February 23, 2005

Mr. George Vanderheyden, Vice President
Calvert Cliffs Nuclear Power Plant, Inc.
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NO. 2 - CORRECTION TO NRC SAFETY EVALUATION FOR AMENDMENT NO. 246 (TAC NO. MC0935)

Dear Mr. Vanderheyden:

On January 27, 2005, the Nuclear Regulatory Commission (NRC) issued Amendment No. 246 to Renewed Facility Operating License No. DPR-69 for the Calvert Cliffs Nuclear Power Plant (CCNPP), Unit No. 2. The amendment modified Technical Specification (TS) 4.3.1, “Criticality,” added TS 3.7.16, “Spent Fuel Pool Boron Concentration,” and added TS 3.7.17, “Spent Fuel Pool Storage.” Specifically, the amendment increased the maximum enrichment limit of the fuel assemblies that can be stored in the Unit 2 spent fuel pool by taking credit for soluble boron, burnup, and configuration control in maintaining acceptable margins of subcriticality.

On February 3, 2005, the NRC issued a letter correcting several errors in the TS pages of Amendment No. 246. Subsequent to the issuance, Donna Mitchell of your staff pointed out a number of errors in the January 27, 2005, safety evaluation (SE). We agree that administrative errors had been inadvertently made. Enclosed please find corrected pages 4, 6, 8, and 9 of the SE, with side bars highlighting the areas of correction. Also the enclosed is table of contents, page v, for Amendment No. 246. The amendment number for CCNPP, Unit 1 was inadvertently listed as Amendment No. 267, in lieu of Amendment No. 269. We apologize if these errors caused you any inconvenience. If there are any questions regarding this matter, please contact me at (301) 415-1030.

Sincerely,

/RA/

Richard V. Guzman, Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-318

Enclosures: As stated

cc w/encls: See next page

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CCNPPI determined that a minimum boron concentration of 350 parts per million (ppm) with uncertainties is required to credit soluble boron and safely store 5.0 weight percent fuel in the SFP. The normal boron concentration maintained in the SFP is expected to be at least the same as that for the refueling boron TS, which is greater than 2150 ppm. However, CCNPPI conservatively chose an initial boron concentration of 2000 ppm for boron dilution event analysis. CCNPPI's proposed license amendment change includes the addition of TS 3.7.16 to provide sufficient negative reactivity to ensure acceptable levels of subcriticality for spent fuel storage, assuming a dilution event. TS 3.7.16 would require a SFP boron concentration greater than or equal to 2000 ppm, which supports the normal and accident conditions.

In the boron dilution event calculations, CCNPPI conservatively utilized a SFP net volume of 80,000 cubic feet up to the SFP overflow limit. This net volume equates to a SFP water inventory of 598,480 gallons and reflects the SFP gross volume minus volume displacements by structures in the SFP (e.g., racks for fuel assemblies). SFP water inventory at a height corresponding to the SFP low water level alarm limit (66 feet, 6 inches) is 590,920 gallons. The SFP net volume is a summation of the volumes for the two halves of the SFP associated with CCNPP Units 1 and 2, respectively.

The potential boron dilution sources include the two pretreated water storage tanks (500,000 gallons each), the two condensate storage tanks (314,800 gallons each), the demineralized water storage tank (350,000 gallons), the two refueling water tanks (420,000 gallons each), and three well water pumps and filters at 175 gpm each. Water for the fire protection system is supplied by two full-capacity 2500 gallons per minute (gpm) fire pumps, which take suction from the two 500,000 gallon capacity pretreated water storage tanks. Plant service water isolation valves are in low flow rate systems which take suction on the two 500,000 gallon pretreated water storage tanks. Demineralized water isolation valves are in low flow rate (150 gpm) systems which take suction on the 350,000 gallon demineralized water storage tank. Plant heating system valve is in a low flow rate system which takes suction on the two 500,000 gallon pretreated water storage tanks. The two SFP cooling pumps (1390 gpm) can supply 420,000 gallons of borated water from each refueling water tank.

Based on CCNPPI's boron dilution analysis, potential initiating events that could cause a dilution of the boron in the SFP to a level below that credited in the criticality analysis comprise three categories: i) dilution by flooding, ii) dilution by loss of coolant induced makeup, and iii) dilution by loss of cooling system induced makeup.

3.2.1 Flooding

Dilution by flooding includes the effects of natural phenomena, failure of the fire protection system, failure of the plant service isolation valves, misalignment of the demineralized water isolation valves, failure of the plant heating system valves, effects of the SFP cooling pumps, tank rupture in the vicinity of the SFP, breaks in the SFP cooling system piping or heat exchangers, and reactor coolant system failures.

The large volume of water necessary to dilute the SFP to the boron endpoint (350 ppm) precludes many small tanks as potential dilution sources. No tanks containing any significant amount of water are stored in the vicinity of the SFP. The large unborated water sources, such as reactor makeup water and demineralized water, are in tanks at elevations below the SFP, so gravity feed from these tanks to the SFP is not possible.

Corrected by letter dated 2/23/05

closure of the gate in the wall dividing the SFP into two halves). For this second example, approximately 2 hours would be required for the water level to reach the SFP overflow limit. Again, if no mitigative actions were taken, other alarms monitored in the control room, including an alarm due to flooding in the auxiliary building, would follow.

3.2.3 Loss of SFP Cooling

Dilution may also occur by loss of SFP cooling. Even though loss of SFP cooling is not part of the design basis because the SFPCS is Class III, the effect of this event has been analyzed. CCNPPI states that assuming that the Units 1 and 2 SFPs contain 1830 assemblies generating the maximum possible heat load of 37.6E06 BTU/hr (british thermal units-per-hour) and assuming the worst case initial SFP temperature of 155 EF, then the time to boil can be calculated as 7.34 hours. Time to core uncovery is calculated to be 78.9 hours. However, loss of coolant by boiling will not result in a loss of soluble boron, since the soluble boron is not volatile. Thus, CCNPPI concludes that loss of SFPC system without makeup water flow is not a mechanism for boron dilution. CCNPPI further states that if sufficient unborated water is added to the SFP to just keep the water from boiling and if the excess fluid flows down the auxiliary building gravity drains associated with the SFP overflow level, it would take 24.88 hours to dilute the SFP to 350 ppm. It is not credible that the dilution could occur for this length of time without operator notice, since this event would activate the high level alarm and initiate auxiliary building flooding. In addition, in excess of 1,043,000 gallons of demineralized water must be added to the SFP to reach 350 ppm soluble boron concentration. This is three times more water volume than is contained in the demineralized water tank.

The NRC staff concurs with CCNPPI's above rationale for evaluating potential boron dilution events associated with loss of SFP cooling.

CCNPPI states that SFP instrumentation available for detection of boron dilution include the following: radiation monitors and alarms, high level alarms, low level alarms, temperature alarms, and cooling system alarms. Additional instrumentation is provided to monitor the pressure and flow of the SFP cooling and cleanup system. CCNPPI further states that in addition, operating and administrative procedures are available for the detection and mitigation of dilution events. For example, plant operators shall make a complete round during each 12-hour shift, including the level indication in the SFP area. The plant operator also shall identify and contain all water leakage and look for damaged piping and instrument tubing, noting excessive vibration.

In summary, CCNPPI states that the potential initiating event that could cause dilution of the boron in the SFP to a level that is below that credited in the criticality analyses comprises three categories: i) dilution by flooding, ii) dilution by loss of coolant induced makeup, and iii) dilution by loss of cooling system induced makeup. CCNPPI concludes that it is not credible that dilution could occur for the required length of time without operator notice, since the initiating event would activate the high level alarm and initiate auxiliary building flooding. In addition, in excess of 1,043,000 gallons of unborated water must be added to the SFP to reach a soluble boron concentration of 350 ppm. This is more water volume that is contained in the demineralized water storage tank and both condensate storage tanks combined. Even in the unlikely event that the SFP is completely diluted of boron, the SFP will remain subcritical by a design margin of k_{eff} not to exceed 0.998.

k_{eff} was greater than the RCA value. The SAS2H generated reactivity was 0.358 percent more reactive than those adjusted to RCA isotopics. Using the uncertainty value of 0.02089 generated by SAS2H was more conservative and reflects the uncertainties associated with burnup calculations. The NRC staff finds using the uncertainty generated by SAS2H to be acceptable since it is the more conservative value.

The overall k_{eff} calculations included a reactivity bias to account for the reactivity difference between a fuel assembly with an explicit axial three-dimensional burnup profile and one with a uniform two-dimensional profile at the same average burnup. CCNPPI compared two-dimensional and three-dimensional modeling as a function of enrichment and soluble boron. The reactivity bias results indicated that the worst case reactivity bias was for the unborated highest enrichment and highest burnup fuel. Thus, all the calculations used a worst case bias of 0.0325 delta-k. CCNPPI generated actual Calvert Cliffs end-of-cycle 26-node burnups for a complete core's assemblies. Two-dimensional and three-dimensional models compared were at the highest enrichment value of 5.0 weight percent and at zero soluble boron. The reactivity bias results indicated that the worst-case reactivity bias was -0.00579 delta-k for the actual 26-node burnups. Use of the 26-node burnup profile for CCNPP Unit 2 specific fuel is less conservative than using the uniform axial burnup model. Therefore, the axial burnup bias of 0.0325 delta-k for the unborated highest enrichment and highest burnup fuel was used for all the burnup cases.

CCNPPI executed multiple cases to determine reactivity as a function of burnup, enrichment, and soluble boron concentration. Cases ran with zero soluble boron concentration and a specific burnup showed the reactivity values were less than 0.998. At 300 ppm soluble boron concentration and the same specified burnup, all of the reactivity values were less than 0.95, in accordance with 10 CFR 50.68, when crediting soluble boron. The burnup values were increased by a measured burnup uncertainty extracted from the Asea Brown Boveri, Inc./Combustion Engineering Inc. Methodology Manual for Physics Biases and Uncertainties for Asea Brown Boveri, Inc./Combustion Engineering, Inc. Fuel Assemblies. The burnups required to store fuel in the Unit 2 SFP crediting 350 ppm of soluble boron including all biases and uncertainties are detailed in Attachment 1 (ADAMS Accession No. ML033140581) of CCNPPI's application dated September 30, 2003, and in the proposed TS 3.7.17, Figure 3.7.17-1. The NRC staff found the burnup value listed with its corresponding enrichment to be acceptable since the SFP is maintained subcritical and the regulatory requirements continue to be met.

3.5 Configuration Control

Each assembly offloaded from either the reactor or from an independent spent fuel storage installation dry storage canister must be evaluated against the above burnup restrictions to determine if it can be safely stored in the CCNPP Unit 2 SFP. The analysis modeled several checkerboard fuel patterns to determine if more reactive fuel can be stored in the CCNPP Unit 2 SFP while meeting regulatory requirements. Of the several checkerboard patterns modeled in the CCNPP Unit 2 SFP, only one checkerboard pattern met 10 CFR 50.68 requirements. The pattern is described in Attachment 5 (ADAMS Accession No. ML033140581) of CCNPPI's application dated September 30, 2003. The analysis showed that a fuel assembly with insufficient burnup must be surrounded on all four adjacent faces by empty rack cells or other nonreactive materials for SFP storage to satisfy regulatory requirements. Additionally, CCNPPI has fuel handling procedures and controls in place to assure assemblies are not misplaced. The NRC staff finds the proposed TS 3.7.17 meets the requirements set forth in 10 CFR 50.68 and that the storage configuration proposed is acceptable.

3.6 Accident Analysis

The postulated accidents for the SFP are the following: 1) a dropped fuel assembly on top of the storage rack, 2) a misloading accident, 3) an abnormal location of a fuel assembly, and 4) loss of normal cooling to the SFP. CCNPPI analyzed these accidents and found there was no increase in the consequences of an accidental drop, accidental misloading, or abnormal placement of a maximum enriched fuel assembly into the SFP storage racks. The criticality analysis demonstrated that the pool will remain subcritical following one of these events. The TS limit of 2000 ppm for SFP boron concentration will assure that an adequate SFP boron concentration will be maintained in the case of an accident to prevent criticality in the CCNPP Unit 2 SFP. The potential initiating events that could cause boron dilution in the SFP to a level below that credited in the criticality analyses were analyzed and CCNPPI found the SFP will remain subcritical by a design margin of k_{eff} not to exceed 0.986. The NRC staff agrees that the design features, instrumentation, administrative procedures and the 24-hour time to dilute as described in the analysis provided in Attachment 6 (ADAMS Accession No. ML033140582) of CCNPPI's application dated September 30, 2003, are adequate to detect and mitigate boron dilution in the SFP before the boron concentration is reduced below 350 ppm and exceed the design basis criticality limit of 0.95 K_{eff}.

3.7 Conclusion

Based on our review of CCNPPI's rationale and evaluation, and the experience gained from our review of precedent LARs involving SFP boron dilution analysis, the NRC staff concludes that CCNPPI adequately identified the boron concentration necessary to (1) maintain K_{eff} less than 0.95, (2) verified subcriticality with unborated water as required by 10 CFR 50.68, (3) established a TS for boron dilution with a surveillance short enough to detect potential boron dilution, and (4) evaluated potential boron dilution scenarios to satisfy the NRC staff's guidelines established in the SE for WCAP-14416. Therefore, the NRC staff concludes that the boron dilution aspects of the proposed LAR are acceptable.

The NRC staff also reviewed the effects of the proposed change using the appropriate requirements of 10 CFR 50.68 and GDC 62. The NRC staff concludes that CCNPPI's amendment request provided reasonable assurance that under normal and accident conditions, CCNPPI would be able to safely operate the plant and comply with NRC regulatory requirements. Therefore, the NRC staff finds CCNPPI's amendment request acceptable.

4.0 <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.

5.0 <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 surveillance requirements. The NRC staff has determined that the amendment involves no