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

ENCLOSURE 2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FRACTURE TOUGHNESS REQUIREMENTS FOR PROTECTION AGAINST PRESSURIZED THERMAL SHOCK EVENTS (10 CFR 50.61)

DUKE POWER COMPANY, ET AL.

CATAWBA NUCLEAR STATION, UNIT 2

DOCKET NO. 50-414

1.0 INTRODUCTION

In accordance with 10 CFR Part 50.61(b)(1), each pressurized water reactor licensee shall have submitted an assessment of the pressure vessel reference temperature by January 23, 1986. This assessment of the reference temperature at the inner surface of the reactor vessel beltline materials is projected from the time of submittal to the expiration of the license. The assessment must specify the bases for the projection and the assumptions regarding core loading patterns. It must be updated whenever changes in core loadings, surveillance measurements, or other information indicate a significant change in projected reference temperature values.

2.0 EVALUATION

By letters dated October 1, 1985, and November 11, 1986, Duke Power Company, et al., (the licensee) submitted information for Catawba Unit 2 on the material properties and the fast neutron fluence (E greater than or equal to 1.0 MeV) of the reactor pressure vessel in compliance with the requirements of 10 CFR 50.61 (See References 1 and 2).

2.1 Material Properties

The controlling beltline material from the standpoint of PTS susceptibility was identified by the licensee to be the intermediate shell plate B8605-2. The material properties of the controlling material and the associated margin and chemistry factor were reported by the licensee to be:

	Licensee Submittal	Staff Evaluation
Cu (copper content, %)	0.07	0.07
Ni (nickel content, %)	0.61	0.61
I (Initial RT_{NDT}, °F)	33	33
M (Margin, °F)	—	48
CF (Chemistry Factor, °F)	—	37.8

8807120388 880628
PDR ADOCK 05000413
P PDR

The results of the staff's evaluation are given in the second column above. The controlling material has been properly identified. The justifications given for the copper and nickel contents and the initial reference temperature (RT_{NDT}), as defined in the ASME Code, Paragraph NB-2331, are acceptable.

The margin has been derived from consideration of the bases for these values, following the PTS rule (10 CFR Part 50.61). Based on the reported values of fluence, Equation 1 of the PTS rule governs and the chemistry factor is as shown in the above table.

2.2 Fast Neutron Fluence

The following evaluation concerns the estimation of the fluence to the pressure vessel for 32 effective full power years of operation and the equations in 10 CFR Part 50.61(b)(2). The 32 effective full power years represent a 40-year design life based on an 80 percent capacity factor.

The fluence calculation was based on the DOT computer code, but used the P_1 approximation and an ENDF/B-II based cross section set (Reference 2). No statement is made on other aspects of the computation such as quadrature approximation, source distribution, reload strategy, etc. It is possible that the peak fluence might be underestimated by as much as 50%. However, as shown above the available margin is much greater. Hence, the staff finds that the proposed RT_{PTS} value is acceptable, subject to the condition that a revision of the peak fluence estimation methodology (E greater than or equal to 1.0 MeV) for 32 effective full power years of operation on intermediate shell plate B8605-2 will be carried out. This revision should be performed with a benchmarked version of the DOT code and as a minimum: (a) use a P_3 scattering cross section approximation, (b) use an S_8 quadrature approximation, (c) use an ENDF/B-IV based cross section set, (d) use a pin wise source distribution for the peripheral assemblies, and (e) should account for future reload strategies.

The applicable equation specified in 10 CFR 50.61(b)(2) for the pressure vessel PTS reference temperature (RT_{PTS}) for Catawba Unit 2 reactor is the following:

$$RT_{PTS} = I+M+(-10+470 \times Cu+350 \times Cu \times Ni) \times f^{0.27}$$

Where: I = Initial RT_{NDT} = 33°F

M = Uncertainty Margin = 48°F

Cu = w/o Copper in intermediate plate B8605-2 = 0.07

Ni = w/o Nickel in intermediate plate B8605-2 = 0.61

f = Peak Azimuthal Fluence for 32 EFPY (E greater than or equal to 1.0 MeV) on intermediate plate B8605-2 in units of 10^{19} n/cm^2 = 2.01

Therefore, for 32 effective full power years of operation, the PTS reference temperature is:

$$RT_{PTS} = 33+48+(-10+470x0.07+350x0.07x0.61)x2.1^{0.27}$$

$$= 81+48.85x1.222=81+46.2=127.2°F$$

This value is considerably lower than 270°F which is the applicable PTS rule screening criterion in 10 CFR Part 50.61 (b)(2) and, therefore, the projected PTS reference temperature for Unit 2 is acceptable.

3.0 Conclusion

The staff concludes, based on the above, that the pressure vessel PTS reference temperature defined in 10 CFR Part 50.61(b)(2) is less than the applicable PTS screening criterion. Because the PTS reference temperature is projected to be within the screening criterion through the expiration of the Unit 1 license, the licensee does not have to address 10 CFR Part 50.61(b)(3). In accordance with 10 CFR 50.61(b)(1), the staff requests that the licensee submit an update to the information provided in its letters dated October 1, 1985, and November 11, 1986, whenever changes in core loadings, surveillance measurements, or other information indicate a significant change in projected reference temperature values.

4.0 References

1. Letter from W. H. Owen, Duke Power Company to H. R. Denton NRR, dated October 1, 1985.

2. Letter from H. B. Tucker, Duke Power Company to H. R. Denton, NRR, dated November 11, 1986.

Principal Contributors: L. Lois, P. N. Randall

Dated: