June 14, 2001

Mr. Charles H. Cruse
Vice President - Nuclear Energy
Calvert Cliffs Nuclear Power Plant, Inc.
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2, RELIEF REQUEST (TAC NOS. MB0557 AND MB0558)

Dear Mr. Cruse:

By letter dated November 17, 2000, Calvert Cliffs Nuclear Power Plant, Inc. (CCNPPI) submitted a request to install Mechanical Nozzle Seal Assemblies (MNSAs) at CCNPPI. CCNPPI also submitted attachments to the letter that provided details regarding the design and testing of the MNSAs. During its review, the Nuclear Regulatory Commission (NRC) staff has determined that additional information is necessary to complete its review. Enclosed is the NRC staff's request for additional information. This request was discussed with your staff on June 7, 2001, and it was agreed that your response would be provided 45 days from the date of this letter.

Sincerely,

/RA/
Robert Clark, Project Manager, Section 1
Project Directorate 1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

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

MECHANICAL NOZZLE SEAL ASSEMBLY INSTALLATION

The Nuclear Regulatory Commission (NRC) staff is currently reviewing the attachments to Reference 1, related to the design and testing of ASEA Brown Bovery/Combustion Engineering (ABB/CE) (now Westinghouse - CE Nuclear Power, LLC) Mechanical Nozzle Seal Assemblies (MNSAs). To complete its review, the staff is requesting the following additional information regarding various aspects of these designs.

1.0 Hydrostatic and Thermal Testing.

1.1 The hex head bolts attaching the pressurizer nozzle seal assembly to the fixture, as shown in Reference 2, are of unequal length. However, all bolts were torqued to produce the same axial pre-load. Explain the measures taken to ensure that the assembly was properly aligned with the axis of the nozzle, since the elongations of the bolts do not appear to have been the same.

1.2 Reference 3 states that additional thermal test cycles are not considered necessary since the MNSA components are designed to go “metal-to-metal,” confining the graphite seal in a fixed volume, and that thermal cycling does not “work” the seal, and, therefore, the MNSA design is not sensitive to thermal cycling effects.

a. Provide a description, including a diagram, of what is meant by “metal-to-metal.”

b. Provide test data or analysis to support the assertion that “thermal cycling does not work the seal” by showing that the graphite seal experiences zero thermal expansion or contraction under varying thermal conditions.

1.3 Provide justification why one hot leg seal assembly test and one pressurizer head seal assembly test represent an adequate sample to show MNSA structural integrity under operating conditions.

1.4 Tests, ranging over years, of flexible graphite gaskets under high temperature conditions have been reported in the open literature (e. g., References 4 and 5). Clarify how the thermal cycling tests reported in Reference 2 provide a basis for extrapolating to two cycles of operation, measured in years, of as-installed MNSAs under transient operating conditions such as those found in the RCS.

2.0 MNSA Analysis

The MNSAs are characterized by simplified models consisting of linear-elastic uni-axial springs representing the MNSA metal member stiffnesses. References 7 and 8 provided detailed ABB/CE analyses of MNSA devices fastened to the hot leg and the

ENCLOSURE

pressurizer. The NRC staff has identified the following concerns that should be addressed in regard to these analyses:

2.1 The loads and stresses in the MNSAs are calculated by excluding the Grafoil gasket from the models. Reference 9 indicates that the Grafoil material is highly compressible. Provide calculations of the loads and stresses in the MNSAs that include the non-linear load-deflection properties of the Grafoil (per Reference 9), and show that the results, as shown in References 7 and 8, bound the more refined analyses with the Grafoil gaskets.

2.2 The analyses did not consider the compression of the gasket due to pre-loading of the hex head bolts.

a. Provide the basis for this assumption.

b. Provide an estimate of the compressed gasket thickness.

c. Provide an evaluation of the effect of gasket compression on the hex head bolt stiffnesses, since significant compression of the gasket could change the as-installed bolt lengths.

2.3 The friction forces acting on the sleeves or nozzles in the MNSA analyses depend on the radial stress (compressive) resulting from the axial compression of the gasket. In the calculation of the friction forces, the radial stress is assumed to be the same as the maximum pressure determined in the hydrostatic test (Reference 2). Provide the basis for this assumption.

2.4 For the upper and bottom pressurizer nozzle MNSA analyzed in Reference 8.2, show that this MNSA remains qualified to the ASME Section III Class 1 1989 stress criteria, if the analysis is based on the following considerations:

a. The net ejection force is determined by considering the friction force based on the compressed gasket thickness.

b. The equivalent stiffness used for calculating the impact forces is based on the equivalent stiffness of the full MNSA, including the stiffness of the Grafoil gasket.

c. The MNSA model is represented by an asymmetric geometry with the actual length hex head bolts, without the assumptions regarding hex head bolt length and compression collar length.

2.5 The thermal stresses in the hex head bolts are determined by assuming that only the bolts take up the thermal expansion. Another assumption is that the length of these bolts is the same as the combined length of the collar and the thickness of the flange. For the MNSAs mounted on the pressurizer top and bottom heads, where pairs of hex head bolts may be of significantly different length, show that the thermal stresses in the hex head bolts is bounded by the current calculation, and that the preload is not lost in the longer bolts as a result of thermal expansion.

2.6 The stress calculations of the hex head bolts do not include an evaluation of bending stresses due to the rotation of the upper flange. Provide verification that these stresses are not significant.

2.7 The MNSA assembly drawings (References 10-13) require the Grafoil gasket to have a final density of 90 lb/ft³. Provide information showing how this requirement will be met.

2.8 The design bolt stresses for the hex head bolts per ASME Section III, NB-3231 and Appendix E, as required by ASME Section XI, IWB-7320, used a value of "m" of 1.3 to calculate the compression load to ensure a tight joint. Reference 9 identifies this value as "m"=2.0, obtained from the same source. Provide an explanation of this inconsistency.

2.9 The stress calculations of clamp components, such as the compression collars, did not include shear stresses due to differential thermal expansion. Provide justification showing these stresses meet the design shear allowable.

2.10 For the MNSAs installed on the pressurizer heads, the hex head bolts are not of equal length. Since the preload forces in all four bolts are the same, the elongations of the bolts are different. The MNSAs may therefore be installed in a tilted condition and the gasket also may not be uniformly compressed, as assumed in the calculation. Describe measures taken to assure that the MNSAs are installed co-axially with the nozzles and heater sleeves.

3.0 <u>REFERENCES</u>

1. Letter of November 17, 2000, from C. H. Cruse, CN, to the NRC Document Control Desk, with Enclosures.

2. Enclosure (9) to Reference 1. Proprietary Vendor Report TR-PENG-042, "Test Report of MNSA Hydrostatic and Thermal Tests," dated July 1997.

3. Enclosure (4) to Reference 1. Proprietary Calculation No. CA04893, Rev. 0, "Design Evaluation of MNSA for Various Applications at Calvert Cliffs Units 1 and 2," dated November 17, 2000.

4. Derenne, M., et. al., "Elevated Temperature Characterization of Flexible Graphite Sheet Materials for Bolted Flanged Joints", WRC Bulletin 419, February 1997.

5. Hahn, R., et. al., "Long-term Behavior of Graphite-Based Gaskets at Elevated Temperature," PVP-Vol. 382, Analysis of Bolted Joints, 1999.

6. Enclosure (12) to Reference 1. BGE Design Specification No. SP-0846, Rev. 01, "Mechanical Nozzle Seal Device," dated November 17, 2000.

7. Enclosure (12) to Reference 1. Proprietary ABB Design Report No. B-PENG-DR-005, Rev. 01, "Addendum to CENC-1179 Analytical Report for BGE CCNPP Units 1 and 2 - Piping," November 17, 2000, with the following proprietary attachments:

7.1 Attachment A, “Analysis of BG&E Units I and II Hot Leg RTD Nozzle MNSA.”

7.2 Attachment B, “Analysis of BG&E Units I and II Hot Leg PDT/Sampling Nozzle MNSA.”

7.3 Attachment D, “Calculation No. A-CCNPP-9449-1230, Rev. 00, Evaluation of Attachment Locations for MNRA Devices on BG&E CCNPP Units I and II Hot Leg Piping RTD and PDT/Sampling Instrument Nozzles.”

8. Enclosure (13) to Reference 1. Proprietary ABB Design Report No. B-PENG-DR-006, Rev. 02, “Addendum to CENC-1179 Analytical Report for BGE CCNPP Units 1 and 2 - Pressurizers,” November 17, 2000, with the following proprietary attachments:

8.1 Attachment A, “Analysis of BG&E Units I and II Side Pressurizer RTD Nozzle MNSA.”

8.2 Attachment B, “Analysis of BG&E Units I and II Upper and Bottom Pressurizer Nozzle MNSA.”

8.3 Attachment D, “Calculation No. A-CCNPP-9449-1229, Rev. 01, Evaluation of Attachment Locations for MNRA Devices on BG&E CCNPP Units I and II Pressurizer Top Head, Shell and Bottom Head Instrument Nozzles and Heater Sleeves.”

8.4 Attachment F, “Analysis of BG&E Units I and II Heater Sleeve MNSA.”

9. Attachment 3 to Enclosure (1) to Reference 1: Raub, H. S., Optimum Gasketing with Grafoil Flexible Graphite. Union Carbide Corporation publication, undated.

10. Enclosure (14) to Reference 1. ABB Drawing No. E-MNSABGE-228-001, Rev. 02, “Hot Leg RTD MNSA.” November 17, 2000.

11. Enclosure (15) to Reference 1. ABB Drawing No. E-MNSABGE-228-002, Rev. 02, “Hot Leg PDT/sampling MNSA.” November 17, 2000.

12. Enclosure (18) to Reference 1. ABB Drawing No. E-MNSABGE-228-007, Rev. 02, “Bottom Pressurizer MNSA.” November 17, 2000.

13. Enclosure (21) to Reference 1. BGE Drawing No. 12019-0079, Rev. 0D, “Side Pressurizer RTD MNSA.” November 17, 2000.

14. Peterson, R. E., “Stress Concentration Factors,” John Wiley and Sons, 1974 Edition.