



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVISION TO THE REACTOR VESSEL SURVEILLANCE

CAPSULE WITHDRAWAL SCHEDULES FOR

NORTH ANNA UNITS 1 AND 2

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NOS: 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated December 17, 1998, the Virginia Electric and Power Company (VEPCO) submitted for NRC approval, their revised withdrawal schedules for North Anna Units 1 and 2, which were based on the American Society for Testing and Materials (ASTM) E 185-73 and ASTM E 185-82 recommendations. VEPCO submitted a revised capsule withdrawal schedule because during the recent North Anna Unit 1 refueling outage, the surveillance capsule withdrawal tool became mechanically bound to Capsule W during its extraction. As a result, VEPCO was unable to relocate Capsules Z and T. VEPCO then assessed the consequences of abandoning plans to relocate Capsules Z and T and determined that the requirements of 10 CFR Part 50, Appendix H and the applicable ASTM E 185 Code could still be met without the relocation of the Z and T capsules during that refueling outage. Therefore, a proposed Unit 1 surveillance capsule withdrawal schedule was prepared to reschedule the relocation of Capsules Z and T. In addition, VEPCO proposed other modifications to the North Anna Units 1 and 2 surveillance capsule withdrawal schedules, as discussed below.

2.0 BACKGROUND

Appendix H to Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Reactor Vessel Material Surveillance Program Requirements," requires licensees to monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region of light water nuclear power reactors. Appendix H states that the design of the surveillance program and the withdrawal schedule must meet the requirements of the edition of ASTM E 185 that is current on the issue date of the ASME Code to which the reactor vessel was purchased. Later editions of ASTM E 185 may be used, but including only those editions through 1982.

The surveillance programs for North Anna Units 1 and 2 were implemented to monitor the radiation-induced changes in the mechanical and impact properties of the pressure vessel materials. The surveillance programs for the North Anna units are specified in the Updated Safety Analysis Report for the units. These surveillance programs were established in accordance with 10 CFR Part 50, Appendix H. ASTM E 185-73 is a later edition of the ASTM standard that was in effect on the issue date of Section III of the ASME Boiler and Pressure Vessel Code (1968) to which the North Anna Units 1 and 2 reactor vessels were purchased.

The surveillance capsule withdrawal schedule and testing criteria for ASTM E 185-73 are divided according to application into two cases, Cases A and B. Case A is recommended to be used when both the predicted increase in transition temperature of the reactor vessel steel is 100°F or less and the calculated peak neutron fluence of the reactor vessel is  $5 \times 10^{18}$  n/cm<sup>2</sup> or less. Case B is recommended to be used when the predicted increase in transition temperature of the reactor vessel steel is greater than 100°F or when the calculated peak neutron fluence of the reactor vessel is greater than  $5 \times 10^{18}$  n/cm<sup>2</sup>.

Case B is applicable to the surveillance capsule withdrawal schedule and testing for North Anna Units 1 and 2. Case B recommends that three capsules be tested and two capsules remain as standby capsules. The withdrawal schedule for Case B includes the following criteria: (1) the first capsule is recommended to be withdrawn and tested when the predicted increase in transition temperature is approximately 50°F or when the exposure of the capsule corresponds to the calculated exposure of the reactor vessel wall at approximately 25 percent of the reactor design life, whichever is earlier; (2) the second capsule is recommended to be withdrawn and tested when the exposure of the capsule corresponds to the calculated exposure of the reactor vessel wall at approximately 50 percent to 75 percent of the reactor design life; (3) the third capsule is recommended to be withdrawn and tested when the exposure of the capsule corresponds to the calculated exposure of the reactor vessel wall at approximately 100 percent to 125 percent of the reactor design life; and (4) the fourth and fifth capsules are recommended to serve as standby capsules.

In addition, the licensee has opted to use ASTM E 185-82 in determining the number of capsules to be withdrawn and the schedule of withdrawing and testing the fourth capsule of North Anna Units 1 and 2. ASTM E 185-82 recommends that four capsules are to be withdrawn and tested if the predicted transition temperature shift at vessel inside surface is greater than 100°F and less than or equal to 200°F, which is applicable to both of the North Anna Units. This edition of the standard also recommends that the last capsule is to be withdrawn and tested at a fluence that is projected between 1- and 2- times the peak end-of-life (EOL) fluence.

### 3.0 EVALUATION

#### 3.1 North Anna Unit 1

The estimated peak EOL fluence for North Anna Unit 1 is  $3.95 \times 10^{19}$  n/cm<sup>2</sup>. Currently, the licensee has tested two capsules for North Anna Unit 1. The first capsule, Capsule V, was removed from the vessel at a fluence of  $0.30 \times 10^{19}$  n/cm<sup>2</sup>. The second capsule, Capsule U, was removed from the vessel at a fluence of  $0.88 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 25 percent of the reactor design life, and therefore, corresponds to the first capsule withdrawal criteria of ASTM E 185-73. The third capsule, Capsule W, was removed from the vessel at an estimated fluence of  $2.04 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 50 percent to 75 percent of the reactor design life, and therefore, corresponds to the second capsule withdrawal criteria of ASTM E 185-73. The fourth capsule, Capsule Z, is to be removed from the vessel at an estimated fluence of  $4.64 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 100 percent to 125 percent of the reactor design life, and therefore, corresponds to the third capsule withdrawal criteria of

ASTM E 185-73. In addition, Capsule Z also meets the fourth capsule withdrawal criteria of ASTM E 185-82 since it is to be withdrawn and tested at a projected fluence that is between 1- and 2- times the peak EOL fluence. Capsules T, Y, S, and X serve as the standby capsules for the subject unit, and therefore, satisfy the standby capsule criteria of ASTM E 185-73.

The staff independently verified that the proposed capsule withdrawal schedule and testing for North Anna Unit 1 are in accordance with ASTM E 185-73. The staff also verified that the subject unit's proposed capsule withdrawal schedule and testing for the fourth capsule are in accordance with ASTM E 185-82. The staff independently concluded that the proposed withdrawal schedule for North Anna Unit 1 complies with the requirements of 10 CFR Part 50, Appendix H.

### 3.2 North Anna Unit 2

The estimated peak EOL fluence for North Anna Unit 2 is  $4.47 \times 10^{19}$  n/cm<sup>2</sup>. Currently, the licensee has tested two capsules for North Anna Unit 2. The first capsule, Capsule V, was removed from the vessel at a fluence of  $0.25 \times 10^{19}$  n/cm<sup>2</sup>. The second capsule, Capsule U, was removed from the vessel at a fluence of  $1.07 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 25 percent of the reactor design life, and therefore, corresponds to the first capsule withdrawal criteria of ASTM E 185-73. The third capsule, Capsule W, is to be removed from the vessel at an estimated fluence of  $2.58 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 50 to 75 percent of the reactor design life, and therefore, corresponds to the second capsule withdrawal criteria of ASTM E 185-73. The fourth capsule, Capsule X, is to be removed from the vessel at an estimated fluence of  $7.95 \times 10^{19}$  n/cm<sup>2</sup>, which is at approximately 100 to 125 percent of the reactor design life, and therefore, corresponds to the third capsule withdrawal criteria of ASTM E 185-73. In addition, Capsule X also meets the fourth capsule withdrawal criteria of ASTM E 185-82 since it is to be withdrawn and tested at a projected fluence that is between 1- and 2-times the peak EOL fluence. Capsules Z, T, Y, and S serve as the standby capsules for the subject unit, and therefore, satisfy the standby capsule criteria of ASTM E 185-73.

The staff independently verified that the proposed capsule withdrawal schedule and testing for North Anna Unit 2 are in accordance with ASTM E 185-73. The staff also verified that the subject unit's proposed capsule withdrawal schedule and testing for the fourth capsule are in accordance with ASTM E 185-82. The staff independently concluded that the proposed withdrawal schedule for North Anna Unit 2 complies with the requirements of 10 CFR Part 50, Appendix H.

### 4.0 CONCLUSION

Based on the staff's review of the VEPCO submittal, the staff found that the revised withdrawal schedules for North Anna Units 1 and 2 satisfy the requirements of Appendix H to 10 CFR Part 50; therefore, they are acceptable.

### 5.0 REFERENCES

1. Letter from Mr. James P. O'Hanlon (VEPCO) to NRC Document Control Desk, "Proposed Reactor Vessel Materials Surveillance Capsule Withdrawal Schedules for North Anna Units 1 and 2," dated December 17, 1998.

2. Code of Federal Regulations, Title 10, Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," dated January 1998.
3. American Society for Testing and Materials, "Standard Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels," ASTM E 185-73.
4. American Society for Testing and Materials, "Standard Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels," ASTM E 185-82.
5. NUREG-1511, "Reactor Pressure Vessel Status Report," dated December 1994.

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Date: August 13, 1999