February 9, 2006

Mr. James A. Spina, 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 NOS. 1 AND 2 , REQUEST FOR ADDITIONAL INFORMATION RE: RESPONSE TO GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN-BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS" (TAC NOS. MC4672 AND MC4673)

Dear Mr. Spina:

On September 13, 2004, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," as part of the NRC's efforts to assess the likelihood that the emergency core cooling system (ECCS) and containment spray system (CSS) pumps at domestic pressurized water reactors (PWRs) would experience a debris-induced loss of net positive suction head margin during sump recirculation. The NRC issued this GL to all PWR licensees to request that addressees (1) perform a mechanistic evaluation using an NRC-approved methodology of the potential for the adverse effects of post-accident debris blockage and operation with debris-laden fluids to impede or prevent the recirculation functions of the ECCS and CSS following all postulated accidents for which the recirculation of these systems is required, and (2) implement any plant modifications that the above evaluation identifies as being necessary to ensure system functionality. Addressees were also required to submit information specified in GL 2004-02 to the NRC in accordance with Title 10 of the *Code of Federal Regulations* Section 50.54(f). Additionally, in the GL, the NRC established a schedule for the submittal of the written responses and the completion of any corrective actions identified while complying with the requests in the GL.

By letter dated March 3, 2005, as supplemented by letters dated July 15, August 30, and November 29, 2005, and February 3, 2006, Calvert Cliffs Nuclear Power Plant, Inc., provided a response to the GL. The NRC staff is reviewing and evaluating your response along with the responses from all PWR licensees. The NRC staff has determined that responses to the questions in the enclosure to this letter are necessary in order for the staff to complete its review. Please note that the Office of Nuclear Reactor Regulation's Division of Component Integrity is still conducting its initial reviews with respect to coatings. Although some initial coatings questions are included in the enclosure to this letter, the NRC might issue an additional request for information regarding coatings issues in the near future.

Please provide your response within 60 days from the date of this letter. If you have any questions, please contact me at (301) 415-1457.

Sincerely,

/RA/

Patrick D. Milano, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure:
Request for Additional Information

cc w/encl: See next page

Please provide your response within 60 days from the date of this letter. If you have any questions, please contact me at (301) 415-1457.

Sincerely,

/RA/

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Division of Operating Reactor Licensing
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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Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2

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GL 2004-02 RAI Questions

Plant Materials

1. Identify the name and bounding quantity of each insulation material generated by a large-break loss-of-coolant accident (LBLOCA). Include the amount of these materials transported to the containment pool. State any assumptions used to provide this response.

2. Identify the amounts (i.e., surface area) of the following materials that are:

   (a) submerged in the containment pool following a loss-of-coolant accident (LOCA),

   (b) in the containment spray zone following a LOCA:

   - aluminum
   - zinc (from galvanized steel and from inorganic zinc coatings)
   - copper
   - carbon steel not coated
   - uncoated concrete

   Compare the amounts of these materials in the submerged and spray zones at your plant relative to the scaled amounts of these materials used in the Nuclear Regulatory Commission (NRC) nuclear industry jointly-sponsored Integrated Chemical Effects Tests (ICET) (e.g., 5x the amount of uncoated carbon steel assumed for the ICETs).

3. Identify the amount (surface area) and material (e.g., aluminum) for any scaffolding stored in containment. Indicate the amount, if any, that would be submerged in the containment pool following a LOCA. Clarify if scaffolding material was included in the response to Question 2.

4. Provide the type and amount of any metallic paints or non-stainless steel insulation jacketing (not included in the response to Question 2) that would be either submerged or subjected to containment spray.

Containment Pool Chemistry

5. Provide the expected containment pool pH during the emergency core cooling system (ECCS) recirculation mission time following a LOCA at the beginning of the fuel cycle and at the end of the fuel cycle. Identify any key assumptions.

6. For the ICET environment that is the most similar to your plant conditions, compare the expected containment pool conditions to the ICET conditions for the following items: boron concentration, buffering agent concentration, and pH. Identify any other

significant differences between the ICET environment and the expected plant-specific environment.

7. (Not Applicable).

Plant-Specific Chemical Effects

8. Discuss your overall strategy to evaluate potential chemical effects including demonstrating that, with chemical effects considered, there is sufficient net positive suction head (NPSH) margin available during the ECCS mission time. Provide an estimated date with milestones for the completion of all chemical effects evaluations.

9. Identify, if applicable, any plans to remove certain materials from the containment building and/or to make a change from the existing chemicals that buffer containment pool pH following a LOCA.

10. If bench-top testing is being used to inform plant specific head loss testing, indicate how the bench-top test parameters (e.g., buffering agent concentrations, pH, materials, etc.) compare to your plant conditions. Describe your plans for addressing uncertainties related to head loss from chemical effects including, but not limited to, use of chemical surrogates, scaling of sample size and test durations. Discuss how it will be determined that allowances made for chemical effects are conservative.

Plant Environment Specific

11. Provide a detailed description of any testing that has been or will be performed as part of a plant-specific chemical effects assessment. Identify the vendor, if applicable, that will be performing the testing. Identify the environment (e.g., borated water at pH 9, deionized water, tap water) and test temperature for any plant-specific head loss or transport tests. Discuss how any differences between these test environments and your plant containment pool conditions could affect the behavior of chemical surrogates. Discuss the criteria that will be used to demonstrate that chemical surrogates produced for testing (e.g., head loss, flume) behave in a similar manner physically and chemically as in the ICET environment and plant containment pool environment.

12. For your plant-specific environment, provide the maximum projected head loss resulting from chemical effects (a) within the first day following a LOCA, and (b) during the entire ECCS recirculation mission time. If the response to this question will be based on testing that is either planned or in progress, provide an estimated date for providing this information to the NRC.

ICET 1 and ICET 5 Plants

13. (Not Applicable).

Trisodium Phosphate (TSP) Plants

14. Given the results from the ICET #3 tests (Agencywide Document Access and Management System (ADAMS) Accession No. ML053040533) and NRC-sponsored head loss tests (Information Notice 2005-26 and Supplement 1), estimate the concentration of dissolved calcium that would exist in your containment pool from all containment sources (e.g., concrete and materials such as calcium silicate, Marinite™, mineral wool, kaylo) following a LBLOCA and discuss any ramifications related to the evaluation of chemical effects and downstream effects.

15. (Not Applicable).

16. Given an active strainer design, discuss your evaluation of potential downstream effects resulting from chemical products that pass through the active strainer into the ECCS system.

Additional Chemical Effects Questions

17. (Not Applicable).

18. (Not Applicable).

19. (Not Applicable).

20. (Not Applicable).

21. (Not Applicable).

22. (Not Applicable).

23. (Not Applicable).

24. (Not Applicable).

Coatings

<u>Generic - All Plants</u>

25. Describe how your coatings assessment was used to identify degraded qualified/acceptable coatings and determine the amount of debris that will result from these coatings. This should include how the assessment technique(s) demonstrates that qualified/acceptable coatings remain in compliance with plant licensing requirements for design-basis accident (DBA) performance. If current examination techniques cannot demonstrate the coatings' ability to meet plant licensing requirements for DBA performance, licensees should describe an augmented testing and inspection program that provides assurance that the qualified/acceptable coatings continue to meet DBA performance requirements. Alternately, assume all containment coatings fail and describe the potential for this debris to transport to the sump.

Plant Specific

26. (Not Applicable).

27. (Not Applicable).

28. (Not Applicable).

29. (Not Applicable).

30. (Not Applicable).

31. Your submittal indicated that you had taken samples for latent debris in your containment, but did not provide any details regarding the number, type, and location of samples. Please provide these details.

32. Your submittal did not provide details regarding the characterization of latent debris found in your containment as outlined in the NRC SE. Please provide these details.

33. How will your containment cleanliness and foreign material exclusion (FME) programs assure that latent debris in containment will be controlled and monitored to be maintained below the amounts and characterization assumed in the ECCS strainer design? In particular, what is planned for areas/components that are normally inaccessible or not normally cleaned (containment crane rails, cable trays, main steam/feedwater piping, tops of steam generators, etc.)?

34. You indicated that you would be evaluating downstream effects in accordance with WCAP 16406-P. The NRC is currently involved in discussions with the Westinghouse Owner's Group (WOG) to address questions/concerns regarding this WCAP on a generic basis, and some of these discussions may resolve issues related to your particular station. The following issues have the potential for generic resolution; however, if a generic resolution cannot be obtained, plant-specific resolution will be required. As such, formal RAIs will not be issued on these topics at this time, but may be needed in the future. It is expected that your final evaluation response will specifically address those portions of the WCAP used, their applicability, and exceptions taken to the WCAP. For your information, topics under ongoing discussion include:

    ee. Wear rates of pump-wetted materials and the effect of wear on component operation
    ff. Settling of debris in low flow areas downstream of the strainer or credit for filtering leading to a change in fluid composition
    gg. Volume of debris injected into the reactor vessel and core region
    hh. Debris types and properties
    ii. Contribution of in-vessel velocity profile to the formation of a debris bed or clog
    jj. Fluid and metal component temperature impact
    kk. Gravitational and temperature gradients
    ll. Debris and boron precipitation effects
    mm. ECCS injection paths

nn. Core bypass design features
oo. Radiation and chemical considerations
pp. Debris adhesion to solid surfaces
qq. Thermodynamic properties of coolant

35. Your response to GL 2004-02 question (d)(viii) indicated that an active strainer design will not be used, but does not mention any consideration of any other active approaches (i.e., backflushing). Was an active approach considered as a potential strategy or backup for addressing any issues?

36. No information was provided by the licensee other than to state that the Nuclear Energy Institute (NEI) and SE methodologies were applied. The licensee states that analyses are only being performed for Unit 1, and that the Unit 2 design will be based on Unit 1 analyses. Please provide a discussion of the technical methods to be applied to demonstrate that this is an acceptable approach and that the Unit 2 design is adequate.

37. The licensee did not provide information on the details of the break selection, ZOI and debris characteristics evaluations other than to state that the NEI and SE methodologies were applied. Please provide a description of the methodology applied in these evaluations and include a discussion of the technical justification for deviations from the SE-approved methodology.

38. How much passive strainer area will be available to complement the active strainer? Describe the passive portion of the strainer. Also, describe whether/how this area was, or will be, credited during plant-specific testing.

39. Is it possible for large pieces of insulation or other large pieces of latent or foreign material debris to be transported to the active strainers (e.g., via blowdown from the break, sheeting flows that might occur during the initial phase of an accident, or floatation)? If so, are the active strainers protected from large pieces of debris, for example, with trash racks or other interceptors? If protection does not exist, then to what extent are the strainers capable of withstanding large pieces of debris, and to what extent has this capability been demonstrated by testing?

40. What is the minimum submergence depth for the active strainers? Describe the testing and analysis that has been performed to demonstrate that high concentrations of debris and/or large pieces of debris at the strainer surface would not prevent the entry of water into the strainer under shallow submergence conditions.

41. Please explain the assumptions and derivation supporting the analysis of the maximum concentration of debris that will arrive at the active strainer, and justify that the analyzed maximum concentration is conservative. How much margin exists between the analyzed maximum concentration and the estimated point of failure of the active strainer?

42. How much margin (i.e., water volume) is available between the maximum containment water level and the level at which the active strainer motors would become flooded?

43. Are there any vents or other penetrations through the active or passive strainer control surfaces which connect the volume internal to the strainer to the containment atmosphere above the containment minimum water level? In this case, dependent upon the containment pool height and strainer and sump geometries, the presence of the vent line or penetration could prevent a water seal over the entire strainer surface from ever forming; or else this seal could be lost once the head loss across the debris bed exceeds a certain criterion, such as the submergence depth of the vent line or penetration. According to Appendix A to Regulatory Guide 1.82, Revision 3, without a water seal across the entire strainer surface, the strainer should not be considered to be "fully submerged." Therefore, if applicable, the licensee explain what sump strainer failure criteria are being applied for the "vented sump" scenario described above.

44. What is the basis for concluding that the refueling cavity drain(s) would not become blocked with debris? What are the potential types and characteristics of debris that could reach these drains? In particular, could large pieces of debris be blown into the upper containment by pipe breaks occurring in the lower containment, and subsequently drop into the cavity? In the case that large pieces of debris could reach the cavity, are trash racks or interceptors present to prevent drain blockage? In the case that partial/total blockage of the drains might occur, do water hold-up calculations used in the computation of NPSH margin account for the lost or held-up water resulting from debris blockage?

45. Has debris settling upstream of the sump strainer (i.e., the near-field effect) been credited or will it be credited in testing used to support the sizing or analytical design basis of the proposed replacement strainers? In the case that settling was credited for any of these purposes, estimate the fraction of debris that settled and describe the analyses that were performed to correlate the scaled flow conditions and any surrogate debris in the test flume with the actual flow conditions and debris types in the plant's containment pool.

46. The September 2005 GL response stated that Constellation Energy analyzed the susceptibility of the Unit 1 ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage and operation with debris-laden fluids identified in GL 2004-02 using the Nuclear Energy Institute (NEI) guidance report "Pressurized Water Reactor Sump Performance Evaluation Methodology," NEI 04-07, and that the analysis has also taken into account the exceptions noted in the NRC SE of NEI-04-07 issued on December 6, 2004. It was not clear to the NRC staff from the GL response whether you applied analytical refinements to the baseline guidance for debris transport. If you did, please explain.