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

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2

COMPLIANCE WITH THE PRESSURIZED THERMAL SHOCK RULE, 10 CFR 50.61

DOCKET NOS. 50-390 AND 50-391

INTRODUCTION

By letter dated July 17, 1992, the Tennessee Valley Authority (TVA), the applicant for the Watts Bar Nuclear Plant, Units 1 and 2, submitted information on reactor vessel fluence as required by the revised 10 CFR 50.61, Fracture Toughness Requirements For Protection Against Pressurized Thermal Shock (PTS) Events (References 1-3); additional information was submitted on January 14, 1993 (References 4-6). The submitted information (References 1-6) discussed the fast neutron fluence methodology and the results with respect to the requirements of 10 CFR 50.61. The PTS rule addresses the pressure vessel material properties as well as vessel irradiation (fluence).

EVALUATION

The revised Westinghouse reports (References 5 and 6) provided the required information. The basic neutron transport calculations were carried out in (R,θ) geometry using a benchmarked DOT two-dimensional discrete ordinates code (Reference 7) using the SAILOR cross section library. The SAILOR library is based on the ENDF/B-IV data set. Anisotropic scattering was treated with a P_3 expansion of the cross section, and the angular discretization was modeled with an S_8 angular quadrature. The source distribution from the reactor stretch power rating of 3565 MWth was normalized to the midplane power density using an axial peaking factor of 1.2. Finally the out-in fuel management was assumed which tends to maximize the source strength and produce conservative results.

The staff reviewed the Watts Bar Final Safety Analysis Report and a TVA letter dated November 30, 1988 (Reference 8), and found that the controlling beltline material from the standpoint of susceptibility to PTS was identified for both units as the intermediate shell forgings. The material properties of the controlling material, the associated margin, and chemistry factor are summarized in the following table:

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	Unit 1 TVA Info.	Unit 1 NRC Eval.	Unit 2 TVA Info.	Unit 2 NRC Eval.
Copper content, %	.17	.17	.05	.05
Nickel content, %	.80	.80	.78	.78
Initial RT_{NDT}, °F	47	47	14	14
Chemistry factor, °F	132	132	31	31
Margin, °F	34	34	34	34

The controlling materials are the base metals in the intermediate shells in Units 1 and 2. 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. Assuming that the reported values of fluence are correct, Equation 1 of the PTS rule governs, and the chemistry factor is as shown above for each unit.

The fluence values obtained in combination with the approved material properties (table above) result in RT_{PTS} values of 32 effective full power years of operation (48, if the operating licenses were to be extended to 60 calendar years). These results are within the screening criteria of 10 CFR 50.61.

The chemistry factor, fluence factor and margin terms that were used to determine the RT_{PTS} at end of the licensed plant life are contained in the PTS rule, and were derived from statistical analysis of surveillance test data from U.S. commericially-operated nuclear power plants. Surveillance data is received by the staff from licensees when materials that are irradiated in capsules in the reactor vessel are periodically removed and tested. These data are reviewed and a file (Power Reactor-Embrittlement Data Base) is maintained by Oak Ridge National Laboratory. The base metal data now indicates that greater margin, approximately 56°F, will be needed to ensure that base metal does not exceed the PTS screening criterion. A staff contractor is currently reviewing the data base to update the chemistry factor, the fluence factor and the margin terms in the PTS rule.

CONCLUSION

The staff finds that the methods used conform with the staff's recommendations on fluence estimates, and the parameter values used would lead to conservative fluence estimates. In addition, the final RT_{PTS} values are within the screening criteria of 10 CFR 50.61. Thus, the staff finds that the Watts Bar reactor vessels satisfy the requirements of 10 CFR 50.61.

However, based on surveillance data from other reactor vessels, the margin term for base metal in the PTS rule may be non-conservative and future flux reduction may be needed. The need for flux reduction will be confirmed by the withdrawal and testing of surveillance specimens for 10 CFR 50, Appendix H requirements, and is outside the scope of this safety evaluation.

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Dated: March 11, 1993

REFERENCES

1. Letter from W. J. Museler, TVA to NRC, "Watts Bar Nuclear Plant (WBN) - Neutron Fluence Used in Reanalysis of Pressurized Thermal Shock," dated July 17, 1992.

2. WCAP-13300, "Evaluation of Pressurized Thermal Shock for Watts Bar Unit 1," by J. M. Chicots et al., Westinghouse Electric Corporation, dated April 1992.

3. WCAP-13301, "Evaluation of Pressurized Thermal Shock for Watts Bar Unit 2," by J. M. Chicots et al., Westinghouse Electric Corporation, dated April 1992.

4. Letter from W. J. Museler, TVA to NRC, "Watts Bar Nuclear Plant (WBN) - Neutron Fluence Used in Reanalysis of Pressurized Thermal Shock," dated January 14, 1993.

5. WCAP-13300, Revision 1, "Evaluation of Pressurized Thermal Shock for Watts Bar Unit 1," by J. M. Chicots et al., Westinghouse Electric Corporation, dated December 1992.

6. WCAP-13301, Revision 1, "Evaluation of Pressurized Thermal Shock for Watts Bar Unit 2," by J. M. Chicots et al., Westinghouse Electric Corporation, dated December 1992.

7. DLC-76, SAILOR RSIC Data Library Collection, "Coupled Self-Shielding, 47 Neutron Group, 20 Gamma Ray, P_3, Cross Section Library for Light Water Reactors."

8. Letter from R. Gridley, TVA to NRC, "Response to Generic Letter 88-11," dated November 30, 1988.

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