



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 46

TO FACILITY OPERATING LICENSE NO. NPF-16

FLORIDA POWER & LIGHT COMPANY

ST. LUCIE PLANT, UNIT NO. 2

DOCKET NO. 50-389

INTRODUCTION

By application dated February 7, 1990, as supplemented June 19, 1990, the Florida Power and Light Company (the licensee) requested an amendment which would incorporate revised pressure/temperature (P/T) limits and the results of a revised low temperature overpressure protection (LTOP) analysis into the Technical Specifications (TS) for St. Lucie Unit 2. The current St. Lucie Unit 2 TS for P/T and LTOP are applicable to 6 effective full power years (EFPY). Accordingly, the St. Lucie 2 TS require revision prior to the plant reaching 6 EFPY. Below is the staff's evaluation of the proposed changes.

The licensee's letter dated June 19, 1990 corrected a typographical error on proposed TS page 3/4 4-31a. This information did not change the staff's initial determination of no significant hazards consideration as published in the Federal Register on March 7, 1990 (55 FR 8224).

PRESSURE/TEMPERATURE LIMITS

In response to Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Effect on Plant Operations," the licensee requested permission to revise the P/T limits in the St. Lucie 2 TS, Section 3.4. This revision also changes the effectiveness of the P/T limits from 6 to 15 EFPY. The proposed P/T limits were developed using Regulatory Guide (RG) 1.99, Revision 2. The proposed revision provides up-to-date P/T limits for the operation of the Reactor Coolant System (RCS) during heatup, cooldown, criticality, and hydrotest.

To evaluate the P/T limits, the staff uses the following NRC regulations and guidance: Appendices G and H of 10 CFR Part 50; the ASTM Standards and the ASME Code, which are referenced in Appendices G and H; 10 CFR 50.36(c)(2); RG 1.99, Rev. 2; Standard Review Plan (SRP) Section 5.3.2; and Generic Letter 88-11.

Each licensee authorized to operate a nuclear power reactor is required by 10 CFR 50.36 to provide TS for the operation of the plant. In particular, 10 CFR 50.36(c)(2) requires that limiting conditions of operation be included in the TS. The P/T limits are among the limiting conditions of operation in the

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TS for all commercial nuclear plants in the U.S. Appendices G and H of 10 CFR Part 50 describe specific requirements for fracture toughness and reactor vessel material surveillance that must be considered in setting P/T limits. An acceptable method for constructing the P/T limits is described in SRP Section 5.3.2.

Appendix G of 10 CFR Part 50 specifies fracture toughness and testing requirements for reactor vessel materials in accordance with the ASME Code and, in particular, that the beltline materials in the surveillance capsules be tested in accordance with Appendix H of 10 CFR Part 50. Appendix H, in turn, refers to ASTM Standards. These tests define the extent of vessel embrittlement at the time of capsule withdrawal in terms of the increase in reference temperature. Appendix G also requires the licensee to predict the effects of neutron irradiation on vessel embrittlement by calculating the adjusted reference temperature (ART) and Charpy upper shelf energy (USE). Generic Letter 88-11 requested that licensees and permittees use the methods in RG 1.99, Rev. 2, to predict the effect of neutron irradiation on reactor vessel materials. This guide defines the ART as the sum of unirradiated reference temperature, the increase in reference temperature resulting from neutron irradiation, and a margin to account for uncertainties in the prediction method.

Appendix H of 10 CFR Part 50 requires the licensee to establish a surveillance program to periodically withdraw surveillance capsules from the reactor vessel. Appendix H refers to the ASTM Standards which, in turn, require that the capsules be installed in the vessel before startup and that they contain test specimens made from plate, weld, and heat-affected-zone (HAZ) materials of the reactor beltline.

Evaluation

The staff evaluated the effect of neutron irradiation embrittlement on each beltline material in the St. Lucie 2 reactor vessel. The amount of irradiation embrittlement was calculated in accordance with RG 1.99, Rev. 2. The staff has determined that the material with the highest ART at 15 EFPY was the intermediate shell plate M-605-1 with 0.11% copper (Cu), 0.61% nickel (Ni) and an initial RT_{NDT} of 30°F.

The licensee has removed one surveillance capsule from St. Lucie 2. The results from capsule W-83 were published in Babcox & Wilcox Report BAW-1880. All surveillance capsules contained Charpy impact specimens and tensile specimens made from base metal, weld metal, and HAZ metal.

For the limiting beltline material, intermediate shell plate M-605-1, the staff calculated the ART to be 139.9°F at 1/4T (T = reactor vessel beltline thickness) and 118.6°F for 3/4T at 15 EFPY. The staff used a neutron fluence of 1.09E19 n/cm² at 1/4T and 3.86E18 n/cm² at 3/4T. The ART was determined by Section 1 of RG 1.99, Rev. 2, because only one surveillance capsule has been removed from the St. Lucie 2 reactor vessel.

The licensee used the method in RG 1.99, Rev. 2, to calculate an ART of 140°F at 15 EFPY at 1/4T for the same limiting intermediate shell plate material. Substituting the ART of 140°F into equations in SRP 5.3.2, the staff verified that the proposed P/T limits for heatup, cooldown, and hydrotest meet the beltline material requirements in Appendix G of 10 CFR Part 50.

In addition to beltline materials, Appendix G of 10 CFR Part 50 also imposes P/T limits based on the reference temperature for the reactor vessel closure flange materials. Section IV.2 of Appendix G states that when the pressure exceeds 20% of the preservice system hydrostatic test pressure, the temperature of the closure flange regions highly stressed by the bolt preload must exceed the reference temperature of the material in those regions by at least 120°F for normal operation and by 90°F for hydrostatic pressure tests and leak tests. Based on the flange reference temperature of 0°F, the staff has determined that the proposed P/T limits satisfy Section IV.2 of Appendix G.

Section IV.B of Appendix G requires that the predicted Charpy USE at end of life be above 50 ft-lb. The licensee has unirradiated USE data for all plate materials, but does not have unirradiated USE data for any of the beltline welds. The staff has determined that all the plate materials for which data are available will meet the requirement that the Charpy USE at end of life be above 50 ft-lb. Since the unirradiated USEs of the welds are unavailable, the staff will monitor closely the irradiated USEs of the welds to ascertain that the USEs will be above 50 ft-lb.

Technical Finding

The staff concludes that the proposed P/T limits for the RCS for heatup, cooldown, leak test, and criticality are valid through 15 EFPY because the limits conform to the requirements of Appendices G and H of 10 CFR Part 50. The licensee's submittal also satisfies Generic Letter 88-11 because the licensee used the method in RG 1.99, Rev. 2 to calculate the ART. Hence, the proposed P/T limits may be incorporated into the St. Lucie 2 TS.

LOW TEMPERATURE OVERPRESSURE PROTECTION

The RCS P/T limits during plant heatup and cooldown are specified in TS Figures 3.4-2 and 3.4-3 for St. Lucie Unit 2. The P/T curves in the current TS are based on an assumed design basis neutron fluence through 6 EFPY.

By letter dated February 7, 1990, as supplemented June 19, 1990, the licensee provided its updated P/T curves in proposed TS Figures 3.4-2 (for heatup and core critical) and 3.4-3 (for cooldown and inservice testing), revised cooldown rates as a function of indicated reactor coolant temperature in proposed Figure 3.4-4, changes in the values of the RCS cold leg temperature at which LTOP should be enabled, and the justification for the changes. The new P/T curves are based on the irradiation damage prediction methods of RG 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2, U.S. Nuclear Regulatory Commission, May 1988, and are applicable for a period up to 15 EFPY.

LTOP for St. Lucie Unit 2 is provided by the power-operated relief valves (PORVs) on the pressurizer and shutdown cooling relief valves (SDCRVs). These valves are set at pressures low enough to prevent violation of the Appendix G heatup and cooldown curves should an RCS pressure transient occur during low temperature operations. The licensee, in its February 7, 1990 submittal, identified the most limiting overpressure transients in determining the PORV setpoints for LTOP. The PORV setpoint limits have been previously set by analysis of the limiting transients for mass addition and energy addition.

The Limiting Conditions for Operation (LCOs) in TS 3.4.9.3, "Overpressure Protection Systems," currently requires that two PORVs or two SDCRVs shall be operable with the setpoints selected for the low temperature mode of operation. The modified TS 3.4.9.3 LCOs a. and c. maintain the same PORV setpoint and revises the values of the applicable temperatures for PORV use for LTOP through reference to a new Table 3.4-4, "minimum cold leg temperature for PORV use for LTOP." The applicability of TS 3.4.9.3 is modified to remove reference to Mode 3 which is outside the proposed LTOP range.

Two design basis mass addition transient were analyzed for representative inadvertent safety injection actuation assumptions. This transient analysis is typically performed to determine the pressure overshoot past the LTOP setpoint such that the Appendix G curves are not exceeded during the transient.

The energy input transient was analyzed assuming a 40°F temperature difference between the steam generator and the RCS. A reactor coolant pump startup in one loop was assumed in order to maximize the heat transfer effect. As was the case for the mass addition transient, the pressure overshoot is calculated such that the Appendix G P/T curves for Unit 2 are not exceeded.

The licensee's analyses were performed using the same methodology as the prior application for 6 EFPY with some changes in the analysis assumptions. For the revised analysis, the LTOP enable temperatures were determined by following the guidance that for LTOP, the enable temperature is the water temperature corresponding to a metal temperature of at least $RT_{NDT} + 90^{\circ}\text{F}$ at the vessel bellline, which was calculated by the licensee to be less than or equal to 247°F during heatup and less than or equal to 230°F during cooldown. The results indicated that changes in the present PORV setpoint of 470 psia and SDCRV setpoint of 350 psia is not required. The new enable temperatures are identified in revised Table 3.4-3, "Low Temperature RCS Overpressure Protection Range."

Table 3.4-4, "Minimum Cold Leg Temperature for PORV Use for LTOP" of LCO 3.4.9.3 is modified to identify the minimum cold leg temperature for PORV use for LTOP as 165°F during heatup and cooldown. This is the temperature identified for transfer of the LTOP function from the SDCRVs to the PORVs which occurs at a temperature above that required for SDCRV alignment to the RCS.

The licensee-proposed changes in TS 3.4.9.3, Tables 3.4-3 and 3.4-4, and the associated Bases sections reflect the above discussed LTOP alignment temperatures and the heatup and cooldown rates identified by the updated Figures 3.4-2, 3.4-3, and 3.4-4 in TS 3.4.9.1. The staff finds that they are based on applicable regulatory guidance in Standard Review Plan (SRP) 5.2.2, Revision 2, are reasonably conservative, and are acceptable.

Other changes identified by the licensee in its amendment request are changes to Definition 1.16, a deletion of the words "for the applicable operating period" in LCO 3.4.1.3 and clarification of the Applicability in TS 3.4.1.4.1 and 3.4.4 to reflect the modified LTOP range. Also, the action statement of

LCO 3.4.9.1 is revised to make reference to the updated Figures 3.4-2, 3.4-3 and 3.4-4. These changes are judged to be administrative in nature and are acceptable.

Technical Finding

Based on the above evaluation, the staff concludes that the licensee's proposed TS and their associated Bases are acceptable to support the updated P/T limits identified in TS 3.4.9.3 applicable for a period up to 15 EFPY.

ENVIRONMENTAL CONSIDERATION

This amendment involves a change to a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. We have determined that this amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

CONCLUSION

We have concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations, and the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

REFERENCES

1. Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2, May 1988.
2. NUREG-0800, Standard Review Plan, Section 5.3.2, Pressure-Temperature Limits.
3. Letter from J. H. Goldberg (FPL) to USNRC Document Control Desk, Subject: "Proposed License Amendment P-T Limits and LTOP Analysis," February 7, 1990.
4. A. L. Lowe, Jr. et. al., "Analysis of Capsule W-83, Florida Power and Light Company, St. Lucie Unit No. 2," BAW-1880, September 1985.

Date: August 1, 1990

Principal Contributors:

J. Tsao
M. McCoy