February 9, 2006

Mr. Mano K. Nazar
Senior Vice President and
Chief Nuclear Officer
Indiana Michigan Power Company
Nuclear Generation Group
One Cook Place
Bridgman, MI 49106

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNITS 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. MC4679 AND MC4680)

Dear Mr. Nazar:

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 4, 2005, as supplemented by letters dated August 31, and December 19, 2005, Indiana Michigan Power Company 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) 415-1451.

Sincerely,

/RA/

Peter S. Tam, Senior Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-315 and 50-316

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) 415-1451.

Sincerely,

/RA/

Peter S. Tam, Senior Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-315 and 50-316

Enclosure:
Request for Additional Information

cc w/encl: see next page

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GL 2004-02 RAI Questions

Plant Materials

1. (Not Applicable).

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. For a large-break loss-of-coolant accident (LBLOCA), provide the time until ECCS external recirculation initiation and the associated pool temperature and pool volume. Provide estimated pool temperature and pool volume 24 hours after a LBLOCA. Identify the assumptions used for these estimates.

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. Results from the ICET #1 environment and the ICET #5 environment showed chemical products appeared to form as the test solution cooled from the constant 140 ^{o}F test temperature. Discuss how these results are being considered in your evaluation of chemical effects and downstream effects.

Trisodium Phosphate (TSP) Plants

14. (Not Applicable).

15. (Not Applicable).

16. (Not Applicable).

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

Generic - All Plants

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. Provide test methodology and data used to support a zone of influence (ZOI) of 5.0 L/D. Provide justification regarding how the test conditions simulate or correlate to actual plant conditions and will ensure representative or conservative treatment in the amounts of coatings debris generated by the interaction of coatings and a two-phase jet. Identify all instance where the testing or specimens used deviate from actual plant conditions (i.e., irradiation of actual coatings vice samples, aging differences, etc.). Provide justification regarding how these deviations are accounted for with the test

demonstrating the proposed ZOI.

27. (Not Applicable).

28. (Not Applicable).

29. (Not Applicable).

30. The NRC staff's safety evaluation (SE) addresses two distinct scenarios for formation of a fiber bed on the sump screen surface. For a thin bed case, the SE states that all coatings debris should be treated as particulate and assumes 100% transport to the sump screen. For the case in which no thin bed is formed, the staff's SE states that the coatings debris should be sized based on plant-specific analyses for debris generated from within the ZOI and from outside the ZOI, or that a default chip size equivalent to the area of the sump screen openings should be used (Section 3.4.3.6). Describe how your coatings debris characteristics are modeled to account for your plant-specific fiber bed (i.e. thin bed or no thin bed). If your analysis considers both a thin bed and a non-thin bed case, discuss the coatings debris characteristics assumed for each case. If your analysis deviates from the coatings debris characteristics described in the staff-approved methodology, provide justification to support your assumptions.

31. Your submittal indicated that you plan to use a debris interceptor as a method to impede transport of debris to the ECCS sump screen. What is the amount (in either volume or percentage) of debris that is expected to be captured by the interceptor? Is there an evaluation for the potential to overload the debris interceptor?

32. What structural analysis was performed on the debris interceptor design?

33. 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:

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

oo. Debris and boron precipitation effects
pp. ECCS injection paths
qq. Core bypass design features
rr. Radiation and chemical considerations
ss. Debris adhesion to solid surfaces
tt. Thermodynamic properties of coolant

47. 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?

48. The licensee states that the final containment walkdowns for Unit 1 and Unit 2 will be completed in accordance with Nuclear Energy Institute (NEI) 02-01 during the fall 2006 and fall 2007 outages, respectively. The licensee also states that bounding analyses have already been completed in the areas of debris generation and transport. Please discuss the plans to incorporate the results of these future containment walkdowns into these analyses.

49. The licensee states that testing to support other than 100% fines generation for calcium silicate (Cal-Sil) and Marinite insulation fragments will be completed in March 2006. Please provide a description of this test plan including purpose for this testing. The staff expects that the licensee will provide information to justify the plant-specific application for the Cal-Sil and Marinite debris size distribution that results from such testing.

50. Please discuss the treatment of LBLOCAs and small-break loss-of-coolant accident (SBLOCAs) in the debris generation analyses. The staff SE on the alternate evaluation methodology defines a "debris generation break size" which distinguishes between customary and realistic design-basis analyses. This methodology classifies all American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1 reactor coolant system (RCS) attached piping, and breaks in the RCS main loop piping equivalent to a double-ended guillotine break (DEGB) of a 14-inch schedule 160 pipe as being analyzed using design-basis analyses. The licensee identifies LBLOCAs as those greater than a 14-inch diameter pipe. It is not clear how the licensee is treating these breaks. For example, the DC Cook 14 inch diameter pressurizer surge line and 14 inch diameter residual heat removal (RHR) system cooldown pipe to RCS Loop No. 2 should be treated in a traditional design-basis analysis fashion. It is not clear that breaks in these lines were treated in this manner.

51. The licensee states that for materials which have no experimentally determined ZOI, a conservative assumption was made and the lowest available destruction pressure and ZOI were adopted (28.6 D). Please provide a listing of the materials for which this ZOI was applied and the technical reasoning for concluding this is conservative.

52. It is not clear from the GL response how the alternate approach is being applied. Please provide a more detailed discussion of the approach taken. Is the proposed sump design based on the 14-inch debris generation break size or the limiting large-break case (Loop 4 cross-over break)?

53. Please discuss any evaluations or considerations for exemption requests as a result of applying the Section 6 methodology. The NEI guidance report, “Pressurized Water Reactor Sump Performance Evaluation Methodology,” NEI 04-07, and associated NRC staff SE recognized that exemptions from the regulations may be needed if this methodology was applied.

54. The licensee acknowledges that use of the alternate evaluation methodology requires that mitigative capability be demonstrated for the Region II breaks (up through the DEGB of the largest RCS pipig). The staff expects that the licensee will provide information to demonstrate this mitigative capability in their updated GL response.

55. The September 2005 response to GL 2004-02 appears to indicate that, while the replacement strainer would be submerged, it would also be continuously vented to the containment atmosphere. In this case, it is not clear to the staff whether a complete water seal would be preserved over the entire strainer surface if the head loss across the strainer were to exceed the vertical distance between the containment pool surface and the top of the vent pipe’s connection to the strainer. The September 2005 response stated that the maximum predicted head loss would be 8.17 ft (which was identified as possibly being overly conservative), and that analyzed containment water levels during the first 10 hours following an accident were identified as being in the range of 5.9 - 7.5 ft. Thus, it appears possible that, as a result of head loss across the suction strainer debris bed, the water level in the vent line could be drawn down to the point of uncovering a portion of the strainer surface. Without a complete water seal over its surface, the replacement strainer would no longer appear to meet the definition of a “fully submerged” sump in Appendix A to Regulatory Guide 1.82, Revision 3. Therefore, the NRC staff requests that the licensee provide further information concerning whether the potential exists for vent uncovery to break the water seal across the strainer surface. If this phenomenon is credible, please additionally state the criteria used to evaluate sump failure for this case.

56. 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 either 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.

57. What is the minimum strainer submergence during the postulated LOCA? At the time that the re-circulation starts, most of the strainer surface is expected to be clean, and the strainer surface close to the pump suction line may experience higher fluid flow than the rest of the strainer. Has any analysis been done to evaluate the possibility of vortex formation close to the pump suction line and possible air ingestion into the ECCS pumps? In addition, has any analysis or test been performed to evaluate the possible accumulation of buoyant debris on top of the strainer, which may cause the formation of an air flow path directly through the strainer surface and reduce the effectiveness of the strainer?