November 21, 2008

Mr. J. R. Morris
Site Vice President
Catawba Nuclear Station
Duke Energy Carolinas, LLC
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING SUPPLEMENTAL RESPONSES TO GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS" (TAC NOS. MC4674 AND MC4675)

Dear Mr. Morris:

By letters dated February 29, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML080650559) and April 30, 2008 (ADAMS Accession No. ML081270091), Duke Energy Carolinas. LLC (the licensee) submitted a supplemental response to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," for the Catawba Nuclear Station, Units 1 and 2 (Catawba). The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's submittals. The process involved detailed review by a team of approximately 10 NRC staff subject matter experts, with a focus on the review areas described in the NRC staff's revised "Content Guide for Generic Letter 2004-02 Supplemental Responses" sent by letter dated November 21, 2007 (ADAMS Accession No. ML073110389). Based on these reviews, the NRC staff has determined that additional information is needed in order to conclude there is reasonable assurance that GL 2004-02 has been satisfactorily addressed for Catawba. The enclosed document describes this request for additional information (RAI).

The NRC staff requests that the licensee respond to this RAI within 90 days of the date of this letter. However, the NRC staff would like to receive only one response letter for all RAI questions with exceptions stated below. If the licensee concludes that more than 90 days are required to respond to this RAI, then the licensee should request additional time and include a basis for why the extension is needed.

If the licensee concludes, based on its review of the RAI, that additional corrective actions are needed for GL 2004-02, the licensee should request additional time to complete such corrective actions as needed. Criteria for such extension requests are contained in SECY-06-0078 (ADAMS Accession No. ML053620174), and examples of previous requests and approvals can be found on the NRC's sump performance website, located at:
http://www.nrc.gov/reactors/operating/ops-experience/pwr-sump-performance.html.

Any extension request should also include results of contingency planning that will result in near term identification and implementation of any and all modifications needed to fully address GL 2004-02. The NRC staff strongly suggests that the licensee discuss such plans with them before formally transmitting an extension request.

The exception to the above response timeline is RAI question 29 contained in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Catawba, as well as at other pressurized water reactors. The licensee's submittal refers to Topical Report (TR) WCAP-16793-NP, Revision 0, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid" (ADAMS Accession No. ML071580139). At this time, the NRC staff has not issued a final Safety Evaluation (SE) for TR WCAP-16793-NP.

In the future, the licensee may demonstrate that in-vessel downstream effects issues are resolved for Catawba by showing that Catawba plant conditions are bounded by the approach described in TR WCAP-16793-NP, after the TR's approval, and by addressing the conditions and limitations described in the final NRC staff's SE for the approved version of this TR. The licensee may also resolve RAI question 29, without reference to the approved version of TR WCAP-16793-NP and the associated conditions and limitations described in the final NRC staff's SE for this TR, by demonstrating that in-vessel downstream effects have been addressed at Catawba. The specific issues raised in RAI question 29 should be addressed regardless of the approach the licensee chooses to take.

The licensee should report how it has addressed the in-vessel downstream effects issue and the associated RAI referenced above within 90 days of issuance of the final NRC staff's SE for TR WCAP-16793-NP. The NRC staff is currently developing a Regulatory Issue Summary to inform licensees of the NRC staff's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,

/RA/

John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosure:
Request for Additional Information

cc w/encl: Distribution Via ListServ

Any extension request should also include results of contingency planning that will result in near term identification and implementation of any and all modifications needed to fully address GL 2004-02. The NRC staff strongly suggests that the licensee discuss such plans with them before formally transmitting an extension request.

The exception to the above response timeline is RAI question 31 contained in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Catawba, as well as at other pressurized water reactors. The licensee's submittal refers to Topical Report (TR) WCAP-16793-NP, Revision 0, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid" (ADAMS Accession No. ML071580139). At this time, the NRC staff has not issued a final Safety Evaluation (SE) for TR WCAP-16793-NP.

In the future, the licensee may demonstrate that in-vessel downstream effects issues are resolved for Catawba by showing that Catawba plant conditions are bounded by the approach described in TR WCAP-16793-NP, after the TR's approval, and by addressing the conditions and limitations described in the final NRC staff's SE for the approved version of this TR. The licensee may also resolve RAI question 31, without reference to the approved version of TR WCAP-16793-NP and the associated conditions and limitations described in the final NRC staff's SE for this TR, by demonstrating that in-vessel downstream effects have been addressed at Catawba. The specific issues raised in RAI question 31 should be addressed regardless of the approach the licensee chooses to take.

The licensee should report how it has addressed the in-vessel downstream effects issue and the associated RAI referenced above within 90 days of issuance of the final NRC staff's SE for TR WCAP-16793-NP. The NRC staff is currently developing a Regulatory Issue Summary to inform licensees of the NRC staff's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,
/RA/
John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
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Enclosure:
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OFFICE	NRR/LPL2-1/PM	NRR/LPL2-1/PM	NRR/LP2-1/LA	NRR/SSIB/BC	NRR/LPL2-1/BC
NAME	JThompson	JStang	MO'Brien	DHarrison	MWong
DATE	11/5/2008	11/19/2008	11/4/2008	11/21/2008	11/21/2008

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REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING SUPPLEMENTAL RESPONSES TO GENERIC LETTER 2004-02,

"POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION

DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS"

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

1. Please state whether or not the break location selection was revisited when the Zone of Influence (ZOI) for fibrous insulation was changed from 17D to 7D. If break selections were not revisited, please provide the rationale for not doing so. If the break selections were revisited, please provide the top four breaks in terms of debris generation for the 7D ZOI. (The supplemental response sent by letter dated February 29, 2008, indicates only that the break locations already identified for a 17D ZOI were reassessed for debris quantity generation and confirmed not to have changed relative ranking.)

2. Please state whether the testing identified in the test report WCAP-16710-P, "Jet Impingement Testing to Determine the Zone of Influence of Min-K and Nukon® Insulation for Wolf Creek and Callaway Nuclear Operating Plants," was specific to the Catawba Nuclear Station, Units 1 and 2, (Catawba) insulation systems. If not, please provide information that compares the Catawba encapsulation and jacketing systems structures with the systems that were used in the testing, showing that the testing conservatively or prototypically bounded potential damage to the insulation materials.

3. Considering that the Catawba debris generation analysis diverged from the approved guidance in NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," Revision 0, please provide details on the testing conducted that justified the ZOI reductions for jacketed Nukon®. The information should include the jacket materials used in the testing, geometries and sizes of the targets and jet nozzle, and materials used for jackets installed in the plant. Please provide information that compares the mechanical configuration and sizes of the test targets and jets versus the potential targets and two-phase jets in the plant. Please evaluate how any differences in jet/target sizing and jet impingement angle affect the ability of the insulation system to resist damage from jet impingement. Please state whether the testing described in test report WCAP-16710-P was bounding for the Catawba insulation systems. If not, please provide information that compares the Catawba encapsulation and jacketing systems structure with the system that was used in the testing, showing that the testing conservatively or prototypically bounded potential damage to the insulation materials.

4. The NRC staff is not convinced that Catawba's currently postulated limiting break, that results in no fine fibrous debris, but does result in 195 ft^3 of small pieces and 130 ft^3 of large pieces, is truly the limiting break from a final head loss perspective. Please provide the fibrous size distribution (including debris amounts determined) for the debris generation calculation based on the 7D ZOI. Please provide the basis for the determination that no fine fibrous debris would be generated by the limiting break. (The NRC staff considers the

assumption of no fine fibrous debris to be non-conservative and inconsistent with previous industry and NRC insulation destruction test data that indicates that a fraction of the debris formed within a 7D ZOI would be destroyed into fines. The NRC staff guidance for break selection (NEI Guidance Report and NRC staff Safety Evaluation) requires that "pipe breaks shall be postulated with the goal of creating the largest quantity of debris and/or the worst-case combination of debris types at the sump screen." Fine fiber is a basic constituent of a limiting debris bed. If a different break location would result in the generation of fine fibrous debris, even if the total debris amount is less than the currently postulated Catawba limiting break, that different break may actually be the limiting break. The licensee should evaluate each potential break location from debris generation to transport (including erosion and ensuing transport) to head loss to determine which break is actually limiting.)

5. Industry debris destruction testing was used as a basis to revise assumptions concerning the ZOIs and debris size distributions for Nukon®, Knauf, and Thermal Wrap low-density fiberglass insulations. Please describe the jacketing, banding and latching mechanisms, and cloth covers of these three types of insulation installed at Catawba and compare them to the insulation for which destruction testing was performed in order to demonstrate the applicability of the industry destruction tests results to Catawba.

6. Please specify whether latent debris samples were collected as part of the containment walkdowns performed described in the supplemental response sent by letter dated April 30, 2008, and describe how these samples were used to estimate the latent debris quantities for both units. In addition, if samples were not collected, please justify how the use of photographs and walkdown notes of the Catawba containments, as described in the response, provide assurance that the 200 lbm of latent debris assumed for the supporting calculations is bounding.

7. Please describe the analytical method used to extrapolate the total amount of latent debris in containment. If a statistical method was used, please provide the confidence level of the results.

8. Please provide the details of the methodology used for the tag and label refinement evaluation. Please provide details of the equipment qualifications and engineering judgments used as basis for reduction of tag and label quantities assumed to fail and reach the sump.

9. Please provide the technical basis for the assumption of 10-percent erosion of fibrous debris in the containment pool. If testing was performed to support this assumption, please demonstrate the similarity of the flow conditions, chemical conditions, and fiberglass material present in the test versus the conditions expected in the Catawba containment pool.

10. Please provide details of the tags and labels equipment qualifications and engineering judgments used as the basis for reduction of tags and label quantities which are assumed to fail and reach the sump. Specifically, please justify the application of Institute of Electrical and Electronics Engineers (IEEE) Standard 323-1974, "IEEE Standard for Qualifying Class 1 E Equipment for Nuclear Power Generating Stations," in qualifying Electromark® labels for a post-loss-of-coolant-accident (post-LOCA) environment with respect to non-debris transport to the sump strainer.

11. Please provide the results of the array testing conducted at Alion Science and Technology Corporation and the Integrated Prototype Test (IPT) testing conducted at Wyle Laboratories. For the IPT testing, in addition to head loss values, please provide the results as a function of time. Please provide a thorough description of the methodology used to combine the two test results to determine the final head loss for the strainer debris bed. If a correlation was developed to determine head loss, please provide the correlation along with the assumptions and bases used in the development of the correlation.

12. Please provide information that establishes that vortex testing was conducted at less than or equal to the expected 3.75-inch minimum strainer submergence. The licensee's response to RAI question 38 in Enclosure 1 to the supplemental response sent by letter dated February 28, 2008, and Enclosure 2 of this supplemental response, Section 3(f)(2), state that the strainer modules are submerged by 3.75 inches under limiting sump level conditions. The licensee's response to RAI question 38 states that testing was conducted at a submergence of 3 inches. Enclosure 2, Section 3(f)(3), states that the testing was conducted with a "few inches" of water coverage above the strainer modules. Separately, Enclosure 2, Section 3(f)(3), states that approach velocities for testing were between 0.01 ft/sec and 0.09 ft/sec, while the expected maximum approach velocity for the plant strainer is 0.045 ft/sec. In order to clarify the conditions under which vortex testing was conducted, please provide the following information:

    a. Please provide the basis for the maximum approach velocity value of 0.045 ft/sec.

    b. Please discuss how flume velocity was controlled during vortex testing.

    c. Please provide a quantitative value for the approach velocity during which any vortices were observed to form.

    d. Please provide a quantitative value for the vortex suppressor grating submergence.

    e. Please verify that all vortex testing was conducted at less than or equal to 3.75 inches of strainer submergence, with or without a vortex suppressor grating.

    f. Please state whether vortex formation occurred during testing and what conditions were present at such times (submergence level, approach velocity and grating installation).

13. Please provide a response to the question from the NRC Content Guide sent by letter dated November 21, 2007, relating to Enclosure 2 of the supplemental response sent by letter dated February 29, 2008, Section 3(f)(5), regarding the ability of the strainer to accommodate the maximum potential debris volume. This response should apply specifically to the Catawba strainer and not be a generic answer.

14. Please provide information that verifies that the debris preparation and introduction methods used during the array test and IPT were prototypical or conservative with respect to the transport evaluation for the plant. In general, protocols for fibrous debris preparation result in debris that is coarser than predicted by the plant-specific transport calculation. In

addition, the NRC staff has noted that debris introduction frequently results in agglomeration of debris such that it may not transport to the strainer prototypically or create a prototypical debris bed. Both of these issues can result in non-conservative head loss values during testing.

15. Please provide information on the flow fields in the array test. The NRC staff is concerned that non-prototypical debris distribution may have occurred during testing as a result of stirring of the tank. Stirring can result in the transport of debris that would otherwise not transport, or result in debris being washed from the strainer screen surfaces. Either of these phenomena can result in reduced (non-conservative) head loss values during testing.

16. Please provide information that verifies that the debris preparation and introduction methods used during the thin bed testing for the top hat strainer design were prototypical with respect to the plant-specific debris generation and transport evaluation for Catawba. Note that for thin bed testing, the NRC staff considers it prototypical or conservative for fine fiber to arrive at the strainer prior to less transportable debris. Overly coarse debris preparation or non-prototypical introduction to the flume may non-conservatively affect the potential for thin bed formation.

17. Please provide the criteria used to judge that differential pressure-induced effects (e.g., boreholes) did not occur during testing. The existence of pressure-induced effects could invalidate the application of temperature scaling. Please state whether pressure-induced effects were identified and, if so, the resultant effect on the application of temperature scaling.

18. Please provide the scaling parameters used for calculation of debris quantities and strainer approach velocities used during testing. Please state whether the scaling accounted for strainer areas blocked by miscellaneous debris such as labels and tape.

19. Please discuss the NRC staff's observation that in the IPT the flow was non-prototypically directed at the top hat strainer in a direction parallel to the top hat long axis. Please address whether this non-prototypical flow direction could result in a non-prototypical formation of debris on the top hat strainer.

20. Please provide the clean strainer head loss for Catawba Unit 1 (only the clean strainer head loss for Catawba Unit 2 was provided).

21. Please provide the time-dependent results and calculation methodology for determining net positive suction head (NPSH) margin throughout the 30-day mission time.

22. Please provide the basis for the debris introduction information that indicates that no fine fibrous debris would be generated during a loss-of-coolant accident (LOCA). If the assumption of zero fibrous debris generation is in error, please provide the amount of fibrous debris generated by the limiting break and justify why, in such a case, the head loss test results would remain valid.

23. Please provide the types and amounts of debris added to each test (Array and IPT) and include information on introduction sequence. Please provide relevant test parameters such as temperature, debris introduction times, and flow rate for the Array and IPT tests.

24. Please provide information on the amounts of debris that settled during testing for each test (IPT, Array, and Thin Bed). Note that Enclosure 1 of supplemental response dated February 29, 2008, stated that near-field settling was not credited during testing. However, the NRC staff observed significant settling during the IPT. Please provide a quantitative evaluation of how this settling affected head losses for each test. Please state whether this settling is prototypical of plant conditions and provide a basis for the conclusion.

25. The supplemental response stated that the head loss across the Catawba Emergency Core Cooling System Sump strainer (clean strainer head loss plus debris bed head loss) is conservatively predicted to be 5.4 ft at switchover to sump recirculation. However, no explanation was provided as to how this value was derived. It appears that credit was taken for time-dependency in head loss, since the 30-day value is 8.2 ft. Please provide the time-dependent results and calculation methodology for determining NPSH margin throughout the 30-day mission time.

26. Please state whether the containment cleaning actions described in Duke's response to Bulletin 2003-01, sent by letter dated August 7, 2003, will remain in effect at Catawba (in order to assure that debris source assumptions made as part of the GL 2004-02 resolution remain valid). Specifically, please identify the procedures which control the cleanliness actions for containment and any commitments regarding the long-term applicability of these procedures.

27. The revised "Content Guide for Generic Letter 2004-02 Supplemental Responses," sent by letter dated November 21, 2007, Section 3k, requests a summary of structural qualification design margins for the various components of the sump strainer structural assembly. This summary should include interaction ratios and/or design margins for structural members, welds, concrete anchorages, and connection bolts as applicable. Please provide this information.

28. Please describe the basis for concluding that there is no potential of debris blockage at the ice condenser drains and refueling canal drains for accident scenarios where containment spray is necessary.

29. The NRC staff considers in-vessel downstream effects to not be fully addressed at Catawba, as well as at other pressurized-water reactors. The supplemental response for Catawba refers to the evaluation methods of Section 9 of Topical Report (TR) WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GS-191," for in-vessel downstream evaluations and makes reference to a comparison of plant-specific parameters to those evaluated in TR WCAP-16793-NP, Revision 0, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." The NRC staff has not issued a final Safety Evaluation (SE) for TR WCAP-16793-NP. The licensee may demonstrate that in-vessel downstream effects issues are resolved for Catawba by showing that the licensee's plant conditions are bounded by the final TR WCAP-16793-NP and the conditions and limitations identified in the final NRC staff's SE. The licensee may also resolve this item by demonstrating without reference to TR WCAP-16793 or the NRC staff's SE that in-vessel downstream effects have been addressed at Catawba. In any event, the licensee should report how it has addressed the in-vessel downstream effects issue within 90 days of issuance of the final NRC staff's SE on TR

WCAP-16793. The NRC staff is developing a Regulatory Issue Summary to inform the industry of the NRC staff's expectations and plans regarding resolution of this remaining aspect of GSI-191.

30. Please discuss why the Integrated Prototype Test (IPT) provided a representative debris bed on the top-hat strainer module for filtering chemical precipitates. The NRC staff observed the debris addition video and concluded that the fibrous debris introduced into the test tank was more agglomerated than what may arrive at the strainer under post-LOCA flow conditions in the plant. Is the amount of bare strainer area observed in the test representative of what is expected to occur with the plant strainer array if a large break LOCA were to occur? The use of chemical effects test results derived from a test which formed a non-prototypically partially clean screen fiber bed would not be appropriate.