressure for this mass input transient case would be:

Setpoint	415	psig
Transient pressure overshoot	30	psig
Calculated vessel core differential pressure . .	57	psid
Total possible reactor vessel actual pressure . .	502	psig

As such, mass injection from running three full speed charging pumps with letdown isolated does not pose a potential overpressure concern.

SAFETY INJECTION PUMP START

The second (and limiting) scenario potentially occurs when an SI pump is started while inadvertently aligned to the RCS during cold, solid conditions with all three RCPs running. Based on the results of a plant specific evaluation which determined parametrically the maximum permissible PORV setpoint, there is no margin between the Appendix G curve at 85°F and the predicted maximum pressure attained. In this case, any differential pressure caused by an operating RCP will cause an overpressure excursion in excess of the Appendix G curve.

The following table reflects the maximum vessel pressure obtained for each combination of running RCPs assuming the inadvertent start of an SI pump with the lack of isolation of the flow path to the RCS:

# of RCPs	ΔP (psid)	Total Pressure
0	0	503
1	25	528
2	36	539
3	57	560

If this limiting mass injection event occurred with any running RCPs, the Appendix G curve would be exceeded. However, as discussed below, the Appendix G curve is not the ultimate pressure limit to determine operability of an OMS system. Several mitigating factors contribute to the OMS being able to protect the vessel in this postulated event. Post-event stress analyses have been completed to evaluate the actual cold overpressure events which have occurred in the industry. These analyses have found that in none of the cases has a problem been noted with regard to the vessel integrity. For pressure excursions less than 100 psig above the Appendix G curve, the NSSS vendor has stated that there is no significant hazard to the vessel.

APPENDIX G REQUIREMENTS

There are numerous conservatisms in the ASME Appendix G pressure/temperature curve calculations. Some of these are:

a) The safety factor of 2 on the principal membrane (pressure) stresses.

b) The margin factor of Reg Guide 1.99 Rev 2 is applied to Nil Ductility Transition Reference Temperature ($RT_{(NDT)}$).

c) The use of an assumed flaw of a length equal to one-quarter of the reactor vessel wall thickness (¼T flaw).

d) The increased mechanical properties of the vessel which accompanies material embrittlement (elevated yield strength and flow stress).

Additionally, there are conservatisms specific to the Turkey Point vessels.

a) It is assumed that the weld is longitudinal. However, vessels such as those at Turkey Point do not contain longitudinal welds. This is equivalent to an additional safety factor of 2 in the calculated results since the postulated flaw (in the embrittled weld material) cannot be oriented normal to the greatest stress (hoop stress). Rather, the only plausible orientation for the postulated flaw is normal to the axial stresses, which in turn is half that of the hoop stress.

b) Inservice inspections of the Turkey Point Units 3 and 4 vessels were performed during the 1991 Dual Unit Outage. During that inspection no unresolved flaws were identified.

The curves resulting from calculations based partly on the above assumptions have historically formed the upper bound of OMS design pressure transients. However, this creates a restrictive operating window resulting in an increased potential for inadvertent PORV actuation (and the associated increased risk of a loss of coolant accident from a failed-open PORV). For these reasons the American Society of Mechanical Engineers Code Committee has recently approved Code Case N-514, "Low Temperature Overpressure Protection," relaxing [OMS] design criteria to limit pressure excursions to 110% of the Appendix G limits during low temperature overpressure transients. The basis for this code case draws upon the inherent conservatism in the formulation of the Appendix G curves. Assuming the 110% of Appendix G limits, the overpressure which could be found during the mass injection scenario is as follows:

110% of Appendix G limit	553	psig
SI pump start scenario maximum pressure	560	psig
Maximum calculated pressure above code allowable	7	psid

As stated earlier, the Appendix G limit at 85 °F is 503 psig; one-hundred and ten percent of the Appendix G curve at 85°F is 553 psig. The only postulated cold overpressure transient that exceeds this limit is the Safety Injection case with three (3) RCPs running during the event. At 105°F, the Appendix G curve has increased to 510 psig, resulting in a 110% limit of 561 psig. At this point, sufficient margin exists to permit unrestricted simultaneous operation of all three RCPs. Based on this, RCP operation should be limited to no more than two RCPs running simultaneously at temperatures less than 105°F.

An alternative to limiting RCP operation is to decrease the stroke time of the PORVs. This action will reduce the time until the PORVs reach full relieving capacity, and correspondingly reducing the magnitude of the pressure overshoot. The 553 psig limit afforded by Code Case N-514 is reduced 57 psig by the RCP differential, resulting in a maximum allowable sensed pressure of 496 psig. A linear interpolation of PORV stroke times between 2 and 3 seconds provides a corresponding stroke time of 2.8 seconds in order to limit pressure to 496 psig. Also, an additional .25 seconds may be added to this time to account for a lack of pressure under the valve disk during testing. Therefore, if the PORVs are verified to stroke full open in less than or equal to 3.0 seconds, the OMS may be considered to be within the limits of the code as amended by N-514. Recent tests of the PORV stoke times have shown consistent opening times of less than three seconds.

IV. CORRECTIVE ACTIONS

1. Administrative controls have been instituted which will provide assurance that a challenge to the overpressure mitigating system will not result in pressure in the reactor vessel rising above the Appendix G limit. These controls are as follows:

   Prior to all three of the following conditions being true:

   a) Technical Specifications 3.4.9.2 require PORVs operable; and

   b) Reactor coolant system water solid and

   c) RCS temperature less than 105°F,

   At least one of the following actions will be taken:

   (a) At least one RCP breaker will be opened and placed under administrative control to prevent the inadvertent start of the associated RCP; or

   (b) The stroke time of both PORVs shall be verified to be equal to or less than 2.8 seconds (3.05 seconds as tested);

Either of these restrictions is sufficient. The restriction of choice will be implemented by incorporation into existing operating procedures prior to the next entry into Mode 5 from the cold condition. Procedure 4-GOP-305 has been revised to require RCP restrictions during the April 1993 refueling shutdown as outlined in this Licensee Event Report. Procedure 3-GOP-305 has been similarly revised to have procedures in place if a shutdown of Unit 3 is required prior to the resolution of the exemption request discussed in corrective action number 2.

2. An exemption request from 10 CFR 50.60 to permit the use of ASME Code case N-514 was submitted to the NRC by FPL letter L-93-093, dated April 8, 1993.

V. ADDITIONAL INFORMATION

System and component identification described in this report:

SYSTEM OR COMPONENT	EIIS CODE	IEEE 803a/83
Overpressure Mitigating System	AB	N/A
Reactor Coolant System	AB	N/A
Reactor Vessel	AB	RPV
Pressure Transmitter	AB	PT
Power Operated Relief Valves (PORVs)	AB	PCV
Steam Generators	SB	SG
Charging Pumps	CB	P
Letdown	CB	N/A
Residual Heat Removal	BP	N/A
Reactor Coolant Pump	AB	P
Safety Injection Pump	BQ	P