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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 131 TO FACILITY OPERATING LICENSE NO. DPR-69

BALTIMORE GAS AND ELECTRIC COMPANY

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 2

DOCKET NO. 50-318

1.0 INTRODUCTION

By letter dated October 22, 1990, the Baltimore Gas and Electric Company (the licensee) proposed to amend the Technical Specifications of the Calvert Cliffs Nuclear Power Plant, Unit 2. In its submittal, the licensee provided Technical Specification changes to support 10 CFR Part 50, Appendix G, heatup and cooldown Pressure/Temperature (P/T) limits applicable to the Unit 2 reactor vessel for a period up to 12 effective full power years (EFPY).

The proposed P/T limits were developed based on Regulatory Guide (RG) 1.99, Revision 2. The proposed revision provides up-to-date P/T limits for the operation of the reactor coolant system (RCS) during heatup, cooldown, criticality, and inservice hydrostatic testing. In addition, the proposed changes included revised heatup and cooldown rates, a change in the Power Operated Relief Valve (PORV) pressure setpoint for Low Temperature Overpressure Protection (LTOP), a change in the LTOP enable temperature, a modification to Reactor Coolant Pump (RCP) controls when in LTOP conditions, a modification to High Pressure Safety Injection (HPSI) pump controls when in LTOP conditions, and changes to the Bases for the affected Limiting Conditions for Operation (LCOs) to reflect the proposed changes.

To evaluate the P/T limits and supporting changes, the staff used the following NRC regulations and guidance: Appendices G and H to 10 CFR Part 50; the American Society of Testing Materials (ASTM) Standards and the American Society of Mechnical Engineers (ASME) Code, which are referenced in Appendices G and H; 10 CFR 50.36(c)(2); RG 1.99, Revision 2; Standard Review Plan (SRP) Sections 5.2.2 and 5.3.2; and Generic Letter 88-11.

Each licensee authorized to operate a nuclear power reactor is required by 10 CFR 50.36 to provide Technical Specifications for the operation of the plant. In particular, 10 CFR 50.36(c)(2) requires that limiting conditions of operation be included in the Technical Specifications. The P/T limits are among the limiting conditions of operation in the Technical Specifications for all commercial nuclear plants in the United States. Appendices G and H of 10 CFR Part 50 describe specific requirements for fracture toughness and reactor vessel material surveillance that must be considered in setting P/T limits. An acceptable method for constructing the P/T limits is described in SRP Section 5.3.2.

Appendix G of 10 CFR Part 50 specifies fracture toughness and tesing requirements of reactor vessel materials in accordance with the ASME Code and, in particular, that the beltline materials in the surveillance capsules be tested in accordance with Appendix H of 10 CFR Part 50. Appendix H, in turn, refers to ASTM Standards. These tests define the extent of vessel embrittlement at the time of capsule withdrawal in terms of the increase in reference temperature. Appendix G also requires the licensee to predict the effects of neutron irradiation on vessel embrittlement by calculating the adjusted reference temperature (ART) and Charpy upper shelf energy (USE). Generic Letter 88-11 requested that licensees and permittees use the methods in RG 1.99, Revision 2, to predict the effect of neutron irradiation on reactor vessel materials. This guide defines the ART as the sum of unirradiated reference temperature, the increase in reference temperature resulting from neutron irradiation, and a margin to account for uncertainties in the prediction method.

Appendix H of 10 CFR Part 50 requires that the licensee establish a surveillance program to periodically withdraw surveillance capsules from the reactor vessel. Appendix H refers to the ASTM Standards which, in turn, require that the capsules be installed in the vessel before initial plant startup and that they contain test specimens made from plate, weld, and heat-affected-zone (HAZ) materials of the reactor beltline.

LTOP is provided by the PORVs on the pressurizer. These PORVs are set at a pressure low enough to prevent violation of the 10 CFR Part 50, Appendix G, P/T limits during heatup and cooldown should a RCS pressure transient occur during low temperature operations. The potential for overpressurization of the RCS can be minimized by a combination of administrative procedures and operator actions. However, because operator action cannot always be assumed, and because possible equipment malfunctions must be considered, additional controls must be in place to ensure adequate protection exists for all postulated events.

The two major concerns for LTOP protection are the mass addition and energy addition transients. The proposed amendment provides restrictions on the use of HPSI pumps to provide protection for mass addition transients. Restrictions are also imposed on the starting and use of the RCPs to provide protection for energy addition transients.

The revised Regulatory Guide 1.99 results in more restrictive P/T limits To meet the revised requirements a new LTOP pressure setpoint and new heatup and cooldown rates are proposed. These new values are such as to ensure that (1) given a limiting mass or energy input to the RCS during normal operation, anticipated operational occurrences, and hydrostatic testing; the Appendix G pressure-temperature limits are not challenged, and (2) operational flexibility is maintained.

2.0 EVALUATION - APPENDIX G-HEATUP AND COOLDOWN P/T LIMITS

The staff evaluated the effect of neutron irradiation embrittlement on each beltline material in the Calvert Cliffs 2 reactor vessel. The amount of irradiation embrittlement was calculated in accordance with RG 1.99, Revision 2. The staff has determined that the material with the highest ART at 12 EFPY was the intermediate shell longitudinal welds 2-203A, B, and C with 0.12% copper (Cu), 1.01% nickel (Ni), and an initial RT_{ndt} of -56°F.

The licensee has removed one surveillance capsule from Calvert Cliffs 2. The results from capsule 263 were published in Southwest Research Institute Report SWRI-7524. The surveillance capsule contained Charpy impact specimens and tensile specimens made from base metal, weld metal, and HAZ metal.

For the limiting beltline materials, intermediate shell longitudinal weld 2-203A, B, and C, the staff calculated the ART to be 170.8°F at 1/4T (T = reactor vessel beltline thickness) and 124.8°F for 3/4T at 12 EFPY. The staff used a neutron fluence of 1.007E19 n/cm^2 at 1/4T and 3.58E18 n/cm^2 at 3/4T. The ART was determined by the Section 1 of RG 1.99, Revision 2, because only one surveillance capsule has been removed from the Calvert Cliffs 2 reactor vessel.

The licensee used the method in RG 1.99, Revision 2, to calculate an ART of 171°F at 12 EFPY at 1/4T for the same limiting weld metal. The staff judges that the licensee's ART 171°F is more conservative than the staff's ART of 170.8°F, and it is acceptable. Substituting the ART of 170.8°F into equations in SRP 5.3.2, the staff verified that the proposed P/T limits for heatup, cooldown, and hydrotest meet the beltline material requirements in Appendix G of 10 CFR Part 50.

In additio [illegible] ne materials, Appendix G of 10 CFR Part 50 also imposes P/T limits [illegible] the reference temperature for the reactor vessel closure flange ma [illegible] Section IV.2 of Appendix G states that when the pressure exceeds 2 [illegible] preservice system hydrostatic test pressure, the temperature [illegible] 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 30°F, the staff has determined that the proposed P/T limits satisfy Section IV.2 of Appendix G.

Section IV.B of Appendix G requires that the predicted Charpy USE at end of life be above 50 ft-lb. The intermediate shell plate D8906-1 (Heat No. C-4483-1) has the lowest (limiting) unirradiated USE of 76.7 ft-lb among all beltline materials. Using an end of life peak fluence of 2.72E19 n/cm^2 at 1/4T, the staff calculated an USE of 53.7 ft-lb for plate D8906-1 at end of life. This is above the 50 ft-lb requirement, and is acceptable.

The staff has determined that the proposed P/T limits for the reactor coolant system for heatup, cooldown, inservice hydrostatic test, leak test, and criticality are valid through 12 EFPY because the limits conform to the requirements of Appendices G and H of 10 CFR Part 50. The licensee's submittal also satisfies Generic Letter 88-11 because the licensee used the method in RG 1.99, Revision 2, to calculate the ART. Hence, the proposed P/T limits may be incorporated into the Calvert Cliffs 2 Technical Specifications.

3.0 EVALUATION - LTOP CONTROLS

The PORV lift setpoint is estimated at 430.0 psia to protect the most restrictive pressure of 471.2 psia which corresponds to a rate of 15°F/hr at 70°F in the RCS. The difference in the setting and the protect pressure is due to instrumentation uncertainty and PORV response time allowances. The LTOP enable temperature is 305°F and was estimated using the Standard Review Plan 5.2.2, Revision 2, for heatup rates to 75°F/hr. Based on the conservative assumptions and approved methods used, the PORV lift setpoint and the LTOP enable temperature are acceptable.

3.1 HPSI Pump Controls

Overpressurization events due to mass addition, in their most limiting case include: HPSI pump flow, charging pump flow and the coolant expansion due to loss of decay heat removal. The only controllable component in this case is the HPSI flow. Thus, the maximum PORV flow determines the HPSI flow after the charging pump and the expansion equivalent have been subtracted and the instrumentation uncertainty been accounted. In this manner a total flow limit of 380 gpm yields an HPSI indicated flow of 210 gpm to ensure an Appendix G pressure limit of 471.2 psia in the pressurizer. The HPSI flow rate was then compared to the requirements of other design basis events. The most limiting such event is the loss of shutdown cooling which requires an actual flow rate of 175 gpm to prevent core uncovering. The proposed flow of 210 gpm meets this limiting design requirement and is, therefore, acceptable.

3.2 RCP Controls

RCP start is the primary concern for the limiting energy addition LTOP transient. In this case we assume RCP start with: letdown isolation, energy addition from two RCPs, energy addition from the pressurizer heaters, and loss of decay heat removal. Mitigation of such transients is provided by the initial pressurizer pressure, pressurizer level, and the steam generator primary -to-secondary change in temperature (delta-T). For two RCPs starting assuming; an initial pressurizer level of 170 inches, a steam generator delta-T of 30°F, initial pressurizer pressure of 300 psia, decay heat at a level of 2 hours after shutdown, and no operator action, the pressurizer insurge peak pressure will be below the PORV setting, thus within the Appendix G acceptance criteria and is acceptable.

3.4 PORV Response Time

The PORV response time is part of the estimated assumptions for the Appendix G limits. For Unit 2 this response time has not been directly measured but assumed to be the same as for Unit 1. The justification for this assumption is that the designs are identical. For Unit 1 the maximum total response time is 0.49 seconds based on confirmatory analysis and testing. The licensee's confirmatory test results are consistent with results of similar tests performed by other utilities and with bench tests performed by EPRI. Based on the results of the Unit 1 tests and the other industry tests, the response time assumed for Unit 2 PORVs is acceptable.

4.0 TECHNICAL SPECIFICATION CHANGES

The licensee provided updated P/T curves in the proposed Technical Specification Figures 3.4-2b and 3.4-2c for heatup and cooldown, respectively. Technical Specification 3.4.9.1.a provides a new heatup rate of 75°F/hr for all temperatures. Technical Specification 3.4.9.1.b provides new cooldown rates as follows:

100°f/hr	for T_{ave}	greater than 180°F
40°F/hr	for T_{ave}	between 180°F and 140°F
15°F/hr	for T_{ave}	less than 140°F

The Action Statements for Technical Specifications 3.4.9.1 and 3.4.9.2 are changed to reflect the proposed cooldown rates. The Bases for Technical Specification 3/4.4.9 have been changed to reflect the revisions in the heatup and cooldown rates. Technical Specification 3.4.9.3 proposes to lower the PORV lift setting to less than 430 psia, and require system vents equivalent to the PORVs for RCS temperatures less than 305°F (for system testing). In addition, two of the three HPSI pumps will be disabled and the HPSI loop motor operated valves be prevented from aligning pump flow to the RCS for RCS temperatures less than 305°F. For one HPSI pump operable, the total flow will be throttled to 210 gpm. The above are not applicable if a system vent greater than 8 square inches exist. The current action times are 7 days to restore a PORV to "Operable" status or must be vented (depressurized) within 8 hours. This is changed to 5 days to restore the PORV to operable and 48 hours to vent. The total time is still the same (7 days) but the venting time is increased for ease of operation. Surveillance requirements are added to verify system operability conditions. The Technical Specification 3.4.9.3 Bases have also been changed to reflect the proposed set of conditions.

Several Technical Specifications have been changed to reflect the new requirements on the HPSI pumps. A footnote is added to Technical Specifications 3.1.2.1 and 3.1.2.3 which defines an "operable" HPSI pump. A footnote is added to Technical Specification 3.5.3 which states that a maximum of one HPSI pump shall be operable when the RCS temperature is less or equal to 305°F. A footnote is added to the surveillance requirements of Technical Specification 4.5.2 allowing full flow testing of a HPSI pump. A footnote is also added to Table 3.3-3 providing information on HPSI pump operation. The Technical Specification 3.5.3 Bases have also been changed to reflect the new requirements on the operation of the HPSI pumps.

The following changes reflect the new restrictions on the RCP operation. A footnote to Technical Specification 3.4.1.3 is changed to require that an RCP not be started if the RCS temperature is less (or equal) to 305°F unless; (1) the pressurizer level is less or equal to 170 inches, (2) the primary to secondary steam generator delta-T is less than or equal to 30°F, and (3) the pressurizer pressure is less than or equal to 320 psia. A footnote is added to Technical Specification 3.4.1.2 to provide RCP start control consistent with that of 3.4.1.3. Finally, the bases of 3/4.4.1 and 3/4.4.9 are changed to reflect the new requirements.

5.0 SUMMARY

The proposed P/T limits for the RCS for heatup, cooldown, inservice hydrostatic testing, and criticality are valid through 12 EFPY because the limits conform to the requirements of Appendices G and H of 10 CFR Part 50. The P/T limits also satisfy Generic Letter 88-11 because the licensee used the methods in RG 1.99, Revision 2, to calculate the ART. Conservative assumptions and approved methodology were used for the LTOP analyses. The analyses defined the HPSI pump and RCP control limitations. We found these proposed revisions acceptable. In addition, Technical Specification changes were defined which correctly reflect the new limitations and restrictions.

The staff has concluded, based on the above and details provided in Sections 2, 3, and 4, that the proposed Technical Specifications and Bases supporting the new 12 EFPY P/T limits and LTOP controls are acceptable.

6.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change to a requirement with respect to the installation or use of the facilities' components located within the restricted areas as defined in 10 CFR Part 20 and to a surveillance requirement. The staff has determined that this 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 this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this 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 this amendment.

7.0 CONCLUSION

We have 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; and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: December 18, 1990

PRINCIPAL CONTRIBUTORS:

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A copy of the related Safety Evaluation is enclosed, Notice of Issuance will be included in the Commission's next regular bi-weekly 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. 131 to DPR-69
2. Safety Evaluation

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