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Vice President
Nuclear Energy

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
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BGE

November 4, 1998

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Response to Request for Additional Information for the Review of the Calvert Cliffs Nuclear Power Plant, Units 1 & 2, Time-Limited Aging Analyses

REFERENCES:

(a) Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated April 8, 1998, "Application for License Renewal"

(b) Letter from Mr. D. L. Solorio (NRC) to Mr. C. H. Cruse (BGE), September 2, 1998, "Request for Additional Information for the Review of the Calvert Cliffs Nuclear Power Plant, Units 1 & 2, Time-Limited Aging Analyses"

Reference (a) forwarded Baltimore Gas and Electric Company's application for license renewal. Reference (b) forwarded questions from NRC staff on Section 2.1 of Reference (a), Time-Limited Aging Analyses. Attachment (1) provides our responses to the questions contained in Reference (b).

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

Very truly yours,

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I, Charles H. Cruse, being duly sworn, state that I am Vice President, Nuclear Energy Division, Baltimore Gas and Electric Company (BGE), and that I am duly authorized to execute and file this response on behalf of BGE. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other BGE employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 4 day of November, 1998.

WITNESS my Hand and Notarial Seal:

Michelle D. Hall
Notary Public

My Commission Expires:

February 1, 2002
Date

CHC/KRE/dim

Attachment: (1) Response to Request for Additional Information, Time-Limited Aging Analyses

cc: R. S. Fleishman, Esquire
J. E. Silberg, Esquire
S. S. Bajwa, NRC
A. W. Dromerick, NRC
H. J. Miller, NRC
C. I. Grimes, NRC
D. L. Solorio, NRC
Resident Inspector, NRC
R. I. McLean, DNR
J. H. Walter, PSC

ATTACHMENT (1)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION; TIME-LIMITED AGING ANALYSES

Baltimore Gas and Electric Company
Calvert Cliffs Nuclear Power Plant
November 4, 1998

NRC Question No. 2.1.1

Baltimore Gas and Electric Company (BGE) did not identify the following as time-limited aging analyses (TLAAs) for the Calvert Cliffs units (*in BGE's License Renewal Application [LRA]*):

- Upper-shelf energy of reactor vessel materials;
- Reactor vessel surveillance program;
- Metal fatigue (thermal cycles) of Class 2 and 3 components (other than main steam piping);
- Metal corrosion allowance;
- Inservice flaw growth;
- Inservice local metal containment corrosion;
- High-energy pipe break postulation;
- Underclad cracking of reactor vessel;
- Reactor vessel internals (such as flow-induced vibration, transient cycle counts, and reduction of fracture toughness);
- Fatigue of reactor coolant pump flywheel; and
- Fatigue of polar crane.

For each of these analyses, please discuss whether it is applicable to the Calvert Cliffs units and the basis if it is not applicable. For each of those analyses that is applicable, discuss whether it meets the definition of a TLAA in 10 CFR 54.3(a) and the basis if it is not a TLAA.

BGE Response

Identification and processing of TLAAs for the BGE LRA is covered in part 2.0 of Section 2.0 of the BGE LRA, the Calvert Cliffs Nuclear Power Plant (CCNPP) Integrated Plant Assessment Methodology. The Methodology provided for a systematic search of the current licensing basis to identify calculations or analyses meeting the definition of a TLAA. The listed topics did not qualify as TLAAs per the definition provided in 10 CFR 54.3. While the issues listed may be applicable in some fashion to CCNPP, either no calculations or analyses were discovered, or one or more of the criteria in the definition of a TLAA were not met.

- Upper-shelf energy of reactor vessel materials — No calculations or analyses meeting the definition of a TLAA were identified that specifically applied to upper-shelf energy. References to upper-shelf energy are contained in some of the documents evaluated for the Irradiation Embrittlement TLAAs discussed in Section 2.1.3.2 of the LRA
- Reactor vessel surveillance program — No calculations or analyses meeting the definition of a TLAA were identified that specifically applied to the reactor vessel surveillance program. References to the reactor vessel surveillance program are contained in some of the documents evaluated for the Irradiation Embrittlement TLAAs discussed in Section 2.1.3.2 of the LRA.
- Metal fatigue (thermal cycles) of Class 2 and 3 components (other than main steam piping) — No calculations or analyses meeting the definition of a TLAA were identified for this issue. Fatigue as a TLAA is discussed in Section 2.1.3.3 of the LRA. The design for Class 2 and 3 components for CCNPP used a fatigue stress reduction factor of 1.0, which corresponds to an assumption of

7000 cycles over plant life. This limit is much higher than the specified cycles, based on plant evolutions/transients, for Class 1 components, and is not expected to be reached during the period of extended operation. In other words, the 7000-cycle limit may be considered to be valid throughout the period of extended operation.

- Metal corrosion allowance — No calculations or analyses meeting the definition of a TLAA were identified for this issue.
- Inservice flaw growth — No calculations or analyses meeting the definition of a TLAA were identified for this issue.
- Inservice local metal containment corrosion — It is not clear whether this item refers to metal containments or to metal liners for concrete containments. If this question refers to metal containments, it is not applicable to Calvert Cliffs. If it refers to containment liners, it is applicable, but no calculations or analyses meeting the definition of a TLAA were identified for this issue. A TLAA relating to the thermal cycling of the containment liner is discussed in Section 2.1.3.5 of the LRA.
- High-energy pipe break postulation — The CCNPP high-energy line break analysis is described in Appendix 10A of the Updated Final Safety Analysis Report. No part of this analysis meeting the definition of a TLAA was identified.
- Underclad cracking of reactor vessel — CCNPP has no experience with this mechanism; therefore, no calculations or analyses meeting the definition of a TLAA were identified relating to this issue.
- Reactor vessel internals:
  - Flow induced vibration — No calculations or analyses meeting the definition of a TLAA were identified for this issue.
  - Transient cycle counts — No calculations or analyses meeting the definition of a TLAA were identified for this issue as it specifically relates to reactor vessel internals. Fatigue as a TLAA is discussed in Section 2.1.3.3 of the LRA.
  - Reduction of fracture toughness — No calculations or analyses meeting the definition of a TLAA were identified for this issue as it specifically relates to reactor vessel internals. The generic issue of fracture toughness reduction is covered under the topic of Irradiation Embrittlement TLAAs as discussed in Section 2.1.3.2 of the LRA.
- Fatigue of reactor coolant pump flywheel — No calculations or analyses meeting the definition of a TLAA were identified for this issue. Calvert Cliffs' Updated Final Safety Analysis Report Section 4.1.3.3.1 discusses an evaluation of crack-induced failure of the reactor coolant pump flywheel, but the postulated cracks are not assumed to propagate in any time-dependent fashion.
- Fatigue of polar crane — No calculations or analyses meeting the definition of a TLAA were identified for this issue.

NRC Question No. 2.1.2

Did BGE perform an analysis for the Calvert Cliffs units to address crud build-up in the reactor core that may result in increased core pressure drop beyond an acceptable range? If yes, discuss whether that analysis meets the definition of a TLAA in 10 CFR 54.3(a).

BGE Response

Baltimore Gas and Electric Company performed core physics analyses in 1979 and 1980 to determine the cause of Unit 1 power distribution anomalies. The anomalies were accompanied by an increase in the core pressure drop and were determined to be caused by crud buildup in the reactor core caused by oxygen ingress to the RCS. We also evaluated alternatives for chemically removing the crud. The causes of the event and BGE corrective action are discussed in the operating experience portion of Section 4.1, "Reactor Coolant System", page 4.1-8, of the LRA.

None of the analyses associated with the crud buildup on the reactor core (fuel clad) is considered a TLAA because they did not involve time-limited assumptions defined by the current operating term. In other words, the analyses are not relied on to permit extended operation with continued abnormal buildup of crud on the core through a period approaching 40 years. Fuel assemblies are considered short-lived components since no individual fuel assembly will remain in the core for more than a few years; any accumulated crud would be removed from the core with the discharged fuel assemblies.

NRC Question No. 2.1.3

Page 2.1-4 of the LRA indicates that the pressure-temperature (P-T) limits in the Calvert Cliffs Technical Specifications are valid for Units 1 and 2 for 48 and 30 effective full power years, respectively. Section 4.2 of Appendix A to the BGE application indicates that the Unit 2 reactor vessel is less susceptible to neutron embrittlement. Discuss why the P-T limits for Unit 2 are valid for a shorter time period than for Unit 1. Also, discuss whether the existing P-T limits "[i]nvolve time-limited assumptions defined by the current operating term, for example, 40 years." [Criterion 3 of the definition of TLAA in 10 CFR 54.3(a).]

BGE Response

Question No. 2.1.3 states that Section 4.2 of the BGE LRA indicates that the Unit 2 reactor vessel is less susceptible to neutron embrittlement. Section 4.2 specifically states that certain welds in Unit 1 are more sensitive to neutron exposure than was originally expected because of the amount of impurities (copper) in the reactor pressure vessel axial weld. This greater susceptibility to neutron embrittlement is primarily a concern regarding meeting limits for pressurized thermal shock. Despite the greater susceptibility to neutron embrittlement of the Unit 1 welds, both CCNPP Units' beltline material is projected to be below pressurized thermal shock screening criteria 20 years after the original 40-year operating license.

Page 2.1-4 of BGE's LRA indicates that the P-T limits in the Calvert Cliffs Technical Specifications are valid for Units 1 and 2 for 48 and 30 effective full power years, respectively. The greater susceptibility of the welds in Unit 1 to neutron exposure, as described above, is not a dominant effect for these limits. The respective time periods are not, therefore, reflective of a difference in susceptibility to neutron embrittlement, but are merely a matter of convenience. It is common practice to calculate P-T limits separately for individual reactors, considering different operating chronologies and flux histories. Also, limits may be expressed for an interval shorter than the 40-year original license period (or a 60-year term to include a period of extended operation) to allow operational flexibility. For these reasons, the current P-T limits for CCNPP Unit 2 are valid for a shorter period than for those of Unit 1.

The existing P-T limits involve time-limited assumptions; however, for the reasons discussed above, these assumptions are not presently defined by the current operating term. Nevertheless, the P-T limits are considered part of the Irradiation Embrittlement TLAA..

NRC Question No. 2.1.4

10 CFR 54.21(c) requires an evaluation of TLAAs as part of the contents of an LRA. However, Section 2.1 of Appendix A to the BGE application contains future commitments to perform the TLAA evaluations. The following are examples:

Subsection	Heading	Statement
2.1.3.2	Irradiation Embrittlement	". . . will continue to be updated . . ."
2.1.3.5	Containment Liner Plate Fatigue Analysis	"This review . . . will be projected . . . by the year 2012."
2.1.3.6	Containment Tendons Prestress Loss	". . . recalculated by the year 2012 . . ."
2.1.3.7	Poison Sheets in Spent Fuel Pool	"This analysis is currently being updated . . ."

In accordance with 10 CFR 54.21(c)(1)(iii), describe how BGE will ensure that the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

BGE Response

For the four TLAAs identified in this request for additional information, BGE has chosen to demonstrate that . . . "the analyses have been projected to the end of the period of extended operation" in accordance with 10 CFR 54.21(c)(1)(ii), rather than choosing to demonstrate that . . . "the effects of aging will be adequately managed for the period of extended operation" in accordance with 10 CFR 54.21(c)(1)(iii). Future commitments to finalize the evaluation of TLAAs are permissible. 10 CFR 54.29(a) provides that a renewed license may be issued if "Actions have been identified and have been or will be taken with respect to . . . time-limited aging analyses that have been identified to require review under 54.21(c)." These analyses will be updated in a timely manner as indicated or as needed to continue plant operation. The commitments will be managed in accordance with CCNPP's formal process for managing commitments, which currently involves procedures RM-1-103, "Commitment Management," and QL-2-102, "Action Item Subsystem."