Docket Nos. 50-317
and 50-318

December 22, 1992

Mr. Robert E. Denton
Vice President - Nuclear Energy
Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, Maryland 20657-4702

Dear Mr. Denton:

SUBJECT: ISSUANCE OF AMENDMENTS FOR CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1 (TAC NO. M84443) AND UNIT NO. 2 (TAC NO. M84444)

The Commission has issued the enclosed Amendment No. 176 to Facility Operating License No. DPR-53 and Amendment No. 153 to Facility Operating License No. DPR-69 for the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, respectively. The amendments consist of changes to the Technical Specifications in response to your application transmitted by letter dated September 1, 1992, as supplemented on November 11, 1992.

The amendments revise the Unit Nos. 1 and 2 spent fuel pool enrichment limit. The enrichment limit is decreased from 5.0 weight percent (w/o) U-235 to a value of 4.52 w/o U-235.

A copy of the related Safety Evaluation is enclosed. A Notice of Issuance will be included in the Commission's next regular biweekly Federal Register notice.

Sincerely,

Original Signed BY:

Daniel G. McDonald, Senior Project Manager
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Amendment No. 176 to DPR-53
2. Amendment No. 153 to DPR-69
3. Safety Evaluation

cc w/enclosures:
See next page

*SEE PREVIOUS CONCURRENCE

PDI-1:LA	PDI-1:PM	OGC*	PDI-1:D		
CVogan	DMcDonald:smm		RACapra		
12/22/92	12/22/92	12/11/92	12/22/92	/ /	/ /

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

December 22, 1992

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and 50-318

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cc w/enclosures:
See next page

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Mr. Robert E. Denton
Baltimore Gas & Electric Company

Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 and 2

cc:

Mr. Michael Moore, President
Calvert County Board of
Commissioners
175 Main Street
Prince Frederick, Maryland 20678

D. A. Brune, Esquire
General Counsel
Baltimore Gas and Electric Company
P. O. Box 1475
Baltimore, Maryland 21203

Jay E. Silberg, Esquire
Shaw, Pittman, Potts and Trowbridge
2300 N Street, NW
Washington, DC 20037

Mr. G. L. Detter, Director, NRM
Calvert Cliffs Nuclear Power Plant
MD Rts. 2 & 4, P. O. Box 1535
Lusby, Maryland 20657-4702

Resident Inspector
c/o U.S. Nuclear Regulatory
Commission
P. O. Box 287
St. Leonard, Maryland 20685

Mr. Richard I. McLean
Administrator - Radioecology
Department of Natural Resources
580 Taylor Avenue
Tawes State Office Building
B3
Annapolis, Maryland 21401

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, Pennsylvania 19406

Mr. Joseph H. Walter
Engineering Division
Public Service Commission of
Maryland
American Building
231 E. Baltimore Street
Baltimore, Maryland 21202-3486

Kristen A. Burger, Esquire
Maryland People's Counsel
American Building, 9th Floor
231 E. Baltimore Street
Baltimore, Maryland 21202

Patricia T. Birnie, Esquire
Co-Director
Maryland Safe Energy Coalition
P. O. Box 33111
Baltimore, Maryland 21218

DATED: December 22, 1992

AMENDMENT NO. 176 TO FACILITY OPERATING LICENSE NO. DPR-53-CALVERT CLIFFS UNIT 1
AMENDMENT NO. 153 TO FACILITY OPERATING LICENSE NO. DPR-69-CALVERT CLIFFS UNIT 2

Docket File
NRC & Local PDRs
PDI-1 Reading
S. Varga, 14/E/4
J. Calvo, 14/A/4
R. Capra
C. Vogan
D. McDonald
OGC
D. Hagan, 3302 MNBB
C. Liang, 8/E/23
G. Hill (8), P1-22
Wanda Jones, P-370
C. Grimes, 11/F/23
L. Kopp, 8/E/23
ACRS (10)
OPA
OC/LFMB
Plant File
C. Cowgill, Region I

cc: Plant Service list

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

BALTIMORE GAS AND ELECTRIC COMPANY

DOCKET NO. 50-317

CALVERT CLIFFS NUCLEAR POWER PLANT UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 176
License No. DPR-53

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Baltimore Gas and Electric Company (the licensee) dated September 1, 1992, as supplemented on November 11, 1992, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-53 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 176 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert A. Capra

Robert A. Capra, Director
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: December 22, 1992

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

BALTIMORE GAS AND ELECTRIC COMPANY

DOCKET NO. 50-318

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 153
License No. DPR-69

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Baltimore Gas and Electric Company (the licensee) dated September 1, 1992, as supplemented on November 11, 1992, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.2 of Facility Operating License No. DPR-69 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 153, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert A. Capra

Robert A. Capra, Director
Project Directorate I-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: December 22, 1992

ATTACHMENT TO LICENSE AMENDMENTS

AMENDMENT NO. 176 FACILITY OPERATING LICENSE NO. DPR-53

AMENDMENT NO. 153 FACILITY OPERATING LICENSE NO. DPR-69

DOCKET NOS. 50-317 AND 50-318

Revise Appendix A as follows:

Remove Pages	Insert Pages
5-5	5-5

VOLUME

5.4.2 The total water and steam volume of the Reactor Coolant System is 10,614 ± 460 cubic feet at a nominal T_{avg} of 532°F.

5.5 METEOROLOGICAL TOWER LOCATION

5.5.1 The meteorological tower shall be located as shown on Figure 5.1-1.

5.6 FUEL STORAGE

CRITICALITY - SPENT FUEL

5.6.1 The spent fuel storage racks are designed and shall be maintained with a minimum 10 3/32" x 10 3/32" center-to-center distance between fuel assemblies placed in the storage racks to ensure a k_{eff} of ≤ 0.95 with the storage pool filled with unborated water. The k_{eff} of ≤ 0.95 includes the conservative allowances for uncertainties described in Section 9.7.2 of the FSAR. The maximum fuel enrichment to be stored in the fuel pool will be 4.52 weight percent.

CRITICALITY - NEW FUEL

5.6.2 The new fuel storage racks are designed and shall be maintained with a nominal 18 inch center-to-center distance between new fuel assemblies such that k_{eff} will not exceed 0.95 when fuel having a maximum enrichment of 5.0 weight percent U-235 is in place and various densities of unborated water are assumed including aqueous foam moderation and full flood conditions. The k_{eff} of ≤ 0.95 includes the conservative allowance for uncertainties described in Section 9.7.2 of the FSAR.

DRAINAGE

5.6.3 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 63 feet.

5.5 METEOROLOGICAL TOWER LOCATION

5.5.1 The meteorological tower shall be located as shown on Figure 5.1-1.

5.6 FUEL STORAGE

CRITICALITY - SPENT FUEL

5.6.1 The spent fuel storage racks are designed and shall be maintained with a minimum 10 3/32" x 10 3/32" center-to-center distance between fuel assemblies placed in the storage racks to ensure a k_{eff} of $\leq$ 0.95 with the storage pool filled with unborated water. The k_{eff} of $\leq$ 0.95 includes the conservative allowances for uncertainties described in Section 9.7.2 of the FSAR. The maximum fuel enrichment to be stored in the fuel pool will be 4.52 weight percent.

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DRAINAGE

5.6.3 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 63 feet.

CAPACITY

5.6.4 The fuel storage pool is designed and shall be maintained with a combined storage capacity, for both Units 1 and 2, limited to no more than 1830 fuel assemblies.

5.7 COMPONENT CYCLIC OR TRANSIENT LIMITS

5.7.1 The components identified in Table 5.7-1 are designed and shall be maintained within the cyclic or transient limits of Table 5.7-1.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 176 TO FACILITY OPERATING LICENSE NO. DPR-53

AND AMENDMENT NO. 153 TO FACILITY OPERATING LICENSE NO. DPR-69

BALTIMORE GAS AND ELECTRIC COMPANY

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

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

By letter dated September 1, 1992, as supplemented November 11, 1992, the Baltimore Gas and Electric Company (BG&E, the licensee) submitted a request for changes to the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2, Technical Specifications (TS). The requested changes would revise the Unit Nos. 1 and 2 spent fuel pool enrichment limit. The spent fuel pool enrichment limit would be decreased from 5.0 weight percent (w/o) U-235 to a value of 4.52 w/o U-235. The change is being requested because of errors identified in the previous calculations performed by Asea Brown Boveri-Combustion Engineering (ABB-CE) to support the 5.0 w/o U-235 enrichment limit. BG&E imposed administrative limits on the maximum allowable enrichment, which were based on analysis performed when the errors were identified, until the requested decrease in the TS enrichment limit to 4.52 w/o U-235 is issued. The November 11, 1992, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination. The information provided supported the use of Pacific Northwest Laboratory (PNL) critical experiments which BG&E used to qualify the analytical methods used and BG&E's evaluation of the calculational uncertainty and bias.

2.0 BACKGROUND

The Unit 1 and Unit 2 spent fuel pool is common for both units. The storage racks located in the common pool are identical except for the different poison (neutron absorber) material used in each. The Unit 1 racks use a poison material made of a boron carbide composite which is not susceptible to shrinkage and associated gap formation. The Unit 2 racks use Boraflex as the neutron poison material. In the past, gaps have been observed in the Boraflex, in some cases, when the material is physically restricted and shrinks under irradiation. On September 8, 1987, the NRC issued Information Notice No. 87-43 alerting all operating licensees to this problem.

In early 1992, ABB/CE informed the NRC of errors in the spent fuel pool criticality calculations performed for several plants including Calvert

Cliffs. This prompted the issuance of NRC Information Notice No. 92-21 and its Supplement. BG&E had used these incorrect calculations to support a maximum allowed enrichment of 5.0 w/o U-235 for fuel in the Calvert Cliffs spent fuel pool.

3.0 EVALUATION

Part of the discrepancy in the previous ABB/CE spent fuel pool reactivity calculation was attributed to the buckling term used in the CEPAK code spectral calculation to obtain four neutron energy group cross sections. A geometric buckling term corresponding to a sparsely populated and unpoisoned array was used as an approximation of buckling in the poisoned configuration. Although this approximation gave good agreement when applied to critical experiments of both unpoisoned and lightly poisoned arrays, it is not appropriate for the specific configuration found in the Calvert Cliffs spent fuel racks where the assembly pitch is small and the fuel assembly is completely surrounded by a strong poison. With this configuration, the buckling caused the fine group spectrum to be shifted to the thermal energies such that the effective broad group thermal removal cross section was overestimated, resulting in an underestimate of the effective multiplication factor (k_{eff}). In the revised analysis, the geometric buckling supplied to CEPAK was derived from a transport theory solution for a fuel assembly in the storage rack environment. The calculation was performed with the two-dimensional discrete ordinates transport code DOT-IV. The staff concludes that the geometric buckling calculated in this manner is indicative of the neutronic environment of the fuel assembly in the spent fuel rack and is, therefore, acceptable.

The other discrepancy in the previous spent fuel pool calculations was attributed to the omission of self-shielding in the epithermal (group 3 of 4) poison absorption cross section. CEPAK performs a one-dimensional thermal calculation (group 4) but a zero-dimensional fast and epithermal calculation (groups 1 through 3). Consequently, no spatial self-shielding of the fast and epithermal cross sections are performed explicitly by CEPAK but must be performed by ancillary codes and input to CEPAK, if needed. Comparisons to explicit one-dimensional calculations for both thermal and fast neutron energies performed by the XSDRNPM code indicated that the group 3 poison cross section is significantly self-shielded and that the omission of self-shielding in the original poison cross sections resulted in an overestimate of poison worth (and underestimate of k_{eff}) by about 2%. The group dependent poison cross sections in the revised analysis were generated by a 123-group XSDRNPM calculation and collapsed to a broad four-group scheme. The staff concludes that the resulting set of four-group poison cross sections properly account for epithermal self-shielding and are acceptable.

The manufacturer of the Calvert Cliffs storage racks has indicated that there were no manufacturing directives which would have led to constraint of the Boraflex sheets during fabrication. Therefore, the Boraflex sheets would be less likely to form gaps upon shrinkage. However, a gap penalty has been applied to account for the possibility that they may exist. Four-inch gaps

were assumed to exist in every sheet of Boraflex and the gaps in the four walls of any given rack cell were assumed to be axially aligned. Based on blackness tests performed on Boraflex panels at other spent fuel storage pools, the assumption of a 4-inch gap size in the Calvert Cliffs analysis appears to be suitably conservative.

In the original Unit 2 analysis, it was very conservatively assumed that Boraflex gaps of 4-inches were located in all box walls at the midplane of the fuel. In the revised analysis, the 4-inch gaps in adjacent rack cells were assumed to be staggered slightly, with a 2-inch vertical separation which leads to an alternative (checkerboard-type) pattern when looking at the entire pool. This is more conservative than assuming a random gap distribution which industry experience indicates is the more likely case. The gaps were assumed to be distributed preferentially around the axial centerline of the fuel assembly. Since the flux is highest at the fuel axial centerline, the worth of the gaps will be the greatest in this region. Therefore, the calculation of the gap penalty at the central fuel region in the reanalysis is conservative and acceptable.

The two-dimensional DOT-IV transport theory code with cross sections generated by CEPAK was used to determine the rack k_{eff} and the three-dimensional Monte Carlo code KENO IV with the AMPX system for cross section generation was used to determine the reactivity penalty associated with the assumed Boraflex gap distributions. These codes are widely used in the nuclear industry and have been benchmarked against experimental data and have been found to adequately reproduce the critical values. In addition, the CEPAK-DOT methodology has been shown to produce k_{eff} values which are in good agreement with the values produced by the AMPX-KENO methodology over a variation of boron poison loadings ranging from critical experiments to the actual Calvert Cliffs spent fuel rack. The intercomparison between different analytical methods is an acceptable technique for validating calculational methods for nuclear criticality safety. The staff, therefore, finds the use of these codes acceptable.

The analysis for the Unit 2 racks assumed fuel assemblies with an enrichment of 4.30 w/o U-235 and produced a nominal k_{eff} of 0.92308. Uncertainties and penalties due to temperature, cell pitch, wall thickness, and Boraflex gaps, as well as a calculational uncertainty and methodology bias resulted in a final k_{eff} of 0.93494. Over the relatively small enrichment range of interest, the licensee has determined a derivative of enrichment with Δk_{eff} of 0.1464 w/o enrichment per % Δk_{eff}. Therefore, the maximum allowable enrichment which maintains k_{eff} no greater than 0.95 is:

$$4.30 + (0.95 - 0.93494) * 100 * 0.1464 = 4.52 \text{ w/o.}$$

Since the only calculational difference between the rack design for Unit 1 and Unit 2 is the penalty associated with the Boraflex gapping for the Unit 2 racks, the use of the lower calculated enrichment limit for the Unit 2 racks for the entire pool is bounding and acceptable. Therefore, the staff has

determined that the proposed enrichment limit of 4.52 w/o U-235 is acceptable for the Calvert Cliffs spent fuel pool.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Maryland State official was notified of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (57 FR 45075). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: L. Kopp

Date: December 22, 1992