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SUBJECT: Forwards confirmatory analysis per 861016 Amend 16 to License NPF-16 re low temp overpressure protection. Confirmatory analysis, "Possible Low Temp Overpressure Protection Sys Alignments... included in 861016 ltr.

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U. S. Nuclear Regulatory Commission
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Gentlemen:

Re: St. Lucie Unit 2
Docket No. 50-389
Confirmatory Analyses for
Low Temperature Overpressure Protection

By letter dated October 16, 1986 (E. G. Tourigny to C. O. Woody) the NRC issued Amendment No. 16 to Facility Operating License No. NPF-16 for St. Lucie Unit 2. This amendment consisted of changes requested by Florida Power & Light Company (FPL) to the reactor coolant system pressure/temperature limit figures. The amendment also added the shutdown cooling system (SDCS) relief valves as Low Temperature Overpressure Protection (LTOP) devices.

In the Safety Evaluation issued with Amendment No. 16, the staff required FPL to submit confirmatory analyses by January 15, 1987. The confirmatory analyses, entitled "Possible LTOP System Alignments and the Required Supporting Analyses" were included as an attachment to the staff's October 16, 1986 letter. Attached to this letter are the above required confirmatory analyses.

Please contact us if you have any question about these analyses.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/EJW/gp

Attachment

cc: Dr. J. Nelson Grace, Region II, USNRC
Mr. Alan Schubert, Florida Dept. of Health and Rehabilitative Services
Harold F. Reis, Esquire

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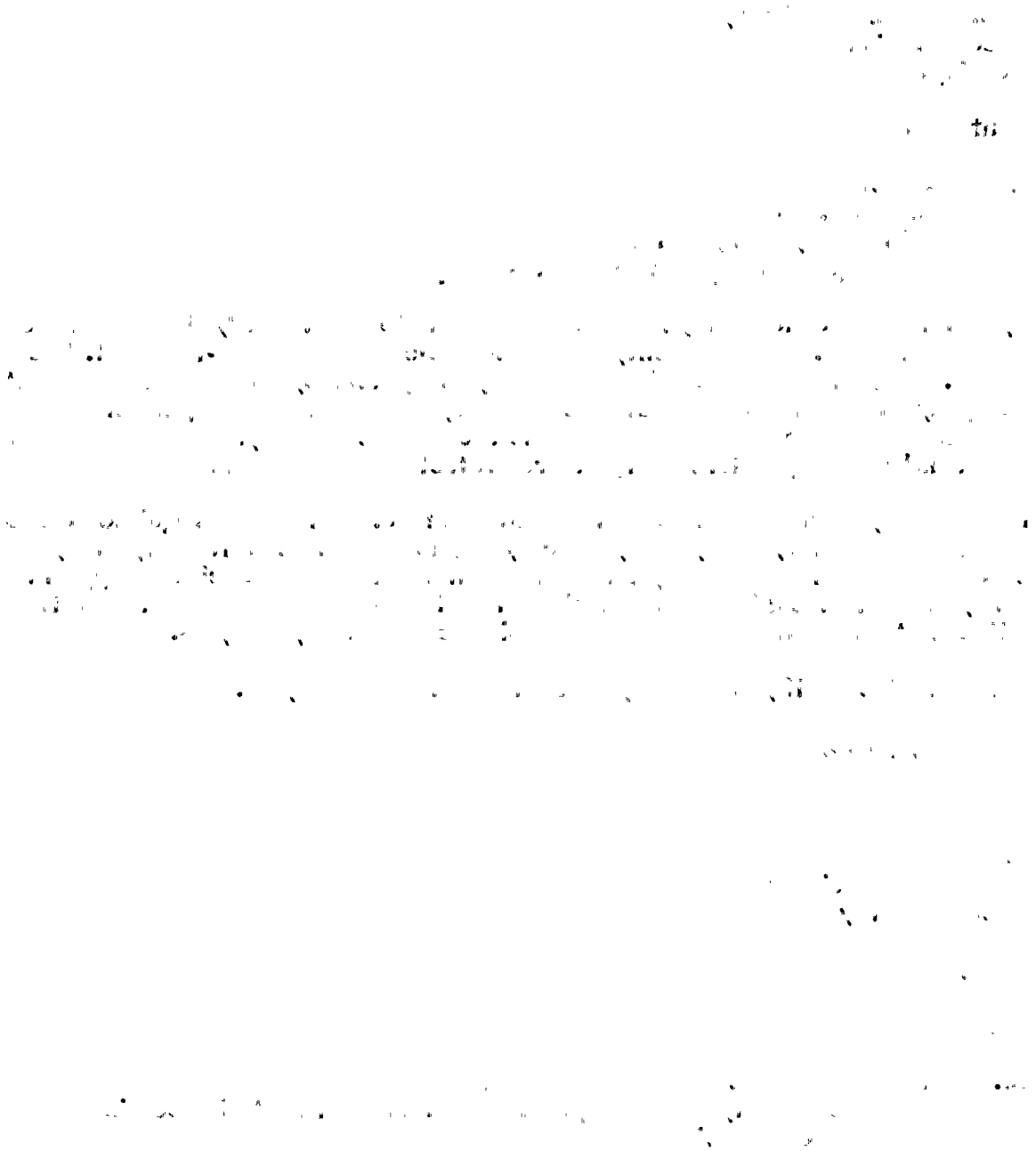

ATTACHMENT

CONFIRMATORY ANALYSES REQUIRED PER ST. LUCIE UNIT 2 AMENDMENT No. 16 TO FACILITY OPERATING LICENSE NPF-16

Response to 1.a.

A mass addition transient due to simultaneous operation of two High Pressure Safety Injection (HPSI) and three charging pumps was considered as one of the two most limiting pressure transients which provided a basis for the original St. Lucie Unit 2 Low Temperature Overpressure Protection (LTOP) system. (See Reference (1), Subsection 5.2.6.2.1). The original LTOP system was also based on the Pressure/ Temperature (P/T) limits for 0 to 2 years and included two Power Operated Relief Valves (PORVs) with the LTOP setpoints of 460 psia and 490 psia which were designated for transient mitigation over the entire LTOP temperature range.

To preclude violation of the P/T limits for 5 Effective Full Power Years (EFPY), 10 EFPY, etc., in the case of a pressure transient at the lower Reactor Coolant System (RCS) temperatures, a lower relief valve setpoint was required. It was determined that reducing the setpoint would not, by itself, preclude violation of new P/T limits if the limiting pressure transients previously assumed were also used as a basis for a new LTOP analysis.

As a result, less severe overpressurization events were assumed for the new St. Lucie Unit 2 LTOP system. (See Reference (2), Response to Question 1). These assumptions, although less conservative than those used previously, meet the requirements for LTOP systems, specified in Reference (3), and the Limiting Conditions for Operation (LCOs) of Reference (4), paragraphs 3.1.2.3, 3.1.2.4, 3.5.2, and 3.5.3.

In the most recent LTOP evaluation, no HPSI pumps were assumed to be operable at Tc 200°F. However, a mass addition transient due to simultaneous operation of one HPSI and three charging pumps at these temperatures was analyzed. The peak RCS pressure in this transient, if mitigated by one Shutdown Cooling System (SDCS) relief valve, was calculated to be 345 psia.

An analysis was performed to determine if one HPSI pump can be operable to Tc 185°F if the RCS is depressurized with a vent of greater than or equal to 3.58 square inches. The analysis confirmed that one HPSI pump can be operable under the above conditions. As a result Technical Specifications 3.1.2.1 and 3.1.2.3 requiring HPSI pump operation were satisfied.

An additional evaluation revealed a marginal difference between the peak pressure of 345 psia discussed above and the controlling pressure of 343 psia which was used to identify heatup and cooldown rates. (This controlling pressure was assumed to equal the rounded off peak pressure in the Reactor Coolant Pump (RCP) start transient with one SDCS relief valve.) Using P_{cont} = 345 psia instead of P_{cont} = 343 psia does not significantly change the identified heatup and cooldown rates.

Consequently, it was concluded that, based on LTOP considerations, one HPSI pump can be aligned to the RCS during the entire LTOP mode including the RCS temperatures below 185°F.

Response to 1.c.

Following are the sequences of events during the most limiting pressure transients which were used as a basis for the St. Lucie Unit 2 LTOP analysis.

I. RCP Start in Water-Solid RCS With Secondary-to-Primary T = 40°F

IA. With a PORV

Time (sec)	Event	Analysis Setpoint or Value (psia)
0.0	Operator starts a RCP. RCS pressure begins to rise from the initial value	300
6.4	PORV opens at the specified setpoint	470
6.5	RCS pressure reaches a peak (at the PORV inlet) and starts decreasing	473.3
7.1	PORV closes at the reseat pressure and RCS pressure begins to rise	462
6.4 - 600	PORV cycles open and closed. Peak pressures at the PORV inlet	471.0 to 474.5

IB. With a SDCS Relief Valve (SDCSRV)

Time (sec)	Event	Analysis Setpoint or Value (psia)
0.0	Operator starts a RCP. RCS pressure begins to rise from the initial value	300
3.0	SDCSRV starts opening at 3% accumulation	360
3.1	RCS pressure reaches a peak (at the SDCSRV inlet) and starts decreasing	362.1
3.7	RCS pressure reaches a minimum, and starts increasing	359.8
9.0	RCS pressure reaches a maximum (at the SDCSRV inlet) and starts decreasing slowly	362.1
9.0-600(1)	RCS pressure continues to decrease with the SDCSRV partially open, or until the valve closes at 10% blowdown	316.5

(1) The transient was not analyzed up to t = 600 sec. However, in either case, the peak pressure of 362.1 psia will not be exceeded, because the intensity of the transient diminishes with time.

II. Mass Addition Due to One HPSI and Three Charging Pump Operation in Water-Solid RCS, with a PORV

Time (sec)	Event	Analysis Setpoint or Value (psia)
0.0	Inadvertent safety injection actuation. RCS pressure begins to rise from the initial value	300
3.3*	PORV opens at the specified setpoint and RCS pressure starts decreasing	470
4.0*	PORV closes at the reseat pressure and RCS pressure begins to rise	462
3.3 - 600	PORV cycles open and closed. Peak pressures at the PORV inlet	470**

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* Estimated

** Based on comparison between the setpoint and the equilibrium pressure of 375 psia which was calculated for this transient.

Response to I.d

Three overpressurization events were chosen and analyzed, as indicated in Reference (2), Response I. These are:

- RCP Start
- Two charging pump operation
- Inadvertent actuation of a HPSI pump, with simultaneous operation of three charging pumps.

These events were assumed to be mitigated by either one PORV, with a setpoint of 470 psia, or one SDCS relief valve, with a setpoint of 350 psia. The pressure transient analyses result in the peak (maximum) RCS pressures in each transient. These pressures are provided below:

		w/PORV (psia)	w/SDCS Relief Valve (psia)
(I)	RCP Start	535	342.7
(2)	Two Charging Pumps	473	341.0
(3)	I HPSIs and 3 Charging Pumps	492	345.0

The identified controlling pressures (i.e. the most limiting pressures) were as follows:

P_{cont} = 535 psia, when LTOP is provided by the PORVs.
P_{cont} = 343 psia, when LTOP is provided by the SDCS relief valves.

It should be noted that a controlling pressure generally identifies an RCS pressure limit which will not be exceeded during any overpressurization event that could occur in the corresponding temperature region while being mitigated by an applicable relief valve. When applied to 10 CFR 50 Appendix G P/T limit curves, a controlling pressure also provides a lower bound pressure limit for these curves. In other words, a controlling pressure is generally more limiting than the P/T limits above it. Therefore, no P/T limits above the controlling pressure will be exceeded during normal operation or an overpressurization event.

P/T limits below the controlling pressure are considered theoretical since restrictions on heatup and cooldown rates (which are a part of LTOP requirements) prevent operation based on these limits.

REFERENCES

1) St. Lucie Unit 2 Final Safety Analysis Report
2) FPL Letter L-86-353 dated September 4, 1986
3) NRC Branch Technical Position RSB 5-2, Overpressurization Protection of Pressurized Water Reactors While Operating at Low Temperatures
4) St. Lucie Unit 2 Technical Specifications