UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 185 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 September 3, 1993, as supplemented February 1, 1994, 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 (TSs). The requested changes would revise the heatup and cooldown curves and the low-temperature overpressure protection (LTOP) controls for Calvert Cliffs, Unit 1, to support modifications to the LTOP system that are scheduled for the spring 1994 refueling outage. The current design utilizes administrative controls and hardware to protect the 10 CFR Part 50, Appendix G, pressure temperature (P-T) limits from an LTOP event for reactor pressure vessel irradiation (accumulated neutron fluence) up to 22 effective full-power years (EFPY). The February 1, 1994, letter provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

The proposed heatup and cooldown curves and rates are based on projected fluence with no reference to the corresponding EFPY due to the fact that vessel embrittlement calculations are actually based on fluence and not EFPY. Therefore, it is more appropriate to base the heatup and cooldown curves on fluence.

To evaluate the P-T limits, the NRC staff uses the following NRC regulations and guidance: Appendices G and H of 10 CFR Part 50; Generic Letter (GL) 88-11; Regulatory Guide (RG) 1.99, Revision 2; and Standard Review Plan (SRP) Section 5.3.2.

Appendix G to 10 CFR Part 50 requires that "...when the core is not critical pressure-temperature limits for the reactor vessel must be at least as conservative as those obtained by following the methods of analysis and the required margins of safety of Appendix G of the ASME Code..." Appendix G also imposes requirements on the minimum temperature for criticality, the closure head flange, and hydrostatic pressure tests or leak tests.

Appendix H of 10 CFR Part 50 requires licensees to establish a surveillance program to monitor embrittlement of reactor vessel materials. The program includes capsules that contain test specimens made from plate, weld, and heat-affected-zone (HAZ) materials of the reactor beltline. Appendix H refers to

the American Society for Testing and Materials Standards which, in turn, require that the capsules be installed in the vessel before startup and be removed from the reactor vessel periodically for testing. The test results may be used in calculating P-T limits.

GL 88-11 indicates that licensees may use the methods in RG 1.99, Revision 2, to predict the embrittlement effect of neutron irradiation on reactor vessel materials. The embrittlement effect is defined in terms of adjusted reference temperatures (ART), which is the sum of unirradiated reference temperature, the increase in reference temperature resulting from neutron irradiation, and a margin to account for uncertainties in the unirradiated reference temperature, copper (Cu) and nickel (Ni) contents, fluence, and the calculational procedures.

SRP 5.3.2 describes a calculation of the P-T limit curves based on the principles of linear elastic fracture mechanics. SRP 5.3.2 calculation follows the methodology specified in Appendix G to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III.

In relation to the LTOP controls, the current LTOP system utilizes two pressurizer power operated relief valves (PORVs). When the LTOP system is enabled, each of the two PORVs is set to open at a reduced pressure. The present configuration of the minimum pressure and temperature (MPT) Enable temperature circuitry (with the single setpoint PORV), combined with the reactor coolant pump (RCP) operating curves, gives a small operating window with a "knee" at the MPT Enable temperature. The MPT Enable temperature is the reactor coolant system (RCS) temperature below which the LTOP controls are required to be in place to protect the Appendix G limits. In addition, the current LTOP system does not allow the use of one RCP in each coolant loop which could be used for recovery from certain postulated accidents.

A variable-setpoint low temperature overpressure protection (VLTOP) system will be installed to increase the allowable operating pressure band in the LTOP region and to increase flexibility in the use of RCPs. The VLTOP system uses a variable PORV setpoint to take advantage of increased Appendix G pressure limits at increased RCS temperatures. The new system will allow operators to cooldown to shutdown cooling (SDC) conditions while running one RCP in each loop. This system will significantly increase the operating window in the LTOP region.

2.0 EVALUATION

2.1 Appendix G Heatup and Cooldown Curves and Rates

The licensee determined that intermediate shell axial weld, 2-203 A, B, and C, was the limiting material. The chemistry for weld 2-203 used in the licensee's calculation was 0.21% Cu and 0.88% Ni. The licensee used a margin of 56 °F and an initial RT_{NDT} of -50 °F. The licensee calculated the limiting ARTs of 241.4 °F at the 1/4T location and 181 °F at the 3/4T location based on Position C.1 of RG 1.99.

The NRC staff has identified the same material, weld 2-203 A, B, and C, as limiting. The NRC staff verified that the Cu content, Ni content, initial RT_{ndt}, and margin used for weld 2-203 in the licensee's calculation are acceptable. Based on the above data and a neutron fluence of 2.61E19 n/cm^2 on the inside surface of the reactor, the NRC staff calculated the same ARTs as the licensee.

Based on SRP 5.3.2, the NRC staff verified that the proposed P-T limits for heatup, cooldown, criticality, and inservice hydrostatic test meet the requirements in Paragraphs IV.A.2 and IV.A.3 of Appendix G of 10 CFR Part 50.

In addition to beltline materials, Appendix G of 10 CFR Part 50, also imposes a minimum temperature at the closure head flange based on the reference temperature for the flange material. Section IV.A.2 of Appendix G states that when the pressure exceeds 20 percent of the preservice system hydrostatic test pressure, the temperature of the closure flange regions highly stressed by the bolt preload must exceed the reference temperature of the material in those regions by at least 120 °F for normal operation and by 90 °F for hydrostatic pressure tests and leak tests. Based on the flange reference temperature of 10 °F, the NRC staff has determined that the proposed P-T limits have satisfied the requirement for the closure flange region during normal operation, hydrostatic pressure test and leak test.

The licensee has removed surveillance capsules 97° and 263° from Calvert Cliffs Unit 1 and has performed the required tests. The NRC staff has determined that the surveillance program has satisfied Appendix H to 10 CFR Part 50.

The NRC staff performed an independent analysis of the P-T limits to verify the licensee's proposed limits. The NRC staff has determined that the proposed P-T limits for heatup, cooldown, inservice hydrostatic test, and criticality are valid for neutron fluences equal or less than 2.61E19 n/cm^2, because the limits conform to the requirements of Appendix G of 10 CFR Part 50 and GL 88-11. Hence, the proposed P-T limits may be incorporated in the Calvert Cliffs Unit 1 TSs.

2.2 Fast Neutron Flux

The proposed heatup and cooldown curves and rates are based on the projected 10 CFR 50.61 limit on the fluence for the critical elements with no reference to corresponding EFPY. For the Unit 1 pressure vessel, the critical elements are the intermediate shell axial welds 2-203 A, B, and C, as noted above. Their estimated fluence value is 2.61×10^{19} n/cm^2. This value was estimated using the methods, approximations, and cross sections described in the 97° surveillance capsule report. The method is based on the discrete ordinates DOT-IV code using an S_8 geometrical quadrature approximation and a P_3 cross section scattering approximation. The nuclear cross sections were from the CASK set which is ENDF/B-IV based; and, the effective dosimeter reaction cross sections were based on the ENDF/B-V. The source distribution was computed

using the Asea Brown Boves-Combustion Engineering (ABB-CE), ROCS/DIT/MC codes. DOT-IV has been benchmarked by ABB-CE. The above methodology, the cross sections and the approximations used, are in accordance with above mentioned NRC staff recommendations and, therefore, are acceptable.

2.3 Technical Specification Changes

As noted, the proposed TSs are based on projected fluence with no reference to EFPY. The reason for this change is that the licensee is planning further fast neutron leakage reduction in future cycles, thus, an estimate of the EFPY required to reach the limiting fluence is not feasible. We find that the change in the titles of Figures 3.4.9-1, 2, and 3 and in the Bases of TS 3/4.4 are essentially editorial changes, and therefore, are acceptable.

The changes involving the heatup and cooldowns curves and rates in TSs 3.4.9.1.a and 3.4.9.1.b, and the RCS P-T limits in Figures 3.4.9.1 and 3.4.9.2, provide the necessary protection for the Appendix G P-T limits as previously discussed in this evaluation and are, therefore, acceptable.

Additional TS changes are proposed to account for the revised heatup and cooldown rates and support a VLTOP system. Specifically, TSs 3.4.9.3.a.1 and 3.4.9.3.a.2 change the pressure limit and the footnote to Figure 3.4.9-3*, TSs 3.1.2.1, and 3.1.2.3. Table 3.3-3, TSs 3.4.1.2, 3.4.1.3, 3.4.9.3, 4.5.2, 3.5.3, Bases 3/4.4.1, Bases 3/4.4.9 and Bases 3/4.5.2 change the minimum Enable temperature from 355 °F to 365 °F. TS 3.5.3 and Table 3.3-3 change the higher Enable temperature when the high-pressure safety injection (HPSI) pumps are placed under manual control on cooldown (and return to automatic on heatup) from 355 °F - 375 °F to 365 °F - 385 °F, TS 3.4.9.3 Bases 3/4.4.9 and Bases 3/4.5.2 change the maximum allowable HPSI pump flow from 200 gpm to 210 gpm. Bases 3/4.4.1 coolant loop and coolant circulation, Bases 3/4.4.9 P-T limits and Bases 3/4.5.2 emergency core cooling system subsystems were changed to be consistent with the above.

These proposed changes are consistent with the revised heatup and cooldown rates and RCS P-T limits which assure that the Appendix G P-T limits are met and are, therefore, acceptable.

3.0 STATE CONSULTATION

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.

4.0 ENVIRONMENTAL CONSIDERATION

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 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 (58 FR 50963). 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.

5.0 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.

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