December 2, 2008

Mr. David H. Jones
Vice President - Engineering
40 Inverness Center Parkway
Birmingham, AL 35242

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 - GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS," REQUEST FOR ADDITIONAL INFORMATION (TAC NOS. MC4727, MC4728)

Dear Mr. Jones:

By letters dated February 28, 2008, May 21, 2008, July 31, 2008, and August 22, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML080640601, ML081640617, ML082170513, and ML082380890, respectively), Southern Nuclear Operating Company (SNC, 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 Vogtle Electric Generating Plant, Units 1 and 2 (VEGP).

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 subject matter experts, with a focus on the review areas described in the NRC’s “Content Guide for Generic Letter 2004-02 Supplemental Responses” (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 VEGP. The enclosed document describes these requests for additional information (RAIs).

The NRC requests that the licensee respond to these RAIs within 90 days of the date of this letter. If the licensee concludes that more than 90 days are required to respond to the RAIs that are being addressed by new testing, the licensee should request additional time, including a basis for why the extension is needed.

If the licensee concludes, based on its review of the RAIs, 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 strongly suggests that the licensee discuss such plans with the staff before formally transmitting an extension request.

The exception to the above response timeline is RAI 28 in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Vogtle, Units 1 and 2, as well as at other pressurized water reactors. The licensee's submittal refers to draft WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." At this time, the NRC staff has not issued a final safety evaluation (SE) for WCAP-16793.

The licensee may demonstrate that in-vessel downstream effects issues are resolved for Vogtle, Units 1 and 2, by showing that the licensee's plant conditions are bounded by the final WCAP-16793 and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may also resolve RAI 28 by demonstrating, without reference to WCAP-16793 or the NRC staff SE, that in-vessel downstream effects have been addressed at Vogtle, Units 1 and 2. The specific issues raised in RAI 28 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 SE on WCAP-16793. The NRC staff is currently developing a Regulatory Issue Summary to inform licensees of the NRC staff expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,

/RA/

Robert E. Martin, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-424 and 50-425

Enclosure:
As stated

cc w/encl: See next page

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VOGTLE ELECTRIC GENERATING PLANT UNITS 1 AND 2

GSI-191/GL 2004-02 REQUEST FOR ADDITIONAL INFORMAITON

DOCKET NOS. 50-424 AND 50-425

SUPPLEMENTAL RESPONSES TO GENERIC LETTER (GL) 2004-02

DATED 02/28/2008, 5/21/2008, 7/31/2008, AND 8/22/2008

1. Please provide a description of the jacketing/banding systems used to encapsulate Nukon insulation at Vogtle (e.g., on piping, steam generators, reactor coolant pumps) and during jacketing/banding system qualification testing. 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, and the potential targets and two-phase jets in the plant. Pleases 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. In doing so, please provide a justification for applying debris generation test data obtained for the Nukon jacketing systems employed at the Wolf Creek and Callaway plants to the jacketing systems used at Vogtle and demonstrating that the Vogtle jacketing systems are as resistant to destruction as the jacketing systems tested. In responding to this question, please address the potential varied jacketing systems for various components of the reactor coolant system which are within the LOCA ZOIs (e.g., piping, coolant pumps and steam generators).

2. Please specify the ZOI radius used to calculate the quantity of Interam fire barrier debris that could be generated. Please provide the characteristics of the Interam fire barrier material including the type of Interam installed and its anticipated debris characteristics. Please provide information on how the material was prepared for inclusion in head loss testing or provide information on the surrogate material used and its properties. Please provide assumptions made regarding the physical properties of LOCA damaged Interam fire barrier material and the bases for how any surrogate material used in testing conservatively model these properties.

3. Please provide the following additional information needed to support the assumption of 15% erosion of fibrous debris pieces in the containment pool:

   a. The similarity of the flow conditions (velocity and turbulence), chemical conditions, and fibrous material present in the erosion tests to the analogous conditions applicable to the expected plant conditions, and
   b. The durations of the erosion tests and how the test results were extrapolated to the sump performance mission time.

4. On pages E1-19 and E1-20 of the supplemental response dated February 28, 2008, it is indicated that, based on the fact that less than 25% of the strainer perimeter area is in excess of the curb lift velocity metric, 25% of small debris pieces are assumed to surmount the curb/plenum on which the strainer modules rest. However, based on the diagram of containment provided on page E1-9 of the same supplemental response, the staff expects that it is likely that flow and debris will preferentially approach the sump from openings in the shield wall. As a result, the fraction of debris approaching the sump in the higher velocity flow channel could significantly exceed 25%. In light of the considerations such as

this, please provide a technical justification for the assumption that only 25% of small pieces of fibrous debris can surmount the curb/plenum and reach the sump strainers.

5. The supplemental response states that the head loss test results were scaled to the full-sized strainer system based on temperature, velocity and bed thickness differences. Without additional information on the methodology used to make these extrapolations, it is not possible to determine whether they were performed conservatively or prototypically. It appears that the head loss test result of 6.84 ft was extrapolated to 8.126 ft. Please provide the details of all extrapolations performed for the head loss test data. Please include the raw test data and conditions, and the final head loss value and the conditions to which it was extrapolated. Please include any differences in temperature, velocity, bed thickness between the head loss testing and anticipated plant conditions.

6. The supplemental response stated that the submergence value for the SBLOCA was not calculated. The stated for this was that an SBLOCA would create less debris and therefore result in a less challenging head loss. This is true for some portions of the evaluation. However, the vortexing evaluation is often most limiting when there is no debris on the strainer. In addition, if the strainer is not fully submerged, the acceptance criteria for maximum head loss may be limited by the strainer height (50% of the strainer height per RG 1.82, Rev. 3) instead of the pump NPSH margin. This would be a reduction to about 25% of the tested strainer head loss. Also, if the strainer is not submerged, air ingestion would have to be evaluated more rigorously. Un-submerged strainer area cannot be credited to accumulate debris, so other areas of the strainer would have to absorb the debris that cannot be collected on the uncovered portion of the strainer. Due to break location, the SBLOCA level may not include some RCS inventory and also may not include all or part of the accumulator volume. Please provide the minimum submergence for an SBLOCA. If the strainer is not fully submerged for this event, please provide appropriate evaluations for air ingestion and strainer head loss, including acceptability based on the guidance in RG 1.82 (or other appropriate methodology).

7. Related to the RAI above on the response of the plant to cases where the strainers may not be fully submerged, have various scenarios such as an SBLOCA with the failure of one train of ECCS and no CS actuation been considered? For this case all debris would transport to a single ECCS strainer that may not be fully submerged. A thin bed with the bulk of the particulate debris could form on the operating strainer surface. Please provide an evaluation that demonstrates that adequate NPSH margin will be provided to the ECCS pumps (reference Regulatory Guide 1.82, Revision 3, Section 1.3.4.4).

8. It was implied that the debris was added to the testing prior to starting the recirculation pump. Please provide justification that this test sequence provides prototypical or conservative test conditions.

9. Scaling was based on the circumscribed area for the test and plant strainers. Normally scaling is based on the screen area. For the module testing the scaling factors based on circumscribed and screen area appear to be the same. The scaling factors for the sector testing could not be determined by the staff. Please provide information that justifies the use of the circumscribed area of the test and plant strainers for scaling of the sector tests.

10. Without information on how debris was prepared and introduced into the thin bed tests it cannot be concluded that the thin bed testing was valid. It is possible that a properly conducted thin bed test would result in higher head loss than the full load test that was

stated to be the limiting head loss condition for Vogtle. Please provide information that justifies that the sector testing conducted to determine the strainer's ability to deal with a thin bed was conducted under conditions that would conservatively model the debris bed. Please reference the staff Head Loss and Vortexing Guidance for thin bed testing considerations (ADAMS Accession No. ML080230038).

11. The supplemental response stated that air ingestion was evaluated at the top of the module. The results of the vortexing evaluation were not provided. Please provide the results of the air ingestion/vortexting evaluation including the plant conditions assumed.

12. No documentation of fiber size distribution used for testing compared to the fiber size distribution predicted to arrive at the strainer was provided. The supplemental response stated that only fine and small pieces of fiber would be created by the break. The size distribution of the fibrous debris used in testing was not provided. In general shredded fiber does not imply that all fine fibers are created. For thin bed testing, only fine fibrous debris should be added to the test flume until all fibrous fines predicted to be created are added. Please provide information regarding the size distribution of fibrous debris used in various tests and how these size distributions compare to the transport evaluation predictions.

13. The documentation of fibrous concentration during addition and methods of addition to the flume were unclear. Documentation should be provided showing that the concentration of debris during addition was controlled so that non-prototypical agglomeration of the debris would not occur. Please provide information that justifies that the debris introduction methods used during testing did not result in non-prototypical settling or agglomeration of debris. Also, please include the amounts of debris added during each addition, the actual size distribution of the debris, and the debris types.

14. Documentation of the amount of debris that settled in the agitated and non-agitated areas of the test tanks was not provided. Please provide the amount of debris that settled in the agitated and non-agitated areas of the test tank for each test.

15. There is no discussion of extrapolation of head loss test results to ECCS mission times, nor discussion of test termination criteria and subsequent extrapolation. Please provide information that shows that the head loss testing was run to a maximum value, or that an extrapolation was performed to obtain the head loss at the end of the strainer mission time. Please provide sufficient time dependent test data so that the termination criteria and any extrapolations conducted can be verified. Please provide a graph of the head loss over time for the limiting module and sector tests. Please specify the sector test that created the limiting head loss.

16. The flashing evaluation did not describe the margin to flashing through the strainer. The supplemental response stated that overpressure is credited, but the amount of overpressure required was not provided, nor was the available margin. The total head loss (without chemicals) is about 8 ft with a submergence of about 3 inches (LBLOCA). Please provide the minimum margin to flashing across the strainer throughout the strainer mission time. Please provide the assumptions used to determine this value.

17. The supplemental response stated that the vortex testing was conducted at a submergence that may have been slightly greater (non-conservative) than that expected under LBLOCA conditions (3.4 in vs. 3.675 +/- 0.5 in). Another section of the supplemental

response stated that the testing was conducted with a representative or conservatively lowered water level, but no other details were provided. No vortex testing appears to have been conducted for SBLOCA conditions. No details on the test flow rates for vortex evaluations were provided. Vortex testing should be conducted with the minimum potential submergence and the maximum potential scaled flow rate through the strainer. Please provide an evaluation of vortex formation for the minimum level at which the strainer is required to operate (likely an SBLOCA condition). Please verify that the flow rates used in the vortex testing were conservative including the potential for higher flow rates in some sections of the strainer (generally those hydraulically closer to the pump suction). Please verify that the level that was tested for the LBLOCA case was in fact conservatively low. Please provide the submergence value for LBLOCA testing. Alternatively, please provide an updated evaluation considering all of these considerations.

18. The clean strainer head loss (CSHL) calculation methodology was not provided. It was not clear how the CSHL was divided between strainer module head loss and piping head loss. Please provide the methodology used to determine CSHL. Please provide information indicating that each section of the strainer, plenum, or piping was included in the calculation, the head loss value for each section, and the method used to determine the head loss for each strainer section. Please include any assumptions made for each portion of the calculation.

19. The supplemental response stated that for the sector tests debris was maintained in suspension using stirring. No information was provided to show that the stirring did not drive non-prototypical debris onto the bed nor prevent debris from collecting naturally on the strainer during these tests. For the module tests, from the provided diagrams it appeared that the stirrer was far enough from the strainer to prevent non-prototypical bed formation. Please provide information that justifies that the debris beds were not disrupted by the stirring and that the stirring did not result in non-prototypical debris accumulation on the strainer (accumulation of larger sizes of debris than would be expected).

20. During module tests stirring was used outside the area of the strainer. The supplemental response stated that the flow in the test flume conservatively represented the plant flow patterns in the area of the strainer to ensure that non-prototypical settling would not occur. No details were provided on how the plant and flume flow rates were modeled to assure that flow and turbulence would be prototypical. In general flow patterns in the plant are affected by, for example, upstream conditions, drainage into the sump pool, flow rates from various locations, upstream obstructions, and obstructions near the strainer. The boundary conditions in the models for determining typical plant flow patterns should be prototypical or conservative. Please provide information that justifies that the flow rates and patterns in the test flume for the module tests were prototypical or conservative with respect to plant conditions.

21. Please provide the basis for the statement in the supplemental response that the debris head loss for the RHR strainers bounds the head loss for the containment spray strainers.

22. Because of the large volume of debris and the relatively low submergence of the strainer it is possible for debris to collect on top of the strainer and provide a pathway for air ingestion. This was not discussed in the supplemental response. Air ingestion could result from a damming effect, or, if head loss exceeds submergence and holes form in the debris bed, these holes could allow air to be ingested through the debris bed. Please

provide an evaluation of the potential for debris to collect on top of the strainer and provide a pathway for air ingestion into the strainer.

23. It was unclear how varying the debris loading affected the results in all of the head loss testing. Please provide the debris amounts added to each test, the resulting theoretical bed thicknesses, and the maximum head loss determined for each test.

24. Please provide the containment sump/pool level both soon after the realignment to containment spray recirculation as well as at the time post-accident when all assumed water contributions and diversions/hold-ups have completely taken effect (except for subsequent sump/pool water thermal contraction). The differences in the assumptions and results for these two cases should be clearly explained, as should the times when the short-term and long-term results are applicable. The strainer submergence should be provided for both cases.

25. The second portion of item 3.k of the revised content guide for the GL2004-02 supplemental responses requests that the licensee “summarize the structural qualification results and design margins for the various components of the sump strainer structural assembly.” Please provide the actual and allowable stresses and show the design margins for the 16 bolt locations of the strainer base frame (in addition to the reaction forces already provided in Table 3.k.8-2 of the supplemental response).

26. Item 3.k.3 of the revised content guide for the GL2004-02 supplemental responses requests that the licensee “summarize the evaluations performed for dynamic effects such as pipe whip, jet impingement, and missile impacts associated with high-energy line breaks (as applicable).” In addition to the information provided in your September 2005 and February 2008 responses, please submit a detailed summary along with any additional supporting information regarding your assessment that the strainers are not subject to the aforementioned dynamic effects.

27. Please provide additional basis for concluding that the refueling cavity drains would not become blocked with debris. Please identify 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 fall into the cavity? In the case that partial/total blockage of the drains might occur, what would be the impact to minimum sump water level and ECCS and CS pump NPSH? Are there any potential flow restrictions in the two 12-inch refueling cavity drain lines (e.g., valves, meshing or gratings), and if so, how are these potential restrictions addressed so as ensure that these lines are not blocked during a LOCA?

28. The NRC staff considers in-vessel downstream effects to not be fully addressed at Vogtle Units 1 and 2, as well as at other PWRs. The supplemental response refers to draft WCAP-16793-NP, “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 WCAP-16793-NP. The licensee may demonstrate that in-vessel downstream effects issues are resolved for Vogtle Units 1 and 2 by showing that the Vogtle’s plant conditions are bounded by the final WCAP-16793-NP and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may alternatively resolve this item by demonstrating, without reference to WCAP-16793 or the staff SE, that in-vessel downstream effects have been addressed at Vogtle Units 1 and 2. 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 SE on WCAP-16793. The NRC staff is developing a Regulatory Issue Summary to inform the industry of the staff's expectations and plans regarding resolution of this remaining aspect of GSI-191.

29. The NRC Staff understands that SNC has changed its test approach to evaluate chemical effects. Please submit the revised chemical effects test results and analyses to the NRC when they become available.

Vogtle Electric Generating Plant, Units 1 & 2

cc:

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