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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING PROJECTED VALUES OF MATERIAL PROPERTIES

FOR FRACTURE TOUGHNESS REQUIREMENTS

FOR PROTECTION AGAINST PRESSURIZED THERMAL SHOCK EVENTS

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

SALEM NUCLEAR GENERATING STATION, UNIT 2

DOCKET NO. 50-311

INTRODUCTION

As required by 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock" (PTS Rule) which was published in the Federal Register July 23, 1985, the licensee for each operating pressurized water reactor "shall submit projected values of RT_{PTS} (at the inner vessel surface) of reactor vessel beltline materials by giving values from the time of submittal to the expiration date of the operating license. The assessment must specify the bases for the projection including the assumptions regarding core loading patterns. This assessment must be submitted by January 23, 1986, and must be updated whenever changes in core loadings, surveillance measurements or other information indicate a significant change in projected value".

By letter dated January 20, 1986, the Public Service Electric & Gas Company (the licensee) submitted projected values of RT_{PTS} together with material properties and fast neutron fluence of reactor vessel beltline material for the Salem Nuclear Generating Station Unit 2. The following evaluation concerns the estimation of the fluence to the end of the current operating license and to 32 effective full power years for Salem Unit 2 and the corresponding values for the RT_{PTS}.

EVALUATION OF THE MATERIAL ASPECTS

The controlling beltline material from the standpoint of PTS susceptibility was identified to be the intermediate shell longitudinal welds 2-422B and C (weld wire heat numbers 13253 and 20291, tandem arc). The material properties of the controlling material and the associated margin and chemistry factor were reported to be:

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	Utility Submittal	Staff Evaluation
Cu (copper content, %)	0.23	0.23
Ni (nickel content, %)	0.73	0.73
I (Initial RT_{NDT}, °F)	-56	-56
M (Margin, °F)	59	59
CF (Chemistry Factor, °F)	--	156.9

CONCLUSION

The controlling material has been properly identified. The justifications given for the copper and nickel contents and the initial RT_{NDT} are acceptable. The margin has been derived from consideration of the bases for these values, following the PTS Rule, Section 50.61 of 10 CFR Part 50. Assuming that the reported values of fluence are correct, Equation 1 of the PTS Rule governs, and the chemistry factor is as shown above.

EVALUATION OF THE FLUENCE ASPECTS

The value of the fleunce was estimated as of the date of the submittal, January 20, 1986, to the expiration of the current operating license (September 25, 2008) and to 32 effective full power years, i.e., the end of the plant design lifetime.

The licensee used the code DOT 4.3 which is generally accepted for deep neutron transport calculations with P_3 and S_8 approximations. The (Watt) spectra for U-235 and Pu-239 were ENDF/B-IV based and the "Bugle 80" cross section data set was used which is also derived from ENDF/B-IV. All of the above constitute an acceptable methodology. The 1/8 core geometry was represented by 82x45 mesh points and the pin power distribution was estimated using PDQ and the SORREL code to adopt the source term to DOT 4.3. Cycle 3 fluxes were used for the extrapolation for future low leakage loadings, which is acceptable. This represents a conservative and acceptable application of the methodology.

In this manner the estimated values of the peak fluence on welds 2-442 A/C are 0.13, 1.01 and 1.46 (in units of 10^{19} n/cm2) for 1/20/86, September 25, 2008 and 32 effective full power years, respectively.

EVALUATION OF THE CALCULATED RT_{PTS}

According to the PTS Rule, 10 CFR 50.61, the applicable equation for calculating RT_{PTS} is:

$$RT_{PTS} = I+M+(-10+470xCu + 350xCuxNi)xf^{.27}$$

Where: I = initial RT_{NDT} = -56°F

M = uncertainty = 59°F

Cu = % copper in welds 2-442 A/C = .23

Ni = % nickel in welds 2-442 A/C = -73

f = peak fluence ($E \geq 1.0$ MeV) on welds 2-442 A/C x 10^{-19} cm^2/n

Then, the equation for RT_{PTS} yields for 32 effective full power years:

$$RT_{PTS} = -56+59+(-10+470x0.23+350x0.23x0.73) \times 1.46^{0.27}$$

$$= 3+156.9x1.108 = 176.8°F$$

CONCLUSIONS

The licensee has calculated a RT_{PTS} of 176.8°F for the limiting welds material for 32 effective full power years which is less than the applicable screening criterion of 270°F. At the expiration of the current operating license the RT_{PTS} = 160.3°F $\leq$ 270°F and is acceptable. In order for us to confirm the licensee's projected estimated RT_{PTS} throughout the life of the license we will request the licensee to submit a re-evaluation of the RT_{PTS} and comparison to the predicted value with future Pressure-Temperature submittals which are required by 10 CFR 50, Appendix G. It should be noted that this re-evaluation is a requirement by 10 CFR 50.61, whenever core loadings, surveillance measurements, or other information indicate a significant change in projected value.

Date:

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