



*A Member of the
Constellation Energy Group*

June 28, 2000

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Revision to Reactor Vessel Surveillance Capsule Withdrawal Schedule

REFERENCE: (a) NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant Units 1 and 2
(b) Letter from Mr. A. W. Dromerick (NRC) to Mr. C. H. Cruse (BGE), dated December 15, 1997, "Baltimore Gas and Electric Company's Revision to the Reactor Vessel Surveillance Capsule Withdrawal Schedule for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC NOS. M99127 AND M99128)"

Pursuant to Appendix H of 10 CFR Part 50, Baltimore Gas and Electric Company hereby submits for approval a revision to its schedule for withdrawal of reactor vessel material surveillance capsules for Calvert Cliffs Units 1 and 2. As required by the NRC Safety Evaluation Report for Calvert Cliffs License Renewal (Reference a), the proposed revision modifies the surveillance capsule withdrawal schedule to reflect the renewed license period of 60 years.

As is the case with the currently approved withdrawal schedule (Reference b), the proposed withdrawal schedule satisfies the requirements of ASTM [American Society for Testing and Materials] E185-70, the version that was current at the time the reactor vessels were designed. In addition, to the extent practicable, both the proposed and the currently approved withdrawal schedules comply with subsequent versions of ASTM E185. The details of the proposed revision are contained in Attachment (1) to this letter.

SCHEDULE

Based on the current reactor vessel surveillance capsule withdrawal schedule, the Calvert Cliffs Unit 2 capsule located at the 284° location is required to be withdrawn during the 2001 refueling outage scheduled to begin on March 17, 2001. However, in the proposed capsule withdrawal schedule, this

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capsule is a standby capsule and the next Unit 2 capsule scheduled to be withdrawn is the capsule located at the 104° location in the year 2009. Therefore, we request that you complete the review of our application by October 31, 2000, to allow us time to prepare for the 2001 outage should you disagree with our proposed withdrawal schedule.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,



CHC/GT/dlm

Attachment: (1) Proposed Revision to the Schedule for Withdrawal of Reactor Vessel Material Surveillance Capsules for Calvert Cliffs Units 1 & 2

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ATTACHMENT (1)

**PROPOSED REVISION TO THE SCHEDULE FOR WITHDRAWAL OF
REACTOR VESSEL MATERIAL SURVEILLANCE CAPSULES FOR
CALVERT CLIFFS UNITS 1 & 2**

**PROPOSED REVISION TO THE SCHEDULE FOR WITHDRAWAL OF
REACTOR VESSEL MATERIAL SURVEILLANCE CAPSULE FOR
CALVERT CLIFFS UNITS 1 & 2**

I. BACKGROUND

Appendix H of 10 CFR Part 50 describes reactor vessel material surveillance program requirements. Paragraph (III)(B)(3) of this Appendix states that a proposed material withdrawal schedule must be submitted with a technical justification per 10 CFR 50.4, and approved prior to implementation. NRC Administrative Letter 97-04 (Reference 1) further clarified this statement by stating surveillance capsule withdrawal schedules that do not conform to the required American Society for Testing and Materials (ASTM) standard referenced in Appendix H will be treated as license amendments requiring public notice and opportunity for a hearing.

As is the case with the currently approved withdrawal schedule, the proposed withdrawal schedule satisfies the requirements of ASTM E185-70, the version that was current at the time the reactor vessel surveillance program was designed. In addition, to the extent practicable, both the proposed and the currently approved withdrawal schedules comply with subsequent versions of ASTM E185.

Tables (1) and (2) show the currently approved withdrawal schedule for Calvert Cliffs Units 1 and 2 reactor vessel surveillance capsules, respectively (Reference 2). The capsules located at the 263° and 97° locations have already been withdrawn from both units, and the capsule analysis results were submitted to the NRC in References (3) through (6).

II. PROPOSED REVISION TO THE WITHDRAWAL SCHEDULE

Tables (3) and (4) provide the proposed revisions to the reactor vessel surveillance capsule withdrawal schedules for Units 1 and 2, respectively. The revised schedules are based on ASTM E185-82 recommendations (Reference 7), and reflect updated fluence information from the surveillance capsules removed in 1992 and 1993 (Units 1 and 2, respectively) with appropriate adjustment made for fuels loaded in subsequent cycles. As shown below in Section IV, the proposed withdrawal schedules satisfy the requirements of ASTM E185-70, the version that was current at the time the reactor vessels were designed. Therefore, the withdrawal schedules satisfy the requirements of Appendix H to 10 CFR Part 50.

III. REASON FOR THE PROPOSED REVISION TO THE WITHDRAWAL SCHEDULE

On March 23, 2000, the NRC approved Baltimore Gas and Electric Company's (BGE's) request for license renewal of the Calvert Cliffs Nuclear Power Plant. 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 is designed based on a 40-year license, needs to be modified to accommodate a 60-year license. Accordingly, the NRC Safety Evaluation Report for Calvert Cliffs License Renewal, NUREG-1705 (Reference 8) requires that BGE modify the surveillance capsule withdrawal schedule. Specifically, Item 69 in Appendix E of NUREG-1705 (Reference 8) states in part:

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, BGE 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.*

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3. *If the last capsule is withdrawn before the 55th year, BGE will install neutron dosimetry to permit tracking of the fluence to the RPV.*

IV. JUSTIFICATION

In order to accommodate the 60-year licensed period the original withdrawal schedule will be spread out over a larger time period. Paragraph III.B(1) of 10 CFR Part 50, Appendix H reads:

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. For each capsule withdrawal, the test procedures and reporting requirements must meet the requirements of ASTM E 185 - 82 to the extent practicable for the configuration of the specimens in the capsule.

The Calvert Cliffs reactor vessels were designed to the 1965 through winter 1967 Addenda, edition of the ASME Code. ASTM E 185-70 was the current standard when the surveillance program was designed. As stated in the Calvert Cliffs Updated Final Safety Analysis Report, the reactor vessel surveillance program meets the requirements of ASTM E185-70. For determination of the withdrawal schedule the requirements in ASTM E185-70 are as follows:

4.6 Specimen Withdrawal---It is recommended that sets of specimens be withdrawn at three or more separate times. 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. One other data point obtained shall correspond to the neutron exposure of the reactor vessel near the end of its design life.

As stated in Section I above, both the currently approved version and the proposed withdrawal schedule meet this requirement.

The currently approved version of the withdrawal schedule also complies, to the extent practicable, with the requirements of ASTM E185-82. To develop a sixty-year surveillance program, BGE again applied the guidance provided in ASTM E185-82 for withdrawal schedules. To meet the additional requirement in NUREG 1705, for a capsule containing dosimetry to be available for withdrawal in the final five years of vessel operation (see Section III above), the proposed schedule includes a capsule containing dosimetry that can be pulled during the final five years of the extended license.

The guidance provided in ASTM E185-82 is consistent with, but more specific than, the guidance provided in earlier editions, including ASTM E185-70 to which the CCNPP reactor vessels' surveillance program is required to conform. Therefore, compliance with the ASTM E185-82 withdrawal schedule guidance ensures compliance with ASTM E185-70 withdrawal schedule guidance. ASTM E185-82 provides a withdrawal schedule in terms of years of operation but also provides the option to develop a schedule tied to target fluences accumulated in the vessel. As in the case of the currently approved withdrawal schedule, the proposed sixty-year withdrawal schedule follows the guidance that ties the withdrawal schedule to vessel fluence targets. The target fluence guidance is as follows:

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Capsule No.	Fluence Target
1.	When the accumulated neutron fluence of the capsule exceeds 5×10^{18} n/cm ² , or when the highest predicted delta RT _{NDT} (nil-ductility reference temperature) of all encapsulated materials is approximately 28°C (50°F), whichever comes first.
2.	At a time when the accumulated neutron fluence of the capsule corresponds to a value midway between the first and the third capsules.
3.	At a time when the accumulated neutron fluence on the capsule corresponds to the approximate end of life (EOL) fluence at the reactor vessel ¼ T location.
4.	At a time when the accumulated neutron fluence on the capsule corresponds to the approximate EOL fluence at the reactor vessel inner wall location.
5.	Not less than once or greater than twice the peak EOL vessel fluence. The capsule may be held without testing following withdrawal.

The current fluence projections for the extended end of life (EEOL) for Unit 1 vessel is:

1. EEOL vessel ¼ T fluence – 2.96×10^{19} n/cm²
2. EEOL vessel ID fluence – 5.09×10^{19} n/cm²
3. 2 X EEOL vessel ID fluence – 10.18×10^{19} n/cm²

The current fluence projections for Unit 2 vessel is:

4. EEOL vessel ¼ T fluence – 3.02×10^{19} n/cm²
5. EEOL vessel ID fluence EEOL vessel ¼ T fluence – 3.02×10^{19} n/cm²– 5.74×10^{19} n/cm²
6. 2 x EEOL vessel ID fluence – 11.48×10^{19} n/cm²

Calvert Cliffs' first two capsules for each Unit have been withdrawn and analyzed. As shown in Tables 3 and 4, the remaining capsules are fit to the criteria for capsules 3, 4, and 5 using the above fluence projections. The 6th capsule will be a spare.

V. UNIT 1 SUPPLEMENTAL SURVEILLANCE CAPSULE WITHDRAWAL

Although not part of CCNPP's 10 CFR Part 50, Appendix H surveillance capsule program, for completeness we have presented the revised supplemental capsule withdrawal schedule that reflects the 60-year extended life in Table 5. The supplemental surveillance capsule was placed in the Unit 1 reactor vessel at the vacated 263° location during the 1988 outage (end of Cycle 9). The supplemental surveillance program provides additional surveillance data for Unit 1 axial weld seams 2-203-A, B, C. When removed in the year 2012, the capsule will be sectioned into two halves, with one-half removed for testing. The second half will be reconstituted for reinstallation in the 263° location and will be removed for final analysis in 2024. Data from this program will be used to verify the embrittlement observed at low to intermediate fluence levels from the McGuire Unit 1 surveillance program. This will support the application of the McGuire Unit 1 surveillance data to predict the embrittlement of Unit 1 weld seams 2-203-A, B, C as discussed in References (9) and (10).

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VI. REFERENCES

- (1) NRC Administrative Letter 97-04, dated September 30, 1997, "NRC Staff Approval for Changes to 10 CFR Part 50, Appendix H, Reactor Vessel Surveillance Specimen Withdrawal Schedules"
- (2) Letter from Mr. A. W. Dromerick (NRC) to Mr. C. H. Cruse (BGE), dated December 15, 1997, "Baltimore Gas and Electric Company's Revision to the Reactor Vessel Surveillance Capsule Withdrawal Schedule for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M99127 and M99128)"
- (3) Letter from Mr. R. F. Ash (BGE) to Mr. R. A. Clark (NRC), dated February 4, 1981, transmitting "Perrin, J. S., et al., Calvert Cliffs Unit No. 1 Nuclear Plant Reactor Pressure Vessel Surveillance Program: Capsule 263, Battelle Report, December 1980"
- (4) Letter from Mr. J. A. Tiernan (BGE) to Mr. A. C. Thadani (NRC), dated April 28, 1986, transmitting "Surveillance Capsule Report No. SwRI-7524, Reactor Vessel Material Surveillance Program for Calvert Cliffs Unit 2 Analysis of 263° Capsule, September 1985"
- (5) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated, June 22, 1993, transmitting "Lowe, A L, Jr., et al., Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 1, B&W Nuclear Service Company, BAW-2160, June 1993"
- (6) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated March 18, 1994, transmitting "Lowe, A L, Jr., et al., Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 2, B&W Nuclear Service Company, BAW-2199, February 1994"
- (7) ASTM E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," American Society for Testing and Materials, Philadelphia, PA
- (8) NUREG-1705, Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant Units 1 and 2
- (9) Letter from Mr. R. E. Denton (BGE) to NRC Document Control Desk, dated November 29, 1993, "Request for Approval to Use Plant-Specific Data for Reactor Vessel Fracture Toughness Analysis"
- (10) Letter from Mr. M. L. Boyle (NRC) to Mr. R E Denton (BGE), dated July 29, 1994, "Request for Approval to Use Plant-Specific Data for Reactor Vessel Fracture Toughness Analysis, Calvert Cliffs Nuclear Power Plant, Unit No. 1"

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Table (1)

**Current Unit 1 Reactor Vessel Surveillance Program
Capsule Removal Schedule**

Capsule Azimuthal Position	Target Fast Neutron Fluence (x 10¹⁹ n/cm²)	Target Fluence Expected at End of Cycle	Projected End of Cycle Date
263°	0.62 ^a	3	Withdrawn, 1979
97°	2.64 ^b	10	Withdrawn, 1992
83°	3.47 ^c	16	2004
104°	3.14 ^d	21	2014
277°	4.31 ^d	21	2014
284°	STANDBY		

Notes:

- (a) Actual capsule fluence [Perrin, J S, et al., "Calvert Cliffs Unit No. 1 Nuclear Plant Reactor Pressure Vessel Surveillance Program: Capsule 263," Battelle Columbus Laboratories, December 1980]
- (b) Actual capsule fluence; at the time of schedule approval corresponded to the projected fluence at the vessel ¼-thickness location for plant life extension (48 EFPY) [Lowe, A L, Jr., et al., "Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 1," B&W Nuclear Service Company, BAW-2160, June 1993]
- (c) Capsule fluence that corresponds to the projected fluence at the vessel inner wall location at end of license (32 EFPY)
- (d) Capsule fluence at end of license

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Table (2)

**Current Unit 2 Reactor Vessel Surveillance Program
Capsule Removal Schedule**

Capsule Azimuthal Position	Target Fast Neutron Fluence (x 10¹⁹ n/cm²)	Target Fluence Expected at End of Cycle	Projected End of Cycle Date
263°	0.806 ^a	4	Withdrawn, 1982
97°	1.85 ^b	9	Withdrawn, 1993
284°	2.04 ^c	13	2001
104°	3.02 ^d	17	2009
277°	3.88 ^e	17	2009
83°	STANDBY		

Notes:

- (a) Actual capsule fluence [Norris, E. B., "Reactor Vessel Material Surveillance Program for Calvert Cliffs Unit 2 Analysis of 263° Capsule," Southwest Research Institute, SwRI-7524, September 1985]
- (b) Actual capsule fluence [Lowe, A L, Jr., et al., "Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 2," B&W Nuclear Service Company, BAW-2199, February 1994]
- (c) Capsule fluence that corresponds to the projected fluence at the vessel ¼-thickness location at end of license
- (d) Capsule fluence that corresponds to the projected fluence at the vessel ¼-thickness location for plant life extension (48 EFPY)
- (e) Capsule fluence that corresponds to the projected fluence at the vessel inner wall location at end of license (32 EFPY)

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Table (3)

**Proposed Unit 1 Reactor Vessel Surveillance Program
Capsule Removal Schedule**

Capsule Azimuthal Position	Target Fast Neutron Fluence (x 10¹⁹ n/cm²)	Target Fluence Expected at End of Cycle	Projected End of Cycle Date
263°	0.62 ^a	3	Withdrawn, 1979
97°	2.64 ^b	10	Withdrawn, 1992
104°	2.96 ^c	18	2008
83°	5.09 ^d	23	2018
277°	6.26 ^e	29	2030
284°	STANDBY		

Notes:

- (a) Actual capsule fluence [Perrin, J S, et al., "Calvert Cliffs Unit No. 1 Nuclear Plant Reactor Pressure Vessel Surveillance Program: Capsule 263," Battelle Columbus Laboratories, December 1980]
- (b) Actual capsule fluence; [Lowe, A L, Jr., et al., "Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 1," B&W Nuclear Service Company, BAW-2160, June 1993]
- (c) Withdrawal criteria - Capsule fluence that corresponds to the projected fluence at the vessel ¼ T location at end of extended life
- (d) Withdrawal criteria - Capsule fluence that corresponds to the projected fluence at the vessel inner wall location at end of extended life
- (e) Withdrawal criteria - Not less than once or greater than twice the peak end of extended life vessel fluence at the vessel inner wall ($5.09 \times 10^{19} < \text{fluence in n/cm}^2 < 10.18 \times 10^{19}$). Note: This capsule also satisfies the requirement in the NRC safety evaluation report for Calvert Cliffs license renewal, that one capsule containing dosimetry is to be removed during the final 5 years of the extended license.

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Table (4)

**Proposed Unit 2 Reactor Vessel Surveillance Program
Capsule Removal Schedule**

Capsule Azimuthal Position	Target Fast Neutron Fluence (x 10¹⁹ n/cm²)	Target Fluence Expected at End of Cycle	Projected End of Cycle Date
263°	0.806 ^a	4	Withdrawn, 1982
97°	1.85 ^b	9	Withdrawn, 1993
104°	3.02 ^c	17	2009
83°	5.74 ^d	24	2023
277°	6.96 ^e	28	2031
284°	STANDBY		

Notes:

- (a) Actual capsule fluence [Norris, E. B., "Reactor Vessel Material Surveillance Program for Calvert Cliffs Unit 2 Analysis of 263° Capsule," Southwest Research Institute, SwRI-7524, September 1985]
- (b) Actual capsule fluence [Lowe, A L, Jr., et al., "Analysis of Capsule 97° Baltimore Gas and Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 2," B&W Nuclear Service Company, BAW-2199, February 1994]
- (c) Withdrawal criteria - Capsule fluence that corresponds to the projected fluence at the vessel ¼ T location at end of extended life
- (d) Withdrawal criteria - Capsule fluence that corresponds to the projected fluence at the vessel inner wall location at end of extended life
- (e) Withdrawal criteria - Not less than once or greater than twice the peak end of extended life vessel fluence at the vessel inner wall ($5.74 \times 10^{19} < \text{fluence in n/cm}^2 < 11.48 \times 10^{19}$). Note: This capsule also satisfies the requirement in the safety evaluation report for Calvert Cliffs license renewal, one capsule containing dosimetry is to be removed during the final 5 years of the extended license.

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Table (5)

**Revised Unit 1 Supplemental Reactor Vessel Surveillance Program
Capsule Removal Schedule**

Capsule Identification	Target Fast Neutron Fluence (x 10¹⁹ n/cm²)	Target Fluence Expected at End of Cycle	Projected End of Cycle Date
S1	2.25	20	2012
S2	3.44	26	2024