UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 258 TO FACILITY OPERATING LICENSE NO. DPR-59

POWER AUTHORITY OF THE STATE OF NEW YORK

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

1.0 INTRODUCTION

By letter dated June 22, 1999, the Power Authority of the State of New York (PASNY or the licensee) submitted a request for changes to the James A. FitzPatrick Nuclear Power Plant (JAFNPP) Technical Specifications (TSs). The requested changes would change the Pressure-Temperature (P-T) limit curves to extend to 24 effective full-power years (EFPY) and 32 EFPY. The current P-T limit curves are valid for service through 16 EFPY. These changes include appropriate changes to TS 3.6.A, "Pressurization and Thermal Limits," and to Figure 3.6-1, "Reactor Vessel Pressure - Temperature Limits . . ." Parts 1, 2, and 3. The proposed changes also include appropriate changes to the TS Bases. The evaluation of the proposed changes to the P-T limit curves is provided in Section 2.0 to this safety evaluation report (SER).

2.0 EVALUATION

2.1 Basis for the Staff's Assessment

The NRC has established requirements in 10 CFR Part 50 to protect the integrity of the reactor coolant pressure boundary in nuclear power plants. The staff evaluates the P-T limits based on the following NRC regulations and guidance: 10 CFR Part 50, Appendix G (Ref. 2); Regulatory Guide (RG) 1.99, Revision 2 (RG 1.99, Rev. 2; Ref. 3); Standard Review Plan Section 5.3.2 (SRP 5.3.2; Ref. 4); and Appendix G to Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Appendix G to the Code; Ref. 5).

10 CFR Part 50, Appendix G, requires that the P-T limits for an operating plant must be at least as conservative as those that would be generated if the methods of Appendix G to Section XI of the ASME Code were applied. The basic parameter in Appendix G to the Code for calculating P-T limit curves is the stress intensity factor KI , which is a function of the stress state and flaw configuration. The methodology of Appendix G to the ASME Code postulates the existence of a sharp surface flaw in the reactor pressure vessel (RPV) that is normal to the direction of the maximum stress. The maximum flaw size in the RPV is postulated to have a depth that is equal to one-fourth of the RPV beltline thickness and a length equal to 1.5 times the RPV beltline thickness. The methodology of Appendix G to the Code requires that licensees determine the KI factors, which vary as a function of temperature, from the reactor coolant system (RCS) operating temperatures and from the adjusted reference temperatures (ARTs) for the limiting materials in the RPV beltline region. The critical locations in the RPV beltline region for

calculating the ARTs used in the generation of the P-T Limit Curves are the 1/4-thickness (1/4T) and 3/4-thickness (3/4T) locations, which correspond to the depth of the maximum postulated flaw, if initiated and grown from the inside and outside surfaces of the RPV, respectively.

RG 1.99, Rev. 2, provides an acceptable method for calculating the ARTs for ferritic RPV materials. The ART is defined as the sum of the initial (unirradiated) reference temperature (initial RT_{NDT}), the mean value of the adjustment in reference temperature caused by irradiation (ΔRT_{NDT}), and a margin (M) term. The ΔRT_{NDT} is a product of a chemistry factor and a fluence factor. The chemistry factor (CF) is dependent upon the amount of copper and nickel in the material and may be determined from the tables in RG 1.99, Rev. 2, or from surveillance data obtained from the plant's applicable reactor vessel material surveillance program. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depths. The margin term is dependent upon whether the initial RT_{NDT} is a plant-specific or a generic value and whether the chemistry factor was determined using the tables in RG 1.99, Rev. 2, or surveillance data. The margin term is used to account for uncertainties in the values of initial RT_{NDT}, copper and nickel contents, fluence and calculational procedures. RG 1.99, Rev. 2, also describes the methodology to be used in calculating the M term.

10 CFR Part 50, Appendix G, imposes the following restrictions on the calculation of P-T limits for an operating nuclear plant:

- During normal operations[1], at times when the reactor core is not critical or during hydrostatic pressure or leak rate testing, 10 CFR Part 50, Appendix G requires that the P-T limits must be at least as conservative as those which would be generated by applying the methods of Appendix G to the Code.

- During normal operations when the reactor core is critical, the requirement in 10 CFR Part 50, Appendix G, changes by adding 40 °F to the values that would be obtained through application of the methods in Appendix G to the Code.

To satisfy these restrictions, proposed P-T curves must satisfy a safety factor of 2.0 on primary membrane and bending stresses during normal operations (including heatup, cooldown, and transient operations), and a safety factor of 1.5 on primary membrane and bending stresses when leak rate or hydrostatic pressure tests are performed on the primary pressure boundary.

10 CFR Part 50, Appendix G, also imposes certain minimum temperature requirements (MTRs) on a RPV at a nuclear power plant. The degree of conservatism in the MTRs specified in 10 CFR Part 50, Appendix G, are dependent upon mode of operation, criticality of the core, and on degree of pressurization of the RCS relative to the preservice hydrostatic test pressure (PHTP). The MTRs for BWRs are summarized below:

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[1] Appendix G to the ASME Code considers normal operating conditions to include conditions of the plant during normal power operations of the reactor, during heatups and cooldowns of the reactor with the reactor core either critical or not critical, and during anticipated operational transients.

- For normal operating or pressure testing conditions of the RCS, when the RCS pressure is less than or equal to 20 percent of the PHTP and the reactor core is not critical, the MTR is equal to the limiting ART for the RPV closure flange.
- For pressure testing conditions of the RCS, when the RCS pressure is greater than 20 percent of the PHTP and the reactor core is not critical, the MTR is equal to the limiting ART for the RPV closure flange plus 90 °F.
- For normal operations, when the RCS pressure is greater than 20 percent of the PHTP and the reactor core is not critical, the MTR is equal to the limiting ART for the RPV closure flange plus 120 °F.
- For normal operations in BWRs, when the RCS pressure is less than or equal to 20 percent of the PHTP and the reactor core is critical, the MTR is equal to the sum of the limiting ART for the RPV closure flange and 60 °F.
- For normal operations, when the RCS pressure is greater than 20 percent of the PHTP and the reactor core is critical, the MTR is equal to the larger of either the minimum temperature for the inservice hydrostatic test or a temperature that is equal to the sum of the limiting ART for the RPV closure flange and 160 °F.

Table 1 of 10 CFR Part 50, Appendix G, summarizes these requirements in slightly more detail. The composite P-T limit curves are generated by superimposing the appropriate minimum temperature requirements over the most limiting generated P-T limit curves for the units, and selecting the most conservative P-T data to establish the limiting composite curves for the plants. Pursuant to 10 CFR 50.60 (Ref. 6), a licensee must request an exemption from complying with requirements of 10 CFR Part 50, Appendix G, when the licensee determines that the P-T limits for an operating plant are not in compliance with the criteria stated in the rule.

2.2 Staff Assessment of the Licensee's Submittal

For the JAFNPP RPV, the licensee provided the P-T limit curves for normal operating conditions and pressure testing conditions effective to both 24 and 32 EFPY[2]. To test the validity of the licensee's proposed curves, the staff performed an independent assessment of

[2] For JAFNPP, normal operating conditions include operating conditions at power with the core being either critical or not-critical, heatups and cooldowns of the RPV at rates up to 100°F/hr, and transient operating conditions. The P-T limit curves for the beltline region of the JAFNPP RPV during normal operating and pressure testing conditions were generated based on the ART values for the most limiting materials in the JAFNPP RPV beltlines, bottom head and pressure vessel nozzles. The feedwater nozzle is the limiting nozzle in the JAFNPP RPV. The proposed P-T limit curves for the JAFNPP RPV also include separate P-T limit curves for the JAFNPP bottom head during normal operating and pressure testing conditions, and a separate P-T limit curve for the limiting non-beltline nozzle (e.g., the feedwater nozzle) during pressure testing conditions. For normal operating conditions the curve for the limiting non-beltline nozzle were incorporated into the P-T limit curve for the beltline, since the P-T limit points for the nozzles were conservative to (e.g., greater than) those for the beltline at the lower operating pressures (e.g., pressures less than 560 psig on the proposed curves) .

the licensee's submittal.[3] The staff applied the methodologies of Appendix G to the Code and 10 CFR Part 50, Appendix G, as the bases for its independent assessment. The assessment included an independent calculation of the limiting ART values for the 1/4T location of the JAFNPP RPV beltline based on neutron fluences for 24 EFPY and 32 EFPY, and an independent generation of the P-T limit curves for the JAFNPP RPV effective to 32 EFPY. For the evaluation of the limiting beltline materials, the staff confirmed that the ARTs and P-T limit curves were based on the latest projected neutron fluences for 24 EFPY and 32 EFPY, and on the methodology in RG 1.99, Rev. 2. The staff also confirmed that the difference between the predicted ΔRT_{NDT} and measured ΔRT_{NDT} values (e.g., predicted ΔRT_{NDT} - measured ΔRT_{NDT}) for the available surveillance materials were within ±2 standard deviations for ΔRT_{NDT}.

The staff determined that the licensee's P-T limit curves incorporated conservative assumptions that made the curves as conservative or slightly more conservative than the P-T limit curves generated by the staff in accordance with the methods of the 1989 Edition of Appendix G to Section XI of the ASME Code. The staff also confirmed that the licensee's P-T limit curves included the appropriate MTRs that were at least as conservative as those required by 10 CFR Part 50, Appendix G and the 1989 Edition of Appendix G to Section XI of the ASME Code. Given these considerations, the staff concludes that the proposed P-T limit curves, effective to 24 and 32 EFPY, are in compliance with 10 CFR Part 50, Appendix G, and acceptable for incorporation into the JAFNPP TS.

2.3 Conclusions on the Staff's Assessment

PASNY's proposed P-T limit curves for normal operating and pressure testing conditions, effective to 32 EFPY, are slightly more conservative with the P-T limit curves generated by the staff in accordance with the methods of Appendix G to the Code. The staff therefore concludes that the P-T limit curves effective to 24 EFPY and 32 EFPY are in compliance with 10 CFR Part 50, Appendix G, and provide sufficient assurance that the JAFNPP reactor will be operated in a manner that will protect the JAFNPP RPVs against brittle fracture. The proposed curves are therefore approved for incorporation into the JAFNPP Technical Specifications.

3.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New York State official was notified of the proposed issuance of the amendment. The State official had no comments.

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[3] For this assessment, since PASNY is proposing to use the same curves for heatups and cooldowns of the JAFNPP, the staff verified that PASNY had applied the data for the 1/4T location of the RPV during cooldown conditions as the basis for establishing the most limiting (conservative) P-T limit curves for the vessel. The staff also confirmed that at 24 EFPY ane 32 EFPY, material heat Nol 27204/12008 (e.g., the weld material for fabrication of the lower shell axial welds) was the limiting material for the 1/4T location of the JAFNPP RPV, and that the ARTs for this material at the 1/4T location are 91.9 °F at 24 EFPY and 110.1 °F at 32 EFPY. These values are based on the latest weld chemistry for this material as provided in CEOG task report CE NPSD-1039, Rev. 2, and 24 EFPY and 32 EFPY neutron fluences of 0.121E19 n/cm^2 and 0.161E19 n/cm^2, respectively. The staff also confirmed that all calculations were performed in accordance with the methods in RG 1.99, Revision 2. For the evaluations of the feedwater nozzle PASNY used an ART of 30 °F instead of the actual value of 20 °F. This is conservative.

4.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the 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 the amendment involves no significant hazards consideration, and there has been no public comment on such finding (64 FR 43775). Accordingly, the 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 the amendment.

5.0 CONCLUSION

The Commission has 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, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 REFERENCES:

1. Letter dated June 22, 1999, from J. Knubel, Senior Vice President and Chief Nuclear Officer, New York Power Authority, to the U.S. Nuclear Regulatory Commission Document Control Desk, "James A. FitzPatrick Nuclear Power Plant . . . Proposed Change to the Technical Specifications Regarding Pressure-Temperature Limits (JPTS-99-003)."

2. Appendix G, "Fracture Toughness Requirements," to Part 50 of Title 10, *Code of Federal Regulations.*

3. Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," (May 1988).

4. Section 5.3.2: "Pressure-Temperature Limits," to NUREG-0800, "U.S. Nuclear Regulatory Commission Standard Review Plan."

5. Appendix G to Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Division 1, "Protection Against Non-ductile Failure."

6. Section 50.60, "Acceptance Criteria for Fracture Prevention Measures for Lightwater Nuclear Power Reactors for Normal Operation," to Part 50 of Title 10, *Code of Federal Regulations.*

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