



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

February 25, 2019

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 – REVISION
TO THE REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL
SCHEDULE (EPID L-2018-LLL-0017)

Dear Mr. Hanson:

By letter dated April 11, 2018 (Agencywide Documents Access and Management System Accession No. ML18103A032), Exelon Generation Company, LLC (Exelon) submitted a request to revise the schedule for withdrawal of reactor vessel surveillance capsules for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs). Specifically, Exelon proposed three revisions that include (1) updating the fluence values of the previously pulled capsules, (2) changing the target fluence values, and (3) changing the withdrawal date for the Unit 2 capsule number 4. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H "Reactor Vessel Material Surveillance Program Requirements," requires, in part, that proposed revisions to the withdrawal schedule be approved prior to implementation.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the proposed revisions to the Calvert Cliffs reactor vessel material surveillance capsules schedule and concludes that the changes to the schedule will continue to meet the reactor vessel surveillance capsule withdrawal schedule criteria in American Society for Testing and Materials E185-82. Therefore, the requirements of 10 CFR Part 50, Appendix H, are met. Additionally, the staff finds that the proposed changes to the withdrawal schedule are acceptable for continued operation and do not result in a decrease in safety or security. The NRC staff, therefore, concludes that the reactor vessel withdrawal schedule, as proposed in the licensee's April 11, 2018, letter are acceptable for implementation.

B. Hanson

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If you have any questions, please contact me at (301) 415-2871 or Michael.Marshall@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael L. Marshall, Jr.", with a stylized flourish at the end.

Michael L. Marshall, Jr., Senior Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure:
Safety Evaluation

cc: Listserv



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING CHANGES TO THE REACTOR VESSEL

MATERIALS SURVEILLANCE PROGRAM

EXELON GENERATION COMPANY, LLC

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

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated April 11, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18103A032), Exelon Generation Corporation (Exelon, the licensee) requested to revise the schedule for withdrawal of reactor vessel surveillance capsules for Calvert Cliffs Nuclear Power Plant (Calvert Cliffs), Units 1 and 2. The request proposed three changes to the capsule removal schedule as a result of the most recent withdrawal and analysis of both units' third capsule. These changes included updating the fluence values of the previously pulled capsules, changing the target fluence values, and changing the withdrawal date for the Unit 2 capsule number 4 to maintain compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix H "Reactor Vessel Material Surveillance Program Requirements."

2.0 REGULATORY EVALUATION

Appendix H to 10 CFR Part 50 requires that reactor vessels that will exceed a neutron fluence of 10^{17} neutron per square centimeter (n/cm^2) at the end of their design life must have their beltline materials monitored by a surveillance program complying with American Society for Testing and Materials (ASTM) E185, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels." Specifically, Appendix H to 10 CFR Part 50 requires that the design of the surveillance program and the withdrawal schedule meet the requirements of the edition of ASTM E185 that was current on the issue date of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) to which the reactor vessel was purchased; however, later editions up to, and including, the 1982 Edition of ASTM E185 (ASTM E185-82), may be used instead. Section III(B)(3) of 10 CFR Part 50, Appendix H, requires that a surveillance capsule withdrawal schedule be submitted to and approved by the NRC staff prior to implementation.

In 1998, pursuant to NUREG-1801, Revision 1, "Generic Aging Lessons Learned (GALL) Report" (GALL Report) (ADAMS Accession No. ML052110005), the licensee applied for an additional 20-year period of extended operation beginning on July, 31, 2014 (Unit 1), and August 13, 2016 (Unit 2). The NRC reviewed the request and issued the renewed license on

March 23, 2000. The GALL Report states, "The plant-specific or integrated surveillance program shall have at least one capsule with a projected neutron fluence equal to or exceeding the 60-year peak reactor vessel wall neutron fluence prior to the end of the period of extended operation." Based on the testing of the most recently pulled capsules at each unit, the licensee proposed to adjust the withdrawal schedule to reflect more accurate fluence values for the removed capsules and updated target fluence values and withdrawal dates for future capsules.

3.0 TECHNICAL EVALUATION

Calvert Cliffs, Units 1 and 2, reactor vessels were designed to the 1965 Edition through Winter 1967 Addenda of the ASME Code, making the 1970 Edition of ASTM E185 (ASTM E185-70) the standard current to when the vessels were designed. Calvert Cliffs is following the requirements in ASTM 185-82, which is consistent with, but more specific than, ASTM E185-70, and complies with the surveillance capsule withdrawal requirements of 10 CFR Part 50, Appendix H. Table 1 of ASTM E 185-82 defines the minimum number of capsules required to be withdrawn and tested based on the predicted transition temperature shift at the inner surface of the reactor vessel. The withdrawal schedule initially assumed a design life of 40 effective full power years (EFPY) and was developed using the column for 5 specimen capsules with the following requirements:

1. The first capsule must be withdrawn either at 1.5 EFPY or at the time when the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm², or at the time when the highest predicted vessel reference nil ductility temperature (ΔRT_{NDT}) of all encapsulated materials is approximately 50 degrees Fahrenheit, whichever comes first.
2. The second capsule must be withdrawn either at 3 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to a value midway between that of the first and third capsules.
3. The third capsule must be withdrawn at 6 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to the approximate end-of-life (EOL) fluence at the reactor vessel $\frac{1}{4}$ T location.
4. The fourth capsule must be withdrawn at 15 EFPY or at the time when the accumulated neutron fluence of the capsule corresponds to the approximate EOL fluence at the reactor vessel inner wall location.
5. The fifth capsule must be withdrawn at the time where the accumulated neutron fluence exceeds the limiting fluence of the reactor vessel at the EOL but not exceeding twice the peak EOL vessel fluence.

Tables 1 and 2 of the licensee's request provided the current reactor vessel surveillance capsule withdrawal schedule for Calvert Cliffs, Units 1 and 2, as well as the withdrawal EFPY and location of the capsules that were previously removed and tested. Table 1 states that capsules at azimuthal positions 263° and 97° of Calvert Cliffs, Unit 1, were withdrawn in 1979 and 1992, with corresponding fluence values of 6.2×10^{18} n/cm² and 2.64×10^{19} n/cm², respectively. Capsules at azimuthal positions 284°, 83°, and 277°, were scheduled to be withdrawn in 2010, 2020, and 2032, with corresponding fluence values of 3.06×10^{19} n/cm², 5.26×10^{19} n/cm², and 6.59×10^{19} n/cm², respectively. The capsule at 104° is designated as a standby capsule. Table 2 states that capsules at azimuthal positions 263° and 97° of Calvert Cliffs, Unit 2, were withdrawn in 1982 and 1993, with corresponding fluence values of 8.06×10^{18} n/cm² and 1.85×10^{19} n/cm², respectively. Capsules at azimuthal positions 104°, 83°, and 277°, were scheduled to be withdrawn in 2011, 2025, and 2033, with corresponding fluence values of 3.24×10^{19} n/cm², 6.16×10^{19} n/cm², and 7.46×10^{19} n/cm², respectively. The capsule at 284° is

designated as a standby capsule. Both of the current schedules comply with ASTM E-185-82 and were deemed acceptable by the NRC staff by letters dated March 12, 2010 (ADAMS Accession No. ML100690393), and February 3, 2009 (ADAMS Accession No. ML090270206).

The licensee proposed three modifications to the previously approved withdrawal schedule that are noted in Tables 3 and 4 of the request. First, the licensee proposed to update the neutron fluence values for the first and second capsules that were withdrawn in both units in order to reflect the current neutron fluence calculations. The NRC staff reviewed WCAP-17365-NP, "Analysis of Capsule 284° from the Calvert Cliffs Unit No. 1 Reactor Vessel Radiation Surveillance Program," and WCAP-17365-NP, "Analysis of Capsule 104° from the Calvert Cliffs Unit No. 2 Reactor Vessel Radiation Surveillance Program," and confirmed that the changes to the previously pulled capsules were due to new Charpy V-notch graphing technology that is more accurate than the previously hand-drawn plots. The NRC staff, therefore, finds this change to the withdrawal schedule acceptable.

Second, the licensee proposed to update the target fluence values for the final two capsules at each unit based on the removal and testing of the capsule at 284° for Calvert Cliffs, Unit 1, and 104° for Calvert Cliffs, Unit 2. Based on the results of these capsules, which are documented in WCAP-17365-NP and WCAP-17365-NP, the peak EOL vessel fluence for the period of extended operation was reduced from 5.26×10^{19} n/cm² to 3.68×10^{19} n/cm² for Unit 1, and 6.16×10^{19} n/cm² to 4.28×10^{18} n/cm² for Unit 2. It is necessary to adjust the target fast neutron fluence for the remaining capsules in order to remain consistent with the requirements set forth in ASTM E185-82; therefore, the staff also finds this change acceptable.

Third, the licensee's final proposal was to adjust the withdrawal date of the fourth capsule (83°) of Unit 2 from the year 2025 to 2023 to allow for the capsule to be pulled at the updated projected peak EOL vessel fluence. The NRC staff finds that this change is acceptable and necessary to prevent the capsule from sitting in the vessel and becoming irradiated beyond the point equivalent to the projected EOL fluence at the reactor vessel inner wall location.

4.0 CONCLUSION

The NRC staff has reviewed Exelon's proposed withdrawal schedule for Calvert Cliffs, Units 1 and 2, and has determined that the changes to the schedule will continue to meet the reactor vessel surveillance capsule withdrawal schedule criteria in ASTM E185-82, and therefore, meet the requirements of 10 CFR Part 50, Appendix H. Additionally, the staff finds that the proposed changes to the withdrawal schedule are acceptable for continued operation and do not result in a decrease in safety or security. The staff, therefore, concludes that the reactor vessel withdrawal schedule, as proposed in the licensee's letter dated April 11, 2018, is acceptable for implementation.

Principal Contributor: Austin Young

Date: February 25, 2019

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 – REVISION TO THE REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE (EPID L-2018-LLL-0017) DATED FEBRUARY 25, 2019

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ADAMS Accession No.: ML19046A043

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