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GEORGE C. CREEL
VICE PRESIDENT
NUCLEAR ENERGY
(301) 260-4455

November 26, 1990

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 2; Docket No. 50-318
Projected Upper Shelf Energy, Unit 2 Reactor Vessel

Gentlemen:

During a recent discussion, a member of your staff requested information concerning the projected Upper Shelf Energy (USE) values for the Unit 2 reactor vessel. In response to this request, we are enclosing information demonstrating that the Unit 2 reactor vessel will not drop below the minimum USE level of 50 ft.-lbs. during the current license term. The assessment performed for Unit 2 was in accordance with Regulatory Guide 1.99, Rev. 2.

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

Very truly yours,

GCC/BSM/dlm

Enclosure: Letter from P. J. Hijeck (ABB) to Jim Lippold (BG&E), dated November 20, 1990, Calvert Cliffs Unit 2 Reactor Vessel Upper Shelf Energy

cc: D. A. Brune, Esquire
J. E. Silberg, Esquire
R. A. Capra, NRC
D. G. McDonald, Jr., NRC
T. T. Martin, NRC
L. E. Nicholson, NRC
R. I. McLean, DNR

A001 1/1 Cert No P447638610

ENCLOSURE

ASEA BROWN BOVERI

November 20, 1990
B-MPS-90-331

Mr. Jim Lippold
Nuclear Engineering Department
Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Generating Station
Lusby, MD 20657

Subject: **CALVERT CLIFFS UNIT 2 REACTOR VESSEL UPPER SHELF ENERGY**

Enclosure: (1) Calvert Cliffs Unit 2 Weld Metal Upper Shelf Energy

Dear Mr. Lippold:

The purpose of this letter is to respond to your request of November 8, 1990 for the review of the Calvert Cliffs Unit 2 Reactor Vessel Weld Metal Upper Shelf Energy (USE).

Review of the available data indicates that none of the Calvert Cliffs Unit 2 Reactor Vessel weld metal will drop below the minimum 50 ft-lb level over the current licensed life. The decrease in USE was predicted using Regulatory Guide 1.99 Revision 02 and a fast neutron fluence value of 4.56×10^{19} n/cm^2 at 32 Effective Full Power Years (EFPY).

Enclosure 1 provides a summary of reactor vessel material properties and their predicted USE values at 32 EFPY. Enclosure 1 has been QA verified in accordance with CE Quality Assurance Procedures.

If you have any questions, please do not hesitate to contact me at (203) 285-3115.

Sincerely,

COMBUSTION ENGINEERING, INC.

Paul Hijeck

P. J. Hijeck, P.E.
Supervisor
Reactor Vessel Integrity

PJH:prr

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Enclosure

cc: S. Byrne
M. McDonald
F. Ferraraccio

PJH003.WP

VERIFICATION STATUS: COMPLETE

The Safety-Related design information contained in this document has been verified to be correct by means of:

✓ Design Review using Checklist(s) 9 of QA/A-101.
____ Alternate Analysis - Copy attached.
____ Verification Testing - Test Report No. ____

CRAIG D. STEWART / Craig D. Stewart / 11-20-90
Independent Reviewer: Name/Signature/Date

Enclosure 1

CALVERT CLIFFS UNIT 2
WELD METAL UPPER SHELF ENERGY

In response to your request, a QA-verified evaluation was performed to prepare an estimate of the initial upper shelf toughness of the two longitudinal weld seams, 2-203A, B and C and 3-203A, B and C, in the Calvert Cliffs Unit 2 reactor vessel beltline. At the time of vessel manufacture, CE Chattanooga was required to perform Charpy impact and unaxial tension tests at a single temperature on a weld sample made using the same weld consumables as used to fabricate the vessel welds. Requirements to generate a full Charpy impact energy versus temperature curve (from which the initial upper shelf toughness is derived) were not in place until later; 10CFR50, Appendix G was first issued in 1973. In the case of the closing girth seam weld 9-203, data generated as part of the Unit 2 surveillance program could be used to characterize the upper shelf toughness of the vessel girth weld since both the surveillance and girth welds were fabricated with the same consumables and process. However, alternate data sources have to be used for the two longitudinal weld seams.

The weld consumables, chemical content, and weld qualification Charpy test results for the two beltline longitudinal weld seams are given in Table 1. The requirements for Charpy impact tests performed at +10°F test data are not necessarily indicative of the upper shelf energy.

The surveillance weld for Calvert Cliffs Unit 1 was fabricated using the same heat of wire and lot of flux as the Unit 2 weld seams 3-203A, B, and C. The initial upper shelf energy from the Unit 1 baseline surveillance materials evaluation was reported as 160 ft-lb. (A value of 152 ft-lb is obtained using an average of all the specimens exhibiting 100% shear fracture.) The baseline and post-irradiation test results for the Unit 1 surveillance weld should be fully representative of the Unit 2 weld seams 3-203A, B and C.

Comparable data are not available for weld wire heat A8746 and Linde 124 flux used to weld seams 2-203A, B and C. However, there are upper shelf toughness measurements for other welds fabricated using Linde 124 flux as shown in Table 2. The data range from 88 to 114 ft-lb shelf energy, with an average of 100 ft-lb. The Unit 2 weld seams 2-203A, B and C can be expected to have an initial upper shelf energy in the same range based on the similarity in consumables and weld processes employed.

The projected upper shelf energy (USE) decrease and the projected USE for an end-of-life (EOL) peak vessel inside surface fluence of 4.56×10^{19} n/cm^2 based on Regulatory Guide 1.99 Revision 02 prediction methods are as follows:

Weld Seam	Initial USE (ft-lbs)	Predicted USE Decrease	EOL USE (ft-lb)
2-203 A, B & C	100 (avg)	37%	63
	88 (min)	37%	55
3-203 A, B & C	152	51%	74

Based on these conservative projections, both welds will will maintain in excess of 50 ft-lbs USE throughout the design life of the vessel even for the case using the minimum initial USE for weld 2-203 A, B & C.

Table 1

CALVERT CLIFFS UNIT 2 REACTOR VESSEL BELTLINE
LONGITUDINAL WELD MATERIALS

Weld Seam Number	Location	Weld Wire[1] Type	Weld Wire[1] Heat No.	Weld Flux[1] Type	Weld Flux[1] Lot No.	Chemical Content[2] Cu	Chemical Content[2] Ni	Charpy Energy[3] at +10°F (ft-lbs)
2-203A, B and C	Intermediate Shell Course	Mil B-4	A8746	Linde 124	3878	0.12	1.01	66, 75, 78
3-203A, B and C	Lower Shell Course	Mil B-4	33A277	Linde 0091	3922	0.23	0.23	155, 121, 123[4] 116, 114, 115[5]

NOTES

(1) Data Source - Vessel Fabrication Records.
(2) Data Source - S. T. Byrne, "RT_{NDT} of Calvert Cliffs Unit 2 Reactor Vessel Materials," MCC-90-295, dated June 6, 1990.
(3) Data Source - Welding Material Qualification Test Report.
(4) Single wire submerged arc weld deposit.
(5) Tandem wire submerged arc weld deposit.

Table 2

UPPER SHELF ENERGY OF LINDE 124 WELDS[1]

Wire Heat No.	Linde 124 Flux Lot No.	Upper Shelf[2] Energy (ft-lbs)
89408	0751	111
3P7246	0951	106
3P7317	0951	99
ES6906	0662	89
91762	0662	88
4P7927	0662	114
4P7869	1061	97
5P8866	1061	107
69025	1061	89
89833	1061	96
90144	1061	91
3P7802	0171	109
651A708	0871	94
4P8632	0281	107
3P8013	0281	92
LP5P9744	0281	108

Mean: 99.8 ft-lbs

Range

High: 114 ft-lbs
Low: 88 ft-lbs

NOTES:

(1) Source: Information Requested b NRC I&E Bulletin No. 78-12, "Atypical Weld Material in Reacto Pressure Vessel Welds," Combustion Engineering, Inc. Report dated June 8, 1979.
(2) Average value of data exhibiting 100% shear fracture.