

November 8, 2000

Mr. Charles H. Cruse
Vice President - Nuclear Energy
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Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
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SUBJECT: SAFETY EVALUATION OF REQUEST TO REVISE REACTOR PRESSURE VESSEL SURVEILLANCE PROGRAM SCHEDULE FOR CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2 (TAC NOS. MA9370 AND MA9371)

Dear Mr. Cruse:

By letter dated June 28, 2000, Baltimore Gas and Electric (BGE, the then licensee) submitted for NRC approval, its revised schedules for withdrawal of reactor vessel material surveillance capsules for Calvert Cliffs Nuclear Power Plant (CCNPP) Units 1 and 2, which were based on the American Society for Testing and Materials (ASTM) E 185-70 and ASTM E 185-82 recommendations. On June 30, 2000, the operating licenses for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 were transferred from BGE to Calvert Cliffs Nuclear Power Plant, Inc.

On March 23, 2000, the NRC approved BGE's request for license renewal of the Calvert Cliffs Nuclear Power Plant. In order to monitor changes in the reactor pressure vessel (RPV) due to neutron irradiation during the extended license period, the current RPV surveillance program, which was designed for a 40-year license, needed to be modified to accommodate a 60-year license. Accordingly, the NRC Safety Evaluation Report for Calvert Cliffs License Renewal, NUREG-1705, states that BGE, the then licensee, will modify the surveillance capsule withdrawal schedules. Accordingly, the licensee proposed to modify the surveillance capsule withdrawal schedules to reflect the renewed license period of 60 years for the units, as stated in NUREG-1705.

The NRC staff reviewed the BGE submittal referenced above. The staff noted that the proposed withdrawal and testing schedules of the capsules, mentioned above, are in accordance with the recommendations of the ASTM E 185-70 and ASTM E 185-82 Code. The

C. Cruse

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staff has independently verified that the proposed withdrawal schedules for the capsules indicated above, of the CCNPP RPV surveillance program, comply with the requirements of 10 CFR Part 50, Appendix H. The staff's safety evaluation is enclosed. This completes the staff's effort for TAC Nos. MA9370 and MA9371.

Sincerely,

/RA/

Alexander W. Dromerick, Sr. Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST TO REVISE THE REACTOR VESSEL PRESSURE SURVEILLANCE

CAPSULE WITHDRAWAL SCHEDULE FOR

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

DOCKET NOS: 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated June 28, 2000, Baltimore Gas and Electric (BGE, the then licensee) submitted for NRC approval, its revised withdrawal schedules of reactor vessel material surveillance capsules for Calvert Cliffs Nuclear Power Plant (CCNPP) Unit Nos. 1 and 2, which were based on the American Society for Testing and Materials (ASTM) E 185-70 and ASTM E 185-82 recommendations. The purpose of the licensee's submittal was to modify the surveillance capsule withdrawal schedules to reflect the renewed license period of 60 years, as required by the NRC Safety Evaluation for CCNPP License Renewal (NUREG-1705). On June 30, 2000 the operating licensee for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 were transferred from BGE to Calvert Cliffs Nuclear Power Plant, Inc. (CCNPPI).

2.0 BACKGROUND

The surveillance programs for CCNPP Units 1 and 2 were implemented to monitor the radiation-induced changes in the mechanical and impact properties of the pressure vessel materials. These surveillance programs were established in accordance with 10 CFR Part 50, Appendix H. Appendix H to 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 including those editions through 1982.

The reactor pressure vessel (RPV) surveillance program for each of the CCNPP units was initially determined per ASTM E 185-70, which was the edition of the ASTM standard that was in effect on the issue date of Section III of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (1965 through winter 1967 Addenda), to which the CCNPP Units 1 and 2 reactor vessels were designed. However, the licensee chose to use a later edition of the ASTM standard (ASTM E 185-82) in establishing its surveillance capsule withdrawal schedules for CCNPP Units 1 and 2. The withdrawal schedule recommended in ASTM E 185-82 is for a vessel with a design of 32 effective-full-power years (EFPYs), which corresponds to 40 years of operation with an 80 percent capacity factor.

The surveillance capsule withdrawal schedule and testing criteria for ASTM E 185-70 recommends that sets of specimens be withdrawn at three or more separate times. It specifically recommends that one of the data points obtained shall correspond to the neutron exposure of the reactor vessel at no greater than 30 percent of its design life. There is no specific requirement for when the data point shall be obtained for the second capsule. And, the third data point obtained shall correspond to the neutron exposure of the RPV near the end of its design life.

The surveillance capsule withdrawal schedule and testing criteria for ASTM E 185-82 depends upon the predicted transition temperature shift at vessel inside surface. For CCNPP Units 1 and 2, the predicted transition temperature shift at vessel inside surface is greater than 200 °F; therefore, ASTM E 185-82 recommends that sets of specimens be withdrawn at five separate times. It specifically recommends that the first capsule shall be withdrawn when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm², or when the highest predicted delta RT_{NDT} of all encapsulated materials is approximately 28°C, whichever comes first. The second capsule is recommended to be withdrawn at a time when the accumulated neutron fluence of the capsule corresponds to a value midway between the first and third capsules. The third capsule is recommended to be withdrawn at a time when the accumulated neutron fluence on the capsule corresponds to the approximate end of life (EOL) fluence at the reactor vessel 1/4 thickness location. The fourth capsule is recommended to be withdrawn at a time when the accumulated neutron fluence on the capsule corresponds to the approximate EOL fluence at the RPV inner wall location. And, the fifth capsule is recommended to be withdrawn at not less than once or greater than twice the peak EOL vessel fluence. This capsule may be held without testing following withdrawal.

In order to monitor changes in the reactor vessel material due to neutron irradiation during the license extension period, the current reactor vessel surveillance program, which was design-based on a 40-year license, needed to be modified to accommodate a 60-year license. Accordingly, the NRC Safety Evaluation Report for Calvert Cliffs License Renewal, NUREG-1705, states that BGE, the then licensee, will modify the surveillance capsule withdrawal schedule.

Specifically, Item 69 in Appendix E of NUREG-1705 contains the following commitments:

1. *The capsule withdrawal schedule will be revised to provide data at neutron fluences equal to or greater than the projected peak neutron fluence at the end of the period of extended operation.*
2. *If the last capsule is withdrawn before the 55th year, CCNPPI will establish reactor vessel neutron environment conditions (fluence, spectrum, temperature, and neutron flux) applicable to the surveillance data and the Unit's pressure-temperature curves. If the plant operates outside the limits established by these conditions, the applicant must inform the NRC and determine the impact of the condition on RPV integrity.*
3. *If the last capsule is withdrawn before the 55th year, CCNPPI will install neutron dosimetry to permit tracking of the fluence to the RPV.*

3.0 EVALUATION

The licensee has opted to use the ASTM E 185-82 standard in determining the number of capsules to be withdrawn and the ASTM E 185-70 and ASTM E 185-82 standards in determining the schedule of withdrawing and testing the capsules of the CCNPP Units 1 and 2 RPV surveillance program. The recommendations of ASTM E 185-70 and ASTM E 185-82 are discussed above. The proposed revisions to the reactor vessel surveillance capsules withdrawal schedules are based on ASTM E 185-70 and -82 recommendations, and reflect updated fluence information from the surveillance capsules removed in 1992 and 1993 (CCNPP Units 1 and 2, respectively) with appropriate adjustment made for fuels loaded in subsequent cycles.

To develop a 60-year surveillance program, CCNPPI, applied the guidance provided in ASTM E 185-70 and ASTM E 185-82 for withdrawal schedules. To meet the commitments of Item 69 in Appendix E of NUREG-1705, for a capsule containing dosimetry to be available for withdrawal in the final 5 years of vessel operation, the proposed schedule includes a capsule containing dosimetry that can be pulled during the final 5 years of the extended license. Details of the CCNPP Units 1 and 2 capsule surveillance withdrawal program are provided below.

CCNPP Unit 1

The estimated peak extended EOL (60-year license) ID fluence for CCNPP Unit 1 is 5.09×10^{19} n/cm². Currently, CCNPPI has withdrawn 2 capsules for CCNPP Unit 1. The first capsule was removed and tested from the vessel with an accumulated neutron fluence of 6.2×10^{18} n/cm². This meets the recommendation of ASTM E 185-82 for the first capsule to be withdrawn and tested. As stated previously, ASTM E 185-82 recommends that the first capsule be withdrawn when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm². The second capsule was removed and tested from the vessel with an accumulated neutron fluence of 2.64×10^{19} n/cm², which meets the ASTM E 185-70 recommendation of the second capsule to be withdrawn and tested, since there is no specific requirement for when the data point shall be obtained for the second capsule. The third capsule is scheduled to be withdrawn and tested when the accumulated neutron fluence is 2.96×10^{19} n/cm², which will meet the recommendation of ASTM E 185-82 for the third capsule, since that is the actual value of the capsule fluence that corresponds to the projected fluence at the 1/4 thickness location of the vessel at the end of the extended life.

The fourth capsule is scheduled to be withdrawn and tested at 5.09×10^{19} n/cm², which will also meet the ASTM E 185-82 recommendation for the fourth capsule to be withdrawn and tested, since this is the actual value of the capsule fluence that corresponds to the projected fluence at the vessel inner wall location at the end of extended life. The fifth capsule is scheduled to be withdrawn and available for testing at an accumulated neutron fluence of 6.26×10^{19} n/cm², which will satisfy the ASTM E 185-82 recommendation for the fifth capsule to be withdrawn, since this value is not less than once (5.09×10^{19} n/cm²) or greater than twice (10.18×10^{19} n/cm²) the peak end of extended life vessel fluence at the vessel inner wall. This capsule also satisfies the commitments of Item 69 in Appendix E of NUREG-1705, which requires that one capsule containing dosimetry be removed during the final 5 years of the extended license. In addition, CCNPPI has 1 standby capsule and 2 supplemental capsules for CCNPP Unit 1.

The staff independently verified that the proposed capsule withdrawal and testing schedule for the capsules of the CCNPP Unit 1 RPV surveillance program is in accordance with the recommendations of ASTM E 185-70 and ASTM E 185-82. The staff has independently verified that the proposed withdrawal schedule for the capsules of the CCNPP Unit 1 RPV surveillance program complies with the requirements of 10 CFR Part 50, Appendix H, and satisfy the commitments of Item 69 in Appendix E of NUREG-1705.

CCNPP Unit 2

The estimated peak extended EOL (60-year license) ID fluence for CCNPP Unit 2 is 5.74×10^{19} n/cm². Currently, CCNPPI, has withdrawn 2 capsules for CCNPP Unit 2. The first capsule was removed and tested from the vessel with an accumulated neutron fluence of 8.1×10^{18} n/cm². This meets the recommendation of ASTM E 185-82 for the first capsule to be withdrawn and tested. As stated above, ASTM E 185-82 recommends that the first capsule shall be withdrawn when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm². The second capsule was removed and tested from the vessel with an accumulated neutron fluence of 1.85×10^{19} n/cm², which meets the ASTM E 185-70 recommendation of the second capsule to be withdrawn and tested, since there is no specific requirement for when the data point shall be obtained for the second capsule. The third capsule is scheduled to be withdrawn and tested when the accumulated neutron fluence is 3.02×10^{19} n/cm², which will meet the recommendation of ASTM E 185-82 for the third capsule, since that is the actual value of the capsule fluence that corresponds to the projected fluence at the 1/4 thickness location of the vessel at end of extended life.

The fourth capsule is scheduled to be withdrawn and tested at 5.74×10^{19} n/cm², which will also meet the ASTM E 185-82 recommendation for the fourth capsule to be withdrawn and tested, since this is the actual value of the capsule fluence that corresponds to the projected fluence at the vessel inner wall location at the end of extended life. The fifth capsule is scheduled to be withdrawn and available for testing at an accumulated neutron fluence of 6.96×10^{19} n/cm², which will satisfy the ASTM E 185-82 recommendation for the fifth capsule to be withdrawn, since this value is not less than once (5.74×10^{19} n/cm²) or greater than twice (11.48×10^{19} n/cm²) the peak end of extended life vessel fluence at the vessel inner wall. This capsule also satisfies the commitments of Item 69 in Appendix E of NUREG-1705, which requires that one capsule containing dosimetry be removed during the final 5 years of the extended license. In addition, CCNPPI has 1 standby capsule for CCNPP Unit 2.

The staff independently verified that the proposed capsule withdrawal and testing schedule for the capsules of the CCNPP Unit 2 RPV surveillance program is in accordance with the recommendations of ASTM E 185-70 and ASTM E 185-82. The staff has independently verified that the proposed withdrawal schedule for the capsules of the CCNPP Unit 2 RPV surveillance program complies with the requirements of 10 CFR Part 50, Appendix H, and satisfy the commitments of Item 69 in Appendix E of NUREG-1705.

4.0 CONCLUSION

Based on its review of the CCNPPI submittal, the staff found that the revised withdrawal schedules for CCNPP Units 1 and 2 RPVs satisfy the requirements of Appendix H to

10 CFR Part 50. In addition, the staff found that the revised withdrawal schedules for CCNPP Units 1 and 2 address the criteria required of NUREG-1705. Therefore, the staff found that the licensee's revised withdrawal schedules for CCNPP Units 1 and 2 acceptable and satisfy the commitments stated in NUREG-1705 for the renewed license period of 60 years.

5.0 REFERENCES

1. Letter from Mr. Charles H. Cruse (BGE) to NRC Document Control Desk, "Revision to Reactor Vessel Surveillance Capsule Withdrawal Schedule, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2," dated June 28, 2000.
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 185-70 and ASTM E 185-82.
4. NUREG-1511 "Reactor Pressure Vessel Status Report," dated December 1994.

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Unit Nos. 1 and 2

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