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BGE

July 21, 1995

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
Request for Approval of Updated Values of Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) Values (10 CFR 50.61)

REFERENCES:

(a) Letter from Mr. D. G. McDonald, Jr. (NRC) to Mr. G. C. Creel (BGE), dated July 15, 1992, Response to the 1991 Pressurized Thermal Shock Rule, 10 CFR 50.61, Calvert Cliffs Nuclear Power Plant, Unit 1 (TAC No. M82504) and Unit 2 (TAC No. M82505)

(b) Letter from Mr. D. G. McDonald, Jr. (NRC) to Mr. R. E. Denton (BGE), dated May 24, 1993, Response to the 1991 Pressurized Thermal Shock Rule, 10 CFR 50.61, Calvert Cliffs Nuclear Power Plant, Unit 2 (TAC No. M82505)

(c) 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 (TAC No. M88316)

(d) Letter from Mr. G. C. Creel (BGE) to NRC Document Control Desk, dated December 13, 1991, Response to the 1991 Pressurized Thermal Shock Rule

Pursuant to 10 CFR 50.61(b)(1), Baltimore Gas and Electric Company hereby submits a request for approval of updated values of the Calvert Cliffs reactor vessels' Pressurized Thermal Shock (PTS) reference temperatures (RT_{PTS}). Paragraph (b)(1) requires licensees to update their PTS submittal whenever there is a significant change in the projected values of RT_{PTS}. Since your approval of the Calvert

Cliffs reactor vessels' PTS projections by References (a), (b), and (c), the following developments have taken place that have significantly changed the previously projected values.

- The best estimate copper and nickel values for some reactor vessel beltline welds have been revised. The best estimate values now incorporate data obtained through detailed search of fabrication records by the Combustion Engineering Reactor Vessel Group, quantitative weld chemistry and variability evaluation by Combustion Engineering Owners Group, chemical analysis of Long Island Lighting Company's Shoreham reactor vessel weldments, and chemical analysis of a sample of Boston Edison's Pilgrim Station archived surveillance test block.

- Estimate of reactor vessel wall neutron exposure has been revised, incorporating the results from the most recent flux reduction measures.

- Duke Power Company has issued the surveillance report for the third McGuire Unit 1 capsule, which changes the best fit chemistry factor by introducing a third data point for Calvert Cliffs Unit 1 Weld Seams 2-203-A,B,C.

- Calvert Cliffs Unit 2's second surveillance capsule report has been issued. As a result, there are now two credible data points for Plate D-8907-2 and Weld 9-203 of the reactor vessel that enabled us to determine the chemistry factor for these materials using the more accurate best fit method of Regulatory Guide 1.99.

The incorporation of these new developments have significantly improved the RT_{PTS} projection for Calvert Cliffs reactor vessels. The PTS limiting material for Calvert Cliffs Unit 1 are the axial Welds 3-203-A,B,C (Reference c). The 60-year RT_{PTS} value for these welds dropped from 270.4°F reported in Reference (d), to 245.5°F in the revised projection. The limiting material for Calvert Cliffs Unit 2 is Plate D-8906-1. The revised 60-year RT_{PTS} projection for this material slightly decreased from 200.2°F reported in Reference (d), to 198.4°F. Therefore, the updated RT_{PTS} projections ensure that both Calvert Cliffs reactor vessels will remain below the 10 CFR 50.61 PTS screening criteria for a period exceeding 20 years beyond the current 40-year operating license.

The revised material chemistry, neutron fluence, and RT_{PTS} calculations are summarized in Attachment (1). Attachment (2) is a detailed evaluation of best estimate chemistries for the Calvert Cliffs reactor vessel beltline welds. Attachment (3) is a report by B&W Nuclear Technologies on Calvert Cliffs reactor vessels weld metal chemical composition variability. We respectfully request a timely review and approval of this submittal to support our continuing effort to achieve optimal management of Calvert Cliffs reactor vessels with respect to postulated PTS events.

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

Very truly yours,

RED/GT/dlm

Attachments: (1) Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) for Calvert Cliffs Reactor Vessel Beltline Materials
(2) Best Estimate Chemistries for Calvert Cliffs Reactor Vessel Beltline Welds
(3) BWNT Report BAW-2220, "Reactor Vessel Weld Metal Chemical Composition Variability Study for Baltimore Gas and Electric Company," June 1995

cc: **(Without Attachments)**
D. A. Brune, Esquire
J. E. Silberg, Esquire
L. B. Marsh, NRC
D. G. McDonald, Jr., NRC
T. T. Martin, NRC
P. R. Wilson, NRC
R. I. McLean, DNR
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ATTACHMENT (1)

UPDATED PRESSURIZED THERMAL SHOCK (PTS) REFERENCE TEMPERATURES (RT_{PTS}) FOR CALVERT CLIFFS REACTOR VESSEL BELTLINE MATERIALS

Baltimore Gas & Electric Company

Docket Nos. 50-317 and 50-318

July 21, 1995

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS})
for
Calvert Cliffs Reactor Vessel Beltline Materials

1.0 REVISED CHEMISTRY CALCULATIONS FOR UNITS 1 AND 2 REACTOR VESSEL BELTLINE MATERIALS

The best estimate chemistry calculations for the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 1 (CC-1) and Unit 2 (CC-2) reactor vessel beltline welds are presented in Attachment (2). The calculations update values provided in earlier PTS submittals (References 1 through 4). The chemistry values for the beltline plate materials remain unchanged from the earlier submittals.

Baltimore Gas and Electric Company (BGE) has searched extensively for chemistry analyses of welds fabricated from the same heats of weld wire as the Calvert Cliffs beltline welds. This led to the discovery, in the 1980s, of the then limiting material for CC-1 reactor vessel in Duke Power Company's McGuire Unit 1 reactor vessel surveillance program. By Reference (5), BGE provided the justification and requested NRC's approval to use the McGuire surveillance results for CC-1 reactor vessel fracture toughness analyses of Weld Seams 2-203-A,B,C. By Reference (6), the NRC approved BGE's request, but imposed a 10°F penalty to account for temperature differences between the two plants. Updated chemistry factor calculations for Weld Seams 2-203-A,B,C are provided in Section 3.0 of this attachment.

Baltimore Gas and Electric Company participated in an ABB/Combustion Engineering Owners Group (CEOG) task (CEOG Task 781) that performed a quantitative evaluation of reactor vessel weld chemistry variability for reactor vessels fabricated by Combustion Engineering (CE) at its Chattanooga, Tennessee shop. Baltimore Gas and Electric Company was also a member of the ABB/CE Reactor Vessel Group, which was formed with the primary objective of searching fabrication records for all CE fabricated reactor vessels. Through the Reactor Vessel Group, BGE identified two other reactor vessels with welds similar to Calvert Cliffs reactor vessel welds; namely, Boston Edison's Pilgrim Station and Long Island Lighting Company's now decommissioned Shoreham Nuclear Power Station. General Electric provided BGE with a sample from the Pilgrim Station surveillance program archive material, and BGE purchased several large segments of the Shoreham reactor vessel while it was being disassembled for removal. After establishing the equivalency of the Pilgrim and Shoreham materials with Calvert Cliffs reactor vessel weld materials, BGE contracted B&W Nuclear Technologies (BWNT) to study the weld chemistry variability. The Pilgrim and Shoreham materials, along with two additional archive materials from the CCNPP surveillance programs, were analyzed by BWNT to determine the chemical content of each sample, and to investigate the variability of chemistry in the samples. Attachment (3) is a report by BWNT that provides detailed documentation of the chemical analyses study.

[Please note that the BWNT Report, Attachment (3), does not explicitly identify the source of the material being tested. Therefore, the following information is provided to identify the source of test material in the BWNT report. Specifically, BWNT analyzed seven separate weldments, representing four weld wire heats. Two weldments were from BGE's CCNPP surveillance program archives, and are identified by BGE Drawing Nos. E-8067-165-111 and E-8167-165-111. One weldment was from Boston Edison's surveillance program archives, and it is identified as block P-1-338. The remaining four weldments were from the Shoreham reactor vessel, and are identified by the seam numbers in the Shoreham vessel. Table 1.1 summarizes this cross-reference. This can be matched directly with Table 3.1, on Page 3-39 of the BWNT Report.]

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS})
for
Calvert Cliffs Reactor Vessel Beltline Materials

The results of the BWNT chemical analyses and other data recently obtained through detailed search of fabrication records by ABB/CE Reactor Vessel Group are used in Attachment (2) for best estimate chemistry calculation of all CCNPP reactor vessel welds. In Attachment (2) calculations, BGE has estimated the number of spools of weld wire used to make each weld, and used these estimates to weight the individual analysis results. The final copper percentages are therefore weighted averages. Since less variation has been observed in the nickel content than the copper content of welds that do not have pure nickel additions, and since Calvert Cliffs welds did not have any pure nickel wire additions, the nickel content values are simple averages. The updated chemistry results in Attachment (2) have been incorporated into the revised RT_{PTS} calculations presented in Tables 3.1.4 and 3.2.3

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) for Calvert Cliffs Reactor Vessel Beltline Materials

TABLE 1.1

SOURCE IDENTIFICATION SUMMARY FOR TEST MATERIALS USED IN THE BWNT CHEMICAL ANALYSIS STUDY (ATTACHMENT 3)

Source	Weld Block ID	Weld Wire Heat Number(s)
CCNPP U1 Surveillance Block	E-8067-165-111	33A277
CCNPP U2 Surveillance Block	E-8167-165-111	10137
Pilgrim Surveillance Block	P-1-338	20291/12008
Shoreham Upper Shell Axial Weld	1-308A	20291/12008
Shoreham Top Head Weld	3-318-2	10137
Shoreham Upper to Upper-Intermediate Shell Girth Weld	4-308A	33A277
Shoreham Bottom Head Weld	5-306	21935

2.0 REVISED FLUENCE ESTIMATION

Baltimore Gas and Electric Company's 1991 PTS submittal (Reference 2) provided fluence estimates through 40 and 60 years of operation for both CCNPP Units. Since that submittal, BGE has withdrawn one reactor surveillance capsule from each Unit, and has updated the total fluence estimates. These updated fluence predictions were submitted to the NRC by References (7) and (8).

In addition, BGE has continued to modify fuel loading patterns to achieve several goals, including extending the nominal fuel cycle to 24 months, and minimizing the neutron flux at the reactor vessel wall. This has been accomplished in both Units through the use of erbium as a burnable poison. Calvert Cliffs Unit 1 also uses flux suppressers in vacant control element assembly guide tubes at several peripheral locations to further reduce the neutron flux at the reactor vessel wall.

2.1 CALVERT CLIFFS UNIT 1 FLUENCE ESTIMATION

At the end of Cycle 10 (11.07 Effective Full Power Years), the neutron fluence at the inner surface of the CC-1 reactor vessel wall was computed to be 1.97E19 n/cm^2 (Reference 7). The current 24-month, low-leakage core design results in a neutron flux at the reactor vessel inner wall of approximately 2.27E10 n/cm^2/sec. Based on these data, the CC-1 end-of-cycle fluences were re-estimated and the results are presented in Table 2.1. Therefore, as shown in Table 2.1, the updated fluence at the inner surface of the reactor vessel is 3.27E19 n/cm^2 at the end of the current license period (2014), and 4.48E19 n/cm^2 at the end of a 20-year renewed license period (2034), should it be pursued.

2.2 CALVERT CLIFFS UNIT 2 FLUENCE ESTIMATION

At the end of Cycle 9 (10.97 Effective Full Power Years), the neutron fluence at the inner surface of the CC-2 reactor vessel wall was computed to be 1.44E19 n/cm^2 (Reference 8). The current 24-month, low-leakage core design results in a neutron flux at the reactor vessel inner wall of approximately 3.69E10 n/cm^2/sec. Based on these data, the CC-2 end-of-cycle fluences were re-estimated and the results are presented in Table 2.2. Therefore, as shown in Table 2.2, the updated fluence at the inner surface of the reactor vessel is 3.80E19 n/cm^2 at the end of the current license period plus one year (2017), and 5.77E19 n/cm^2 at the end of a 20-year renewed license period plus one year (2037), should license renewal be pursued.

2.3 SUMMARY

Baltimore Gas and Electric Company's fuel management practices over the past four years have significantly reduced the estimated end-of-life neutron fluences at the inner surfaces of both reactor vessels, as compared to the earlier estimates provided in Reference (2). These updated fluences have been incorporated into the revised RT_{PTS} calculations presented in Tables 3.1.4 and 3.2.3

TABLE 2.1

CALVERT CLIFFS UNIT 1 FLUENCE ESTIMATION

Cycle(s)	End-Of-Cycle Date	EFPD	Fluence Increment (n/cm^2)	Total Fluence (n/cm^2)
1 to 10	March 1992	4039.8	1.97E19	1.97E19
11	March 1994	506.6	0.09E19	2.06E19
12	March 1996	610.0 (Estimated)	0.12E19	2.18E19
13	March 1998	621.0 (Estimated)	0.13E19	2.31E19
14 to 21	March 2014	615 / Cycle (Est)	0.12E19 / Cycle	3.27E19
22 to 31	March 2034	615 / Cycle (Est)	0.12E19 / Cycle	4.48E19

TABLE 2.2

CALVERT CLIFFS UNIT 2 FLUENCE ESTIMATION

Cycle(s)	End-Of-Cycle Date	EFPD	Fluence Increment (n/cm^2)	Total Fluence (n/cm^2)
1 to 9	February 1993	4004.0	1.44E19	1.44E19
10	March 1995	581.7	0.18E19	1.62E19
11	March 1997	621.0 (Estimated)	0.20E19	1.82E19
12 to 13	March 2001	615.0 (Estimated)	0.195E19 / Cycle	2.21E19
14 to 21	March 2017	621 / Cycle (Est)	0.20E19 / Cycle	3.80E19
22 to 31	March 2037	621 / Cycle (Est)	0.20E19 / Cycle	5.77E19

NOTE: Totals in the tables above, and subsequent tables, are based on carrying all significant digits. Values presented are rounded.

3.0 PROJECTED VALUES OF RT_{PTS} FOR THE END 40-YEAR AND 60-YEAR LICENSE TERMS

In this section, the revised reactor vessel material chemistry values and updated fluence estimations discussed in Sections 1 and 2 are used to project the RT_{PTS} values for the end of the current 40-year license period, and for the end of a 20-year additional license renewal period. The RT_{PTS} projections are made using the calculative procedures given in Paragraphs b(2) and b(3) of 10 CFR 50.61. For those reactor vessel beltline materials with two or more credible plant-specific surveillance data, as defined in Regulatory Guide 1.99, Revision 2 (RG 1.99), the RT_{PTS} projections are made in accordance with Paragraph b(3) using the methodology described in Regulatory Position 2.1 of RG 1.99. When credible plant-specific surveillance data are not available, the calculative procedure of Paragraph b(2) is used.

3.1 PROJECTED VALUES OF RT_{PTS} FOR CALVERT CLIFFS UNIT 1

To project the RT_{PTS} values, the calculative procedure described in paragraph b(2) of 10 CFR 50.61 is used for all CC-1 reactor vessel beltline materials except Weld Seams 2-203-A,B,C, and 9-203, and Plate D-7206-3, where the calculative procedure in Paragraph b(3) is used.

As mentioned in Section 1, the NRC has approved the use of Duke Power Company's McGuire Unit 1 reactor vessel surveillance results for reactor vessel fracture toughness analyses of CC-1 Weld Seams 2-203-A,B,C (Reference 6). Since that approval, a third capsule has been withdrawn from the McGuire surveillance program (Reference 11) which changes the best-fit chemistry factor calculated in accordance with Regulatory Position 2.1 of RG 1.99. Table 3.1.1 summarizes the updated best-fit chemistry calculation for Weld Seams 2-203-A,B,C, using the results from the third McGuire capsule and the updated chemistry and fluence values discussed in Sections 1 and 2.

By Reference (6), the NRC has also approved the use of CC-1 reactor vessel surveillance capsule results (References 7 and 9), in accordance with Regulatory Position 2.1 of RG 1.99, for RT_{PTS} projections of Girth Weld 9-203 and Plate D-7206-3. Tables 3.1.2 and 3.1.3 summarize the updated best-fit chemistry factor, for these materials, using the updated chemistry values discussed in Section 1. In addition, since Plate D-7206-2 is fabricated from the same heats as Plate D-7206-3, the best-fit chemistry factor for D-7206-3 is used for Plate D-7206-2.

Table 3.1.4 provides a comprehensive summary of the updated RT_{PTS} projection for all CC-1 beltline materials. For welds or plates which use the Regulatory Position 2.1 shift predictions and the surveillance data meets the criteria of RG 1.99 such that the predicted ΔRT_{NDT} falls within one standard deviation of the actual ΔRT_{NDT}, then the RT_{NDT} shift uncertainty (σ_Δ) was reduced by half. This criterion was satisfied for all CC-1 surveillance data with the exception of Weld Seams 2-203-A,B,C.

ATTACHMENT (1)

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) for Calvert Cliffs Reactor Vessel Beltline Materials

TABLE 3.1.1
BEST-FIT CHEMISTRY FACTOR CALCULATION FOR CC-1 WELD SEAMS 2-203-A,B,C

Capsule Ident.	Charpy 30 Ft-lb Shift	Best Est CF / Surv CF	Adjusted ΔRT_{NDT}	Fluence	Fluence Factor	Shift x FF	FF Squared	Predicted Shift	Predicted - Actual (Adjusted)
U	160	1.003	160.5	4.71E+18	0.79	126.8	0.62	124.9	-35.5
X	165	1.003	165.5	1.41E+19	1.10	181.3	1.20	173.2	7.7
V	175	1.003	175.5	2.19E+19	1.21	212.8	1.47	191.7	16.2
					Sum:	520.9	3.29		
					Chemistry Factor	158.1			

NOTES:
1) Capsule Identifiers refer to McGuire Unit 1 Capsules
2) Best Estimate CF based on Cu=0.22 Ni=0.83 CF=204.8
3) Surveillance CF based on Cu=0.20 Ni=0.87 CF=204.2

TABLE 3.1.2
BEST-FIT CHEMISTRY FACTOR CALCULATION FOR CC-1 GIRTH WELD 9-203

Capsule Ident.	Charpy 30 Ft-lb Shift	Best Est CF / Surv CF	Adjusted ΔRT_{NDT}	Fluence	Fluence Factor	Shift x FF	FF Squared	Predicted Shift	Predicted - Actual (Adjusted)
W263	59	1.044	61.6	6.20E+18	0.87	53.3	0.75	65.1	3.5
W97	93	1.044	97.1	2.64E+19	1.26	122.3	1.59	94.7	-2.4
					Sum:	175.7	2.34		
					Chemistry Factor	75.2			

NOTES:
1) Best Estimate CF based on Cu=0.23 Ni=0.16 CF=113.8
2) Surveillance CF based on Cu=0.22 Ni=0.16 CF=109.0

TABLE 3.1.3
BEST-FIT CHEMISTRY FACTOR CALCULATION FOR CC-1 PLATE D-7206-3

Capsule Ident.	Charpy 30 Ft-lb Shift	Best Est CF / Surv CF	Adjusted ΔRT_{NDT}	Fluence	Fluence Factor	Shift x FF	FF Squared	Predicted Shift	Predicted - Actual (Adjusted)
W263(L)	60	1.00	60.0	6.20E+18	0.87	52.0	0.75	72.4	12.4
W97(L)	108	1.00	108.0	2.64E+19	1.26	136.0	1.59	105.3	-2.7
W97(T)	111	1.00	111.0	2.64E+19	1.26	139.8	1.59	105.3	-5.7
					Sum:	327.8	3.92		
					Chemistry Factor	83.6			

NOTES:
1) (L) refers to plate specimens oriented parallel to the rolling direction of the plate.
2) (T) refers to plate specimens oriented perpendicular to the rolling direction of the plate.
3) No observed differences between the surveillance plate and the overall best estimate chemistry, therefore the ratio term is 1.0.

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) for Calvert Cliffs Reactor Vessel Beltline Materials

TABLE 3.1.4

CALVERT CLIFFS UNIT 1 REACTOR VESSEL BELTLINE MATERIALS

Weld Identifier	Wire Heat & Flux Type	Copper (w/o)	Nickel (w/o)	Chemistry Factor (°F)	Initial RT_{NDT} (°F)	σ-initial (°F)	σ-delta (°F)	Margin (°F)	40-Year Projection Fluence (n/cm2)	40-Year Projection Fluence Factor	40-Year Projection RT_{PTS} (°F)	60-Year Projection Fluence (n/cm2)	60-Year Projection Fluence Factor	60-Year Projection RT_{PTS} (°F)
2-203-A/B/C (a)	12008/20291 Linde 1092	0.22	0.83	168	-50	0	28	56.0	3.27E+19	1.31	226.2	4.48E+19	1.38	237.9
3-203-A/B/C	21935 Linde 1092	0.17	0.72	171	-56	17	28	65.5	3.27E+19	1.31	233.7	4.48E+19	1.38	245.5
9-203 (b)	33A277 Linde 0091	0.23	0.16	75	-80	0	14	28.0	3.27E+19	1.31	46.3	4.48E+19	1.38	51.5

Plate Identifier	Heat Number	Copper (w/o)	Nickel (w/o)	Chemistry Factor (°F)	Initial RT_{NDT} (°F)	σ-initial (°F)	σ-delta (°F)	Margin (°F)	40-Year Projection Fluence (n/cm2)	40-Year Projection Fluence Factor	40-Year Projection RT_{PTS} (°F)	60-Year Projection Fluence (n/cm2)	60-Year Projection Fluence Factor	60-Year Projection RT_{PTS} (°F)
D-7206-1	C-4351-2	0.11	0.55	74	20	0	17	34.0	3.27E+19	1.31	151.0	4.48E+19	1.38	156.1
D-7206-2 (b)	C-4441-2	0.12	0.64	84	-30	0	8.5	17.0	3.27E+19	1.31	97.1	4.48E+19	1.38	102.9
D-7206-3 (b)	C-4441-1	0.12	0.64	84	10	0	8.5	17.0	3.27E+19	1.31	137.1	4.48E+19	1.38	142.9
D-7207-1	C-4420-1	0.13	0.54	90	10	0	17	34.0	3.27E+19	1.31	162.0	4.48E+19	1.38	168.2
D-7207-2	B-8489-2	0.11	0.56	74	-10	0	17	34.0	3.27E+19	1.31	121.0	4.48E+19	1.38	126.1
D-7207-3	B-8489-1	0.11	0.53	74	-20	0	17	34.0	3.27E+19	1.31	111.0	4.48E+19	1.38	116.1

NOTES:

(a) Weld Seam 2-203 Chemistry Factor based on McGuire Unit 1 surveillance data. Calculations shown in Table 3.1.1.

(b) Weld Seam 9-203 and Plate D-7206-2 and -3 Chemistry Factors based on CCNPP surveillance data. Calculations shown in Tables 3.1.2 and 3.1.3.

3.2 PROJECTED VALUES OF RT_{PTS} FOR CALVERT CLIFFS UNIT 2

All previously reported RT_{PTS} projections for CC-2 used the calculative procedure described in Paragraph b(2) of 10 CFR 50.61. Since there are now two credible surveillance data sets for CC-2 (References 8 and 10) in this submittal, we are proposing to use the more accurate calculative procedure in Paragraph b(3) for Girth Weld 9-203 and Plate D-8907-2. Tables 3.2.1 and 3.2.2 summarize the best-fit chemistry factor calculation, for these materials, using the updated chemistry values and fluence values discussed in Sections 1 and 2. In addition, since CC-2 Weld Seams 3-203-A,B,C are fabricated from the same heat of weld wire as CC-1 Girth Weld 9-203, we are also proposing to use the calculative procedure in Paragraph b(3) for the CC-2 weld seams using the best-fit chemistry factor from CC-1 surveillance program.

Table 3.2.3 provides a comprehensive summary of the updated RT_{PTS} projection for all CC-1 beltline material. For welds or plates which use the Regulatory Position 2.1 shift predictions, and where the surveillance data meet the criteria of RG 1.99 such that the predicted ΔRT_{NDT} falls within one standard deviation of the actual ΔRT_{NDT}, then the RT_{NDT} shift uncertainty (σ_Δ) was reduced by half. This criterion was satisfied for all CC-2 surveillance data.

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS}) for Calvert Cliffs Reactor Vessel Beltline Materials

TABLE 3.2.1

BEST-FIT CHEMISTRY FACTOR CALCULATION FOR CC-2 GIRTH WELD 9-203

Capsule Ident.	Charpy 30 Ft-lb Shift	Best Est CF / Surv CF	Adjusted ΔRT_{NDT}	Fluence	Fluence Factor	Shift x FF	FF Squared	Predicted Shift	Predicted - Actual (Adjusted)
W263	69	1.00	69.0	8.06E+18	0.94	64.8	0.88	68.1	-0.9
W97	84	1.00	84.0	1.85E+19	1.17	98.2	1.37	84.7	0.7
					Sum:	163.0	2.25		
					Chemistry Factor	72.5			

NOTE:

1) There are no observed differences between the surveillance weld and the overall best estimate chemistry, therefore the ratio term is 1.0.

TABLE 3.2.2

BEST-FIT CHEMISTRY FACTOR CALCULATION FOR CC-2 PLATE D-8907-2

Capsule Ident.	Charpy 30 Ft-lb Shift	Best Est CF / Surv CF	Adjusted ΔRT_{NDT}	Fluence	Fluence Factor	Shift x FF	FF Squared	Predicted Shift	Predicted - Actual (Adjusted)
W263(L)	84	1.00	84.0	8.06E+18	0.94	78.9	0.88	85.5	1.5
W97(L)	106	1.00	106.0	1.85E+19	1.17	123.9	1.37	106.4	0.4
W97(T)	108	1.00	108.0	1.85E+19	1.17	126.2	1.37	106.4	-1.6
					Sum:	329.0	3.61		
					Chemistry Factor	91.0			

NOTES:

1) (L) refers to plate specimens oriented parallel to the rolling direction of the plate.
2) (T) refers to plate specimens oriented perpendicular to the rolling direction of the plate.
3) There are no observed differences between the surveillance plate and the overall best estimate chemistry, therefore the ratio term is 1.0.

Updated Pressurized Thermal Shock (PTS) Reference Temperatures (RT_{PTS})
for
Calvert Cliffs Reactor Vessel Beltline Materials

TABLE 3.2.3

CALVERT CLIFFS UNIT 2 REACTOR VESSEL BELTLINE MATERIALS

Weld Identifier	Wire Heat & Flux Type	Copper (w/o)	Nickel (w/o)	Chemistry Factor (°F)	Initial RT_{NDT} (°F)	σ-initial (°F)	σ-delta (°F)	Margin (°F)	40-Year Projection Fluence (n/cm2)	40-Year Projection Fluence Factor	40-Year Projection RT_{PTS} (°F)	60-Year Projection Fluence (n/cm2)	60-Year Projection Fluence Factor	60-Year Projection RT_{PTS} (°F)
2-203-A/B/C	A-8746 Linde 124	0.16	0.10	79	-56	17	28	65.5	3.80E+19	1.35	115.8	5.77E+19	1.43	122.4
3-203-A/B/C (a)	33A277 Linde 0091	0.23	0.16	75	-80	0	14	28.0	3.80E+19	1.35	48.9	5.77E+19	1.43	55.2
9-203 (a)	10137 Linde 0091	0.21	0.06	73	-60	0	14	28.0	3.80E+19	1.35	66.2	5.77E+19	1.43	72.4

Plate Identifier	Heat Number	Copper (w/o)	Nickel (w/o)	Chemistry Factor (°F)	Initial RT_{NDT} (°F)	σ-initial (°F)	σ-delta (°F)	Margin (°F)	40-Year Projection Fluence (n/cm2)	40-Year Projection Fluence Factor	40-Year Projection RT_{PTS} (°F)	60-Year Projection Fluence (n/cm2)	60-Year Projection Fluence Factor	60-Year Projection RT_{PTS} (°F)
D-8906-1	A-4463-1	0.15	0.56	108	10	0	17	34.0	3.80E+19	1.35	189.3	5.77E+19	1.43	198.4
D-8906-2	B-9427-2	0.11	0.56	74	10	0	17	34.0	3.80E+19	1.35	143.5	5.77E+19	1.43	149.8
D-8906-3	A-4463-2	0.14	0.55	98	5	0	17	34.0	3.80E+19	1.35	170.8	5.77E+19	1.43	179.1
D-8907-1	C-5804-1	0.15	0.60	110	-8	0	17	34.0	3.80E+19	1.35	174.0	5.77E+19	1.43	183.2
D-8907-2 (a)	C-5286-1	0.14	0.66	91	20	0	8.5	17.0	3.80E+19	1.35	159.4	5.77E+19	1.43	167.1
D-8907-3	C-5803-3	0.11	0.74	77	-16	0	17	34.0	3.80E+19	1.35	121.6	5.77E+19	1.43	128.1

NOTE:

(a) Welds 3-203 and 9-203 and Plate D-8907-2 Chemistry Factors based on plant specific surveillance data. Calculations shown in Tables 3.1.2, 3.2.1, and 3.2.2.

4.0 REFERENCES

1. Letter from Mr. J. A. Tiernan (BGE) to Mr. A. C. Thadani (NRC), dated January 23, 1986, Response to the Pressurized Thermal Shock Rule

2. Letter from Mr. G. C. Creel (BGE) to Document Control Desk (NRC), dated December 13, 1991, Response to the 1991 Pressurized Thermal Shock Rule

3. Letter from Mr. G. C. Creel (BGE) to Document Control Desk (NRC), dated May 22, 1992, Response to NRC's Request for Additional Information Regarding Baltimore Gas and Electric Company's Response to the 1991 Pressurized Thermal Shock Rule, dated March 31, 1992

4. Letter from Mr. R. E. Denton (BGE) to Document Control Desk (NRC), dated February 16, 1993, Response to NRC's Request for Additional Information Regarding Baltimore Gas and Electric Company's Response to the 1991 Pressurized Thermal Shock (PTS) Rule, dated July 15, 1992

5. Letter from Mr. R. E. Denton (BGE) to Document Control Desk (NRC), dated November 29, 1993, Request for Approval to Use Plant-Specific Data for Reactor Vessel Fracture Toughness Analysis

6. 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

7. Letter from Mr. R. E. Denton (BGE) to Document Control Desk (NRC), dated June 22, 1993, Analysis of the Calvert Cliffs Unit No. 1 Reactor Vessel Surveillance Capsule Withdrawn from the 97° Location

8. Letter from Mr. R. E. Denton (BGE) to Document Control Desk (NRC), dated March 18, 1994, Analysis of the Calvert Cliffs Unit No. 2 Reactor Vessel Surveillance Capsule Withdrawn from the 97° Location

9. Letter from Mr. R. F. Ash (BGE) to Mr. R. A. Clark (NRC), dated February 4, 1981, Reactor Vessel Material Surveillance Program for Calvert Cliffs Unit No. 1, Analysis of 263° Capsule

10. Letter from Mr. J. A. Tiernan (BGE) to Mr. A. C. Thadani (NRC), dated April 28, 1986, Reactor Vessel Material Surveillance Program for Calvert Cliffs Unit No. 2, Analysis of 263° Capsule

11. Westinghouse Electric Corporation Report WCAP-13949, "Analysis of Capsule V Specimens and Dosimeters and Analysis of Capsule Z Dosimeters from the Duke Power Company McGuire Unit 1 Reactor Vessel Radiation Surveillance Program", February 1994