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William J. Museler
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JAN 28 1993

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Gentlemen:

In the Matter of the Application of)
Tennessee Valley Authority)

Docket Nos. 50-390

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - REQUEST FOR EXEMPTION FROM REQUIREMENTS OF 10 CFR 50, APPENDIX G, IV.A.1

Reference: Letter from TVA to NRC dated July 7, 1992, "Browns Ferry Nuclear Plant (BFN), Sequoyah Nuclear Plant (SQN), and Watts Bar Nuclear Plant (WBN) - Response to Generic Letter 92-01 (Reactor Vessel Structural Integrity)

In the referenced letter, TVA notified the NRC that the initial reactor pressure vessel upper shelf energy (USE) of WBN Unit 1 would be below the Appendix G requirement of 75 ft-lb and could fall below the 50 ft-lb requirement before the end-of-life (32 effective full power years). In accordance with 10 CFR 12(a)(2)(ii), TVA hereby requests an exemption from the requirements of Appendix G, IV.A.1, of 75 ft-lb for initial operation.

Enclosed is TVA's evaluation that describes proposed actions to ensure the integrity of the vessel and maintain to adequate safety margins, even if USE does decrease below 50 ft-lb before end-of-life.

If you have any questions, please telephone John Vorees at (615) 365-8819.

Very truly yours,

W. J. Museler

William J. Museler

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Enclosure
cc: See page 2

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JAN 28 1993

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
REACTOR VESSEL STRUCTURAL INTEGRITY
LOW UPPER SHELF ENERGY (USE)

BACKGROUND

Intermediate shell forging 05 (axial direction, Heat No. 527536) at the beltline of WBN Unit 1 reactor pressure vessel (RPV) is predicted to fall below the 50 ft-lb USE criteria of 10 CFR 50, Appendix G. This prediction is based on the conservative methodology of Regulatory Guide 1.99, Revision 2, and assumes the peak design basis fluence of 3.18×10^{19} n/cm^2 and a high copper content of 0.17 percent for this forging.

The RPV surveillance program for WBN Unit 1 was initially developed in 1978 to conform to ASTM E 185-73 and documented in WCAP-9298[1]. Because of the higher copper content, intermediate shell forging 05 was considered to be the limiting base material for the beltline and was included in the surveillance program. Unirradiated Charpy V-notch transition curves were established for intermediate shell forging 05 for both the axial and tangential directions. These data indicate an USE of 132 ft-lb for the tangential direction and 62 ft-lb for the axial direction (data and curves are in WCAP-9298). This low initial USE for the axial direction fails to meet the 75 ft-lb initial USE criterion of 10 CFR Part 50, Appendix G, and may fall below 50 ft-lb should the USE exceed a 19 percent decrease. Employing the methodology of Regulatory Guide 1.99, Revision 2, with the design basis fluence at an end-of-life (EOL) of 32 effective full power years (EFPY), a decrease of approximately 30 percent is predicted with the RPV reaching the 50 ft-lb criterion at 5.8 EFPY of power operation. The discussion that follows outlines the steps TVA will take in order to ensure safe operation of the RPV.

DISCUSSION

Surveillance Program

Intermediate shell forging 05 is the limiting material in the WBN Unit 1 reactor vessel and is part of the reactor vessel surveillance program. Each of the material surveillance capsules contain 15 axial and 15 tangential Charpy V-notch, three tensile, and four 1/2 thickness (T) compact tension specimens of this material. TVA will revise the capsule withdrawal schedule to withdraw two capsules before the vessel exceeds 5.4 EFPY. The first capsule, with a lead factor of 3.6, is scheduled to be withdrawn at the end of the first core cycle. This capsule, with its relatively large lead factor, should provide an early indication of the degree of conformity with Regulatory Guide 1.99, Revision 2, predictions. The results of the capsule analysis will be reviewed, and should an amended removal schedule be required (i.e., should an additional capsule need to be withdrawn before the scheduled second capsule at 5.4 EFPY), two standby capsules installed in the vessel are available for additional monitoring. The compact tension specimens can also be tested as required.

The second capsule currently scheduled to be removed at 5.4 EFPY represents the EOL fluence at the 1/4T position in the vessel. Analysis of this capsule provides a direct measure of the USE at EOL and provides verification of the need for any supplemental analysis that may be required to demonstrate that a margin of safety against fracture exists.

Projected Neutron Fluence

Predictions of the USE are based upon "design basis" fluence values[2]. The actual fluence values are estimated to be less than the design basis values. For the present fuel loading schemes, the fluence at EOL can reasonably be expected to be at least 30 percent below the design basis values. Additionally, a low-leakage core configuration is planned for WBN Unit 1 after the first cycle and should reduce the fluence still further.

Industry Evaluations

Several studies have been conducted to investigate the fluence on the USE of vessel materials. Palme[3] and Yanichko[4] showed the decrease in USE could be correlated with the weight percent copper in the reactor vessel materials, and that the majority of the decrease in upper shelf impact energy occurs early in plant life at a fluence of approximately 5×10^{18} n/cm^2 (E >1 MeV). Mager[5] developed an empirical correlation based upon initial upper shelf impact energy and copper content of RPV base materials. His correlation estimates the decrease in upper shelf impact energy for fluence greater than 5×10^{19} n/cm^2 to be:

Initial Upper Shelf Energy	Expected Decrease in USE
< 65 ft-lb	0.5 ft-lb/0.01 Cu
> 65 ft-lb and < 90 ft-lb	1.0 ft-lb/0.01 Cu
> 90 ft-lb and < 125 ft-lb	1.5 ft-lb/0.01 Cu
< 125 ft-lb	2.0 ft-lb/0.01 Cu

Mager[5], utilizing a data base containing greater than 100 measurements, further concluded that the decrease in USE would reach a steady-state condition at approximately 1×10^{19} n/cm^2.

Using Mager's correlations, WBN Unit 1 intermediate shell forging 05 would be expected to reach a steady-state USE of approximately 53.5 ft-lb.

However, Regulatory Guide 1.99, Revision 2, does not consider the industry studies which conclude that the decrease in upper shelf impact energy reaches a steady-state at a given fluence. Furthermore, the regulatory guide does not consider that the decrease in USE is a function of the initial USE.

Westinghouse Owners Group (WOG) Project on USE

WOG has initiated a project to support the NUMARC recommendation to perform a bounding analysis for all WOG plants. The purpose of this analysis is to demonstrate that a margin of safety equivalent to that of 10 CFR 50, Appendix G, exists when the USE of the reactor vessel material drops below 50 ft-lb, using ASME Section XI, Appendix X, criteria. The ultimate objective of this analysis and those being conducted by other owners groups is to provide a basis to demonstrate that the USE issue is a non-safety compliance issue. The WOG analysis is scheduled for completion during April 1993. TVA is actively following that project.

SUMMARY

Using the design basis fluence and the methodology of Regulatory Guide 1.99, Revision 2, intermediate shell forging 05 of Unit 1 is projected to drop below 50 ft-lb before the EOL. Several factors are presented that indicate the predicted decrease in USE may be conservative for this material and that the vessel forging may not drop below the compliance criteria of Appendix G, to 10 CFR Part 50. Surveillance capsules containing the material in question are installed in the vessel and will be tested before the time the USE is predicted to decrease to 50 ft-lb. Also, a WOG project is underway to perform "bounding" analyses for Westinghouse plants and to demonstrate applicability of the bounding analysis to the Westinghouse plants.

The testing of the first two surveillance capsules withdrawn from WBN Unit 1 will determine if USE will fall below the acceptance criteria before EOL. If the results of the testing predict an EOL USE of < 50 ft-lb, TVA will perform the necessary analysis required by Appendix G, IV.A.1, to ensure adequate safety margins. This letter supersedes the commitments for WBN Unit 1, discussed in TVA's letter dated October 23, 1981, concerning NRC's Unresolved Safety Issue (USI), A-11, "Reactor Vessel Materials Toughness."

REFERENCES

1. Tennessee Valley Authority Watts Bar Unit 1, Reactor Vessel Radiation Surveillance Program, WCAP-9298, Westinghouse Electric Corporation, Pittsburgh, PA, July 1978.

2. J. M. Chicots and P. L. Strauch, Westinghouse WCAP-13300, Revision 1, "Evaluation of Pressurized Thermal Shock for WBN Unit 1," dated December 1992, submitted to NRC January 14, 1993.

3. H. S. Palme, "Radiation Embrittlement Sensitivity of Reactor Vessel Steel," BAW-10056, March 1973.

4. S. E. Yanichko, "Review of Select Material Properties for Reactor Pressure Vessels Relative to 10 CFR Part 50, Appendix G," WCAP-8291, May 1974.

5. T. R. Mager, Unpublished data reported in Westinghouse's letter to TVA, WAT-D-8919, dated July 17, 1992.