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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO THE FRACTURE TOUGHNESS REQUIREMENTS FOR PROTECTION AGAINST PRESSURIZED THERMAL SHOCK EVENTS, 10 CFR 50.61

CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT

DOCKET NO. 50-213

1.0 INTRODUCTION

By letters dated January 23, 1986, April 1, 1987, and August 21, 1987, the Connecticut Yankee Atomic Power Company, licensee for the Haddam Neck plant, submitted information on the material properties and the fast neutron fluence ($E > 1.0$ MeV) of the reactor pressure vessel in compliance with the requirements of 10 CFR 50.61. The Haddam Neck analysis of the fast neutron flux at the inside diameter of the pressure vessel was performed in connection with surveillance capsule D. The calculation was performed using the DOT 3.5 code with P_1, S_8 approximations and a nonstandard ENDF/B based cross-section set.

2.0 Evaluation

The licensee used the P_1 approximation which is widely known to underestimate the fluence calculation. Information provided to the licensee by Westinghouse indicates that the potential error between using the P_1 and the P_3 approximations could be as large as 20%.

By letter dated August 27, 1987, CYAPCO submitted the results of a limited reevaluation of the RT_{pts} which increased the calculated fluence by 20% to account for the known error. The calculated RT_{pts} value was 177°F, an increase of 8°F over the RT_{pts} value provided in the CYAPCO letter dated

January 23, 1986. Our evaluation of the RT_{pts} using the information provided by CYAPCO and the equation specified by 10 CFR 50.61 supports the RT_{pts} value calculated by CYAPCO, as shown below.

Fast Neutron Fluence Effects

The controlling beltline material was identified to be the intermediate shell longitudinal welds 6-373-A, B and C (Ref. 3). The equation specified in 10 CFR 50.61 as applicable for the Haddam Neck plant is:

$$RT_{pts} = I + M + (-10 + 470 \times C_u + 350 \times N_i) f^{0.27}$$

where:

I	=	Initial RT_{NDT}	= -56°F
M	=	uncertainty margin	= 59°F
C_u	=	w/o Copper in long. welds 6-373-A, B, C	= 0.22
N_i	=	w/o Nickel in long. welds 6-373-A, B, C	= 0.10
f	=	Peak fluence on long. welds 6-373-A, B, C for 32 effective full power years in units of 10^{19} n/cm^2	= 7.51

Therefore:

$$RT_{pts} = -56 + 59 + (-10 + 470 \times 0.22 + 350 \times 0.22 \times 0.10) \times 7.51^{0.27}$$

$$= 3 + 101.1 \times 1.72 = 177.25°F$$

Material Properties

The controlling beltline material from the standpoint of PTS susceptibility was identified to be the intermediate shell longitudinal welds 6-373 A, B, and C, weld wire heat No. 86054 B.

The material properties of the controlling material and the associated margin and chemistry factor were reported to be:

	Utility Submittal	Staff Evaluation
Cu (copper content, %)	0.22	0.22
Ni (nickel content, %)	0.10	0.10
I (Initial RTNDT, °F)	-56	-56
M (Margin, °F)	59	59
CF (Chemistry Factory, °F)		101.1

The staff has reviewed the licensee's submittals and has concluded that the controlling material has been properly identified. The justifications give for the copper and nickel contents and the initial RT_{NDT} are acceptable. For the copper content, reference was made to WCAP 10433 "Determination of the Copper Content of the Longitudinal Weld Seams in the Intermediate Shell Region of the Haddam Neck Reactor Vessel," which was submitted by letter dated February 17, 1984. 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.

Summary

The calculated RT_{pts} value of 177°F is much lower than the applicable 10 CFR 50.61 value of 270°F. However, as mentioned above, the inability to quantify the uncertainty in using a nonstandard cross-section set prevents the staff from concluding that the calculated RT_{pts} value is a

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complete representation of the condition of the reactor pressure vessel at the Haddam Neck Plant to the end of life of the plant. Given the extremely large margin between the calculated value and the 10 CFR 50.61 criterion of 270°F, the staff has concluded that there is sufficient margin to assure safe operation of the reactor for at least the next 3 operating cycles (end of Cycle 18).

As mentioned above, the staff has discussed our concerns with the licensee. CYAPCO has agreed to provide a reevaluation of the RT_{pts} in response to its planned conversion from stainless steel cladding to zircaloy cladding during Cycle 17. (Note that this would be required by 10 CFR 50.61 because it significantly changes the core loading inside the reactor vessel.) The staff concludes that submittal of a reevaluation of RT_{pts} in connection the planned conversion is acceptable.

However, should for some unforeseen reason the planned conversion be delayed or cancelled, we would interpret the commitment contained in the August 27, 1987 letter as commitment to provide a reevaluation of the RT_{pts} by or prior to Cycle 17 operation. This is consistent with the position taken on the Northeast Utilities plant Millstone Unit 2.

3.0 CONCLUSION

We have reviewed the information submitted by the Connecticut Yankee Atomic Power Company, the licensee for the Haddam Neck plant, in accordance with the requirements of 10 CFR 50.61. We find the estimated value of the fast neutron fluence to the pressure vessel to have conservative error margins and thus is acceptable. The value of the RT_{pts} based on this fluence estimate is less than the 10 CFR 50.61 screening criterion and is acceptable. The licensee has committed to update this estimate in the future.

The staff concludes based on the considerations discussed above, that the Haddam Neck plant satisfies the fracture toughness requirements for protection against pressurized thermal shock, therefore: (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 will not be inimical to the common defense and security or to the health and safety of the public.

4.0 REFERENCES

1. Letter from J. F. Opeka, Northeast Utilities, to C. L. Grimes, NRC dated January 23, 1986.

2. Letter from J. F. Opeka, Northeast Utilities, to NRC dated April 1, 1987.

3. Memorandum from D. M. Crutchfield to F. Akstulewicz, "Haddam Neck, Material Properties for Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events, 10 CFR 50.61", dated October 19, 1986.

4. Letter from E. J. Mroczka (Connecticut Yankee Atomic Power Company) to NRC dated August 21, 1987.

5. Yanichko, S. E., et al., "Analysis of Capsule D from the Connecticut Yankee Reactor Vessel Radiation Surveillance Program" (WCAP-10236), dated January 1983.

5.0 ACKNOWLEDGEMENTS

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