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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 170 TO FACILITY OPERATING LICENSE NO. DPR-53

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1

DOCKET NO. 50-317

1.0 INTRODUCTION

By letter dated December 10, 1991, as supplemented April 17, 1992, the Baltimore Gas and Electric Company (the licensee) submitted a request for changes to the Calvert Cliffs Nuclear Power Plant, Unit No. 1, Technical Specifications (TS). The requested changes would amend the TS to support Cycle 11 operation, which is the second 24-month cycle for Unit 1. The proposed TS changes involve those needed because of variations between the current cycle, Cycle 10, and the upcoming cycle, Cycle 11. The Unit 2, Cycle 9, design is the reference design for Unit 1, Cycle 11, because of the similar basic system characteristics of the two reload cores which are 24-month cycles using low leakage fuel management.

The April 17, 1992, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination. Cycle 10 operation of Unit 1 was extended subsequent to the initial submittal and the reload analysis required updating due to increased fuel burnup. The licensee indicated that there was no impact on the safety, setpoint, and performance analysis as a result of the additional fuel burnup.

2.0 EVALUATION

2.1 Reload Description

The Cycle 11 core consists of 217 fuel assemblies, which are eighty-four fresh Batch N assemblies, 132 presently operating Batch L and M assemblies, and one reinserted Batch K* assembly which was discharged at the end of Unit 1, Cycle 9. The 84 fresh assemblies consist of 12 unshimmed Batch N assemblies, 20 4-shimmed (B_4C) Batch NX assemblies, and 52 8-shimmed (B_4C) Batch N fuel assemblies which contain an assembly average enrichment of 4.20 Wt% U-235. Four of the irradiated Batch M assemblies are the Advanced Nuclear Fuel (ANF) demonstration assemblies containing gadolinium-bearing fuel pins which were installed in Cycle 10 to qualify ANF fuel for 24-month Cycle operation. The fuel management for Cycle 11 will be similar to that employed for the reference cycle, Unit 2 Cycle 9, and for Unit 1 Cycle 10 with two modifications which are: (1) fresh fuel on the periphery near the critical weld is being replaced with twice burned fuel; and (2) Guide Tube Flux

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Suppressors (GTFS) are being placed in selected guide tubes near the periphery.

The Cycle 11 core loading pattern is 90° rotationally symmetric. That is, if one quadrant of the core were rotated 90° into its neighboring quadrant, each assembly would be aligned with a similar assembly. This similarity includes batch Type, numbers of fuel rods, initial enrichment, burnup and GTFS placement.

The Cycle 11 fuel management pattern will accommodate Cycle 10 termination burnups from 17,500 MWD/T to 21,500 MWD/T. The end of Cycle 11 core average exposure is approximately 34,500 MWD/T and the average discharge exposure is approximately 43,050 MWD/T.

2.2 Fuel Design

The mechanical design of each assembly in the Batch N reload fuel is similar to that of the Batch L fuel previously inserted in Calvert Cliffs Unit 2 Cycle 9 with the two following exceptions:

(1) The Batch N assemblies use the new GUARDIAN design of debris-resistant feature. The design entails new grid and fuel pin designs in place of the small flow hole debris resistant feature in the Unit 2 Cycle 9 Batch L fuel. The GUARDIAN design has a redesigned Inconel spacer grid assembly that improves lower grid assembly's capability to entrap debris and redesigned rods that have long, solid Zircaloy-4 end caps to absorb any wear induced by the debris trapped within the Inconel spacer grid assembly. The rods are secured by a detent spring feature that holds the rods in place but permits reconstitution, if necessary. Specific design features are described in Reference 1.

(2) The Zircaloy spacer grids used for Batch N are longer than those used previously. They were redesigned to allow the fuel rods located along the periphery of the fuel bundle to receive more coolant flow when in contact with adjacent bundles. This change was accomplished by increasing the size of the outer pin cell through enlargement of the outside envelope of the spacer grid assembly.

The licensee has reviewed all fuel to be loaded in Cycle 11 to ensure that adequate shoulder gap clearance exists. The review took into consideration the mechanical fuel design changes due to the use of the GUARDIAN debris resistant feature. All clearances were found to be acceptable for Cycle 11 operation by the licensee using the approved SIGREEP models (Ref. 3).

During the Unit 1 Cycle 10 to Cycle 11 outage, the center Control Element Assembly (CEA) will be replaced with a newly-designed CEA. This new design will correct the swelling problem experienced during Unit 1 Cycle 10 operation by replacing the Zircaloy plug on the bottom of the CEA with a stainless steel slug, which eliminates the potential for hydriding of the zirconium to cause the swelling. This new CEA is identical in design to the replacement CEA loaded into Unit 2 for Cycle 9.

Neutron flux suppressors, called GTFS, will be installed in the fuel assemblies at selected core locations to help reduce the fluence at the critical vessel weld. The basic design of the GTFS is identical to that of control rod fingers.

The above design changes represent minor improvements which do not affect the fuel mechanical design basis. The staff, therefore, finds these changes acceptable.

The licensee has evaluated the thermal performance of the fuel in Cycle 11 using the approved FATES3B fuel evaluation model in conjunction with the maximum pressure methodology (No-Clad-Lift-Off). The analysis included the reduction in internal pin volume in the fresh Batch N fuel due to the introduction of the GUARDIAN design. The burnup range analyzed was in excess of that expected for Cycle 11. The maximum fuel pin internal pressure was verified to remain below the No-Clad-Lift-Off critical pressures. Because the result of this analysis satisfies Standard Review Plan (SRP) Section 4.2 criteria, the thermal design of the Cycle 11 Core is acceptable.

2.3 Nuclear Design

The Cycle 11 core will use a low-fluence pattern along with GTFS. This arrangement of fuel and GTFS results in a very low fluence to the critical pressure vessel weld. As a result of this shift in power and fluence away from the periphery, there are slightly higher power levels in the interior of the core

The fresh Batch N fuel is comprised of the three sets of assemblies, all using non-poison fuel pins of just one enrichment with each set containing a unique number of B_4C shims per assembly. The unique number of shims per assembly was chosen to minimize radial power peaking and to control BOC MTCs.

Hot full power (HFP) fuel assembly relative power densities are presented for beginning-of-cycle (BOC), middle-of-cycle (MOC), and end-of-cycle (EOC) unrodded configurations. Radial Power distributions at BOC and EOC are also provided with control element assembly (CEA) Bank 5, the lead regulating bank, fully inserted. These distributions assume the high burnup end of the Cycle 10 shutdown window and this assumption increases the radial power peaking in the Cycle 11 core. The distributions were calculated with approved methods. In addition, the safety and setpoint analyses for the DNB and linear heat rate conservatively include uncertainties and other allowances so that the power peaking values used are higher than those expected at any time in Cycle 11.

The Moderator Temperature Coefficient (MTC) for HFP equilibrium xenon conditions is predicted to be $-0.04X10^{-4}$ delta rho/°F at BOC. In response to concern about positive MTC effects on the generic anticipated transients without scram (ATWS) assumption, BG&E has stated that it will design reload cores with full power MTCs less than 0.0 until the generic ATWS implications are adequately addressed in the future. The Unit 1 Cycle 11 reload core design continues to meet that commitment.

Control Element Assembly worths and shutdown margin requirements for Unit 1 Cycle 11 are most limiting at EOC. The assessed shutdown margin requirements for Cycle 11 are based on the results of the EOC hot zero power (HZP), steam line break event. After consideration of all reactivity uncertainties and bias, a worst case assessment for Cycle 11 results in a shutdown margin at EOC of 4.5% delta rho. A reanalysis of this event concluded that sufficient shutdown margin is available to accommodate the reactivity effects of the steam line break event, at the worst time in core life, while allowing for the most reactive CEA stuck in the fully withdrawn position.

The methods to determine the new bias and uncertainty pertaining to scram worth/shutdown margin calculations are described in CEPD-266-P-A and CEPD-275-P-A, which were generically approved by the NRC. Several method improvements have been implemented for Unit 1 Cycle 11. These improvements included the use of anisotropic scattering within pin cells and anisotropic neutron currents at pin cell interfaces in the DIT code, and the application of the Nodal Expansion Method (NEM) in the ROCS code. In preparation for the transition to the improved methodology, CE performed an extensive reevaluation of the entire set of biases and uncertainties using the same statistical methodology which had been approved in the ROCS/DIT Topical Report. The licensee addressed in Reference 2 the staff's concern on a reduced total allowance of 7% due to the effect of the new bias and uncertainty values pertaining to scram worth/shutdown margin calculations. The staff has reviewed the licensee's response and found the new methodologies and the associated biases and uncertainties to be acceptable for application to Calvert Cliffs Unit 1 since approved methods were used for the analyses.

2.4 Thermal-Hydraulic Design

Steady-state Departure from Nucleate Boiling Ratio (DNBR) analyses of Cycle 11 at rated level of 2700 MWt have been performed using approved core thermal-hydraulic codes. The cycle specific models used for designing Cycle 11 account for the flow reduction caused by the GUARDIAN design. Hot channel factors and calculational factors were combined statistically with other uncertainty factors using the approved Extended Statistical Combination of Uncertainties (ESCU) methodology and it was determined that the Cycle 11 Core will operate within the DNBR limit of 1.15.

The effects of fuel rod bowing on the departure from nucleate boiling (DNB) margin for Cycle 11 have been evaluated using approved methods. There is a 0.006 DNBR rod bow penalty included in ESCU uncertainty allowance to account for the adverse effects of rod bowing on CHF for 14X14 fuel with burnup not exceeding 45 GWD/T. For higher burnup rods (greater than 45,000 MWD/T) the lower power peaking provides sufficient margin to offset rod bowing increases.

Based on the result of the analyses stated above, we have found the thermal-hydraulic design is acceptable since the approved methods are used.

2.5 Transient and Accident Analysis

All the non-LOCA transient safety analysis for Unit 1 Cycle 11 are bounded by previously presented and approved analyses. All key transient input parameters of Cycle 11 non-LOCA analyses, including consideration of the GUARDIAN design, are equal or conservative with respect to the reference cycle values (Unit 2 Cycle 9), with one exception. The shutdown margin at the end of Cycle decreased from 5.0% delta rho to 4.5% delta rho due to the low fluence fuel loading. The change in shutdown margin impacts return to power following a steam line break event. The result of a reanalysis performed with the revised shutdown margin indicates a lower peak power would be reached during a return to power following a steam line break. Thus, the reference Cycle is more conservative and bounds the steam line break.

An ECCS performance analysis (large and small break LOCA) using approved methods was done for Unit 1 Cycle 11 to demonstrate compliance with 10 CFR 50.46. In addition to the normal differences in fuel related parameters, the differences between Cycle 11 and the reference cycle, were: (1) use of the GUARDIAN design for the Batch N fuel assemblies, and (2) the assumption of 500 plugged steam generator tubes (small break LOCA analysis only). These two changes required reanalyses of the hydraulic portion of both analyses. The results of the reanalysis show that: (1) the peak cladding temperature (PCT) is 2014 °F for the limiting LBLOCA and 1991 °F for the limiting SBLOCA as compared to the acceptance criterion value of 2200 °F; and (2) the maximum local and core wide cladding oxidation percentages are 4.65% and 0.51%, respectively, for the limiting LBLOCA and 7.19% and 0.875%, respectively, for the limiting SBLOCA as compared to the criterion value of 17% and 1%, respectively. These results are in conformance with the acceptance criteria of 10 CFR 50.46. We have reviewed the analysis and found it acceptable since the approved methodologies were used.

3.0 TECHNICAL SPECIFICATION CHANGES

The proposed Technical Specification changes involves: those changes which have already been implemented in the Unit 2 Technical Specifications, the changes which are associated with the removal of the special exemption granted for Cycle 10 that permits continued operation should the center CEA become inoperable, and two new changes.

The following are the proposed TS changes:

1. Figure 2.2.1

   The negative Axial Shape Index (ASI) side is modified to accommodate the increased core average linear heat generation rate (CALHGR) of Unit 1

Cycle 11 because of the increased number of B_4C shims.

2. Technical Specification 3...3.1.f and Figure 3.1-3

   The maximum allowed premisaligned total integrated radial peaking factor (F_r^T) is increased from 1.65 to 1.70 to accommodate the increased neutron flux peaking associated with this 24-month cycle for Unit 1. Also, this TS reflects the use of the CECOR 3.3/BASSS computer codes.

3. Figure 3.2-3b

   The acceptable value region is reduced due to a reduction in the 100% power total planar radial peaking factor F_{xy}^T value from 1.54 to 1.50. This reduction is needed to accommodate the increased core average linear heat generation rate.

4. Specification 3.2.2.1, Surveillance Requirements 4.2.2.1.2., 4.2.2.1.3, 4.2.2.1.4, 4.2.2.2.2, 4.2.2.2.3, 4.2.2.2.4., 4.2.3.2, 4.2.3.3, 4.2.3.4, and 4.2.5.3 and Basis 3/4.1.3.

   These changes reflect the use of the CECOR 3.3/BASSS computer codes as the on-line incore LCO monitoring system.

5. Specification 3.2.3 and Figure 3.2-3c

   The F_r^T is increased from 1.65 to 1.70 to accommodate the increased neutron flux peaking associated with this 24-month cycle for Unit 1 and implementation of the CECOR 3.3/BASSS on-line incore monitoring system.

6. Specification 3.2.5.d and Table 3.2-1

   The terminology "core power" is changed to "thermal power" to maintain consistency with other Technical Specifications.

7. Basis 3/4.7 1.2.

   The maximum allowed Auxiliary flow is increased from 1300 gpm to 1550 gpm which is bound by previously reported and approved analyses.

8. Specification 5.3

   The maximum enrichment for a reload core is increased from 4.1 to 4.35 weight percent U-235 because of the higher enriched fuel being used in the Unit 1 Cycle 11 reload core.

9. Figure 3.1-1b

   The scram worth available at the end of this cycle is shown to accommodate the reduced shutdown margin which is due principally to the low-fluence fuel management used in this cycle.

10. Figure 3.2-1

   Specific cycle times in Effective Full Power D· s are eliminated and replaced by Time in Cycle because a constant ⲁlowable Peak Linear Heat R·te is used throughout the cycle.

11. Specifications 3.1.3.1, 3.1.3.3, 3.1.3.4, 3.1.3.6, 3.10.1, 3.2.2.1, and 3.2.3, Surveillance Requirements 4.1.1.1.1, 4.1.1.2, 4.1.3.1.1, 4.1.3.1.2, 4.1.3.1.3, 4.1.3.3.1, 4.1.3.3.2, 4.1.3.4, 4.1.3.5, 4.1.3.6, 4.10.1.1, 4.10.1.2, ·.2.1.3, 4.2.2.1.3, 4.2.? 2.3 and 4.2.3.3.

   The replacement of the center CEA on Unit 1 eliminates the need for the footnote "Excluding the center CEA during Cycle 10."

Items 1 through 8 are those changes which have already been implemented in the Unit 2, Item 11 is the changes associated with removing the CEA exclusion and Items 9 and 10 a· two new changes. Based on the details above and the staff's evaluation included in Section 2 of this safety evaluation, we have determined the proposed TS are acceptable.

4.0 <u>SUMMARY</u>

The staff has reviewed the licensee's submittal to support Cycle 11 operation and the proposed TS changes for the Calvert Cliffs Unit 1. The staff concludes that the Cycle 11 operation and proposed TS changes are acceptable.

5.0 <u>STATE CONSULTATION</u>

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

6.0 <u>ENVIRONMENTAL CONSIDERATION</u>

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes to surveillance requirements. The NRC staff has determined that the amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding

(56 FR 2587). Accordingly, the amendment meets 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 amendment.

7.0 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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor:
T. Huang

Date: May 26, 1992

May 26, 1992

Docket No. 50-317

Mr. G. C. Creel
Vice President - Nuclear Energy
Baltimore Gas and Electric Company
alvert Cliffs Nuclear Power Plant
MD Rts. 2 & 4
P. O. Box 1535
Lusby, Maryland 20657

Dear Mr. Creel:

SUBJECT: ISSUANCE OF AMENDMENT FOR CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 1 (TAC NO. M82277)

The Commission has issued the enclosed Amendment No. 170 to Facility Operating License No. DPR-53 for the Calvert Cliffs Nuclear Power Plant, Unit No. 1. This amendment consists of changes to the Technical Specifications (TS) in response to your application transmitted by letter dated December 10, 1991, and supplemented on April 17, 1992.

The amendment revises the Unit 1 TS to support Cycle 11 operation.

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. 170 to DPR-53
2. Safety Evaluation

cc w/enclosures:
See next page

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May 26, 1992

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Vice President - Nuclear Energy
Baltimore Gas and Electric Company
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