UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 4, 2009

Mr. John T. Carlin
Vice President R.E. Ginna Nuclear Power Plant
R.E. Ginna Nuclear Power Plant, LLC
1503 Lake Road
Ontario, NY 14519

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RE: GENERIC LETTER 2004-02 (TAC NO. MC4687)

Dear Mr. Carlin:

Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," was issued on September 13, 2004. The GL addressed the potential susceptibility of pressurized-water reactor (PWR) recirculation sump screens to debris blockage during design-basis accidents requiring recirculation operation of emergency core cooling systems (ECCS) or containment spray systems (CSS) and on the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CSS recirculation and containment drainage.

The Nuclear Regulatory Commission (NRC) staff has reviewed previous submittals from your facility regarding the GL and has determined that additional information is needed to complete its review. Enclosed is the staff's request for additional information (RAI). As discussed with your staff, we understand that you intend to respond to this RAI within approximately 90 days of the date of this letter. Also, as discussed with your staff, we understand that you will be prepared to discuss your proposed responses in detail with the NRC staff in early January 2010.

Please contact me at 301-415-1364 if you have any questions.

Sincerely,

James Kim for

Douglas V. Pickett, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-244

Enclosure:
As stated

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REQUEST FOR ADDITIONAL INFORMATION (RAI)

GENERIC LETTER 2004-02

POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING

DESIGN-BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

R.E. GINNA NUCLEAR POWER PLANT

DOCKET NO. 50-244

Debris Characteristics

RAI 1 The staff requested that the licensee provide a comparison of the banding, jacketing, and manufacturing processes for the calcium silicate insulation installed at Ginna with the corresponding properties for the material used for destruction testing. The licensee's response provided sufficient information to address the aspect of this question associated with the insulation manufacturing processes for the plant and test materials. However, the staff considers the following additional information necessary regarding the jacketing and banding:

a. A comparison of the type banding used at Ginna with that used for the Ontario Power Generation testing (e.g., band thickness and/or nominal failure strength).
b. A basis for concluding that the 0.01"-thick stainless steel jacketing installed on piping at Ginna is more robust than the 0.016"-thick aluminum jacket used for the Ontario Power Generation testing.

Debris Transport

RAI 3 Eight new RAIs are listed below. This area was a new review of material not supplied previously. The following new RAIs derive from the previous general RAI 3 to provide a description of the transport analysis:

1. Based on the information provided in the June 2, 2009, supplemental response, it appeared that 3% of small pieces and 37% of large pieces of fibrous debris were assumed to be trapped on gratings during the blowdown phase. Please clarify whether the grating credited with this debris capture is located below postulated break locations, and provide a technical basis (e.g., specific tests from which data was applied) to justify the assumed capture fractions.

2. The June 2, 2009, supplemental response stated that 5% of the small fiberglass debris blown upward would be trapped due to changes in flow direction. It appeared to the staff that much of this debris considered to be trapped due to inertial capture may be only temporarily held up against vertical surfaces or the underside of horizontal surfaces. As such, it was not clear that the debris would remain trapped for the 30-day sump mission time. Please discuss whether this debris that was assumed to be trapped due to a change in flow direction is

assumed to remain trapped for the 30-day sump mission time. If a 30-day holdup cannot be justified, please discuss the manner in which the subsequent potential transport of some or all of this debris to the strainers is considered. Please provide a technical basis to justify the assumptions made.

3. The June 2, 2009, supplemental response described the methodology used to determine transport of small fibrous debris pieces on the operating deck level. Based on this methodology, the licensee calculated 0% transport on the upper level of the operating deck, and 40% transport on the lower level of the operating deck. The staff considered several aspects of the licensee's methodology to be unacceptable, including the following:

   a. The use of a single transport metric for all small pieces (which range in size from pieces larger than fines to pieces up to 4 inches in size) does not appear to be sufficient to lead to realistic transport percentages, particularly for the upper operating deck.

   b. The methodology assumed that the small pieces of fibrous debris would be saturated with water. The basis for this assumption is unclear, given that the fraction of small pieces of fiber that was fragmented and blown to the upper containment would have been impacted with a two-phase jet that had largely flashed to steam before contacting the insulation. Furthermore, the water on the operating deck would largely be spray drainage at cooler temperatures, which does not rapidly penetrate insulation debris due to its viscosity. In addition, on the upper level, the debris pieces would not be fully submerged. Accounting for trapped air in small pieces of fibrous insulation would lead to increased tumbling transport versus the licensee's evaluation, and also to the consideration of the potential for transport via floatation, which did not appear to have been evaluated due to the assumption of the debris being water saturated.

   In addition, several aspects of the methodology are not sufficiently clear, including the following:

   a. The basis for assuming a weir model with uniform radial flow across the operating deck elevation was not stated. From the information provided, it is not clear whether the geometric location of the stairways and hatches, as well as the location of any flow obstacles that may be present, are consistent with this model. Also, the significant amount of debris assumed to reach the operating deck and settle out (e.g., it appeared from the information provided that well over 100 ft^3 of small pieces of fiber alone could settle out on the operating deck level) could result in channeled flowpaths at higher velocities. It is not clear to the staff that the simplified flow approximations used by the licensee are sufficient to determine the behavior of the gradually varying open channel flow across the operating deck.

   b. It is unclear that the derivation of partially submerged transport metrics from submerged transport metrics is valid. In addition to the concerns identified above, submerged, tumbling transport would seemingly be associated with a static coefficient of friction, whereas partially submerged transport would seemingly be associated with a dynamic coefficient of friction. Without benchmarking, the staff believes there is significant uncertainty associated with the licensee's transport metrics that cannot be accounted for.

Please provide additional justification, or else modify the approach used to determine the transport percentages across the operating deck, in response to the issues noted above.

4. Based upon the information presented in the June 2, 2009, supplemental response, the staff did not have confidence that the licensee had adequately addressed several items associated with post-loss-of-coolant accident (LOCA) debris erosion.

    a. Please discuss any testing used to justify the assumption of 10% fibrous debris erosion in the containment pool, including a description of the test facility, 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 plant condition. Please also identify the duration of the erosion tests and how the results were scaled to the plant condition.

    b. The licensee's June 2, 2009, supplemental response indicates that a significant quantity of fibrous debris is predicted to settle out on the operating deck. The response further indicates that the flow velocities will be quite high across the operating deck, with average flows in the range of 0.5 – 1.9 ft/s. Although the supplemental responses indicate that spray operation will be terminated prior to recirculation, based upon these high flow rates and erosion test results at much lower velocities that appear to demonstrate that loose fibers can be rapidly released from pieces of fiberglass (i.e., promptly upon exposure to the flow stream), it appears that neglect of erosion is non-conservative for this debris even during the relatively short duration of containment spray operation.

    c. Although erosion of debris retained on gratings resulting from the impact of containment spray droplets is typically not a major effect, it was not clear to the staff that erosion of retained debris due to break flow could be neglected for Ginna. In particular, the June 2, 2009, supplemental response appears to indicate that retention of fibrous debris on gratings below the break location is credited. Please discuss how erosion of debris due to break flow, which can be a major effect, was evaluated.

5. The June 2, 2009, supplemental response indicates that the head loss testing performed for Ginna resulted in more than half the debris added to each test settling onto the test flume floor. It appeared that a significant part of this settled debris was composed of large pieces of fibrous debris, and potentially other types of erodible debris as well (e.g., small pieces of fiber and calcium silicate). Please address the following points associated with the settled debris in the test flume.

a. Based on the information in the supplemental response, the staff did not consider the head loss test flume flow conditions as being representative of the plant from a debris transport perspective. Furthermore, the staff noted that, while the transport analysis suggests that a significant portion of the transported large pieces of fibrous debris seemed to be Temp-Mat that transported via floatation, the supplemental response describes the large fibrous debris pieces as being soaked with water prior to the test, which would prevent floatation under the test conditions. Particularly given that the transport analysis for the plant flow conditions took significant credit for settlement of fine debris, it was not clear to the staff why large debris pieces soaked with water under the flow conditions in the test flume would have been considered potentially transportable. In light of this information, please provide a basis for considering the behavior observed in the test flume to be representative of the plant condition.

b. A significant quantity of debris settled during the design basis head loss tests. Based on the response, it is not clear that erosion of this settled debris was accounted for in the analysis. Please describe how erosion of debris that settled in the test flume was accounted for in the analysis, or provide a basis for neglecting the erosion of a potential significant fraction of the debris added to the test flume.

6. The June 2, 2009, supplemental response stated that any debris washed to the refueling cavity would be held up in the refueling cavity or reactor cavity rather than reaching an active portion of the containment pool. Please clarify whether filling of the inactive volumes prior to the termination of the containment sprays could occur for any post-LOCA scenarios, resulting in a portion of the debris assumed to wash to the inactive volumes reaching the active containment pool instead.

7. The June 2, 2009, supplemental response discusses crediting the settlement of fine debris (fiberglass and inorganic zinc fines). It appears that values in a range of approximately 7–59% of the total quantities of fine fiberglass and zinc powder were assumed to settle during recirculation for certain cases, although the supplemental response does not explicitly quantify the credit taken. Please state the quantities of fine debris assumed to settle onto the containment floor or other areas of containment. In addition, technical justification is needed regarding the following points: (1) lack of experimental benchmarking of analytically derived turbulent kinetic energy metrics; (2) uncertainties in the predictive capabilities of turbulent kinetic energy models in computational fluid dynamics codes, particularly at the low turbulent kinetic energy levels necessary to suspend individual fibers and 10-micron particulate; (3) the basis for analytical prediction of settling velocities in quiescent and non-quiescent water due to the specification of shape factors and drag coefficients for irregularly shaped debris; and (4) the basis for the theoretical correlation of the terminal settling velocity to turbulent kinetic energy that underlies the methodology for fine debris settling. Please address these points to demonstrate that the credit taken for fine debris settling is technically justified.

8. It appeared from the June 2, 2009, supplemental response that the same debris transport metrics used for Thermal Wrap may have been applied to Temp-Mat as well. Please confirm this statement or provide the transport metrics used for Temp-Mat.

Head Loss and Vortexing

The reviewer noted that most of the previous RAIs were adequately addressed, with an issue remaining regarding RAI 14.

RAI 14 The clean strainer head loss calculation was apparently conducted at 195 °F. It is likely that the clean strainer head loss at lower temperatures would be higher. The licensee should verify that the head loss evaluation considers the potential for higher clean strainer head loss later in the event when the sump temperature is likely to be colder.

The round 2 review also identified a number of new issues. The staff identified the following additional issues that should be answered in order to assure that the licensee's head loss evaluation was conducted conservatively:

1. The licensee should perform a deaeration evaluation to ensure that any gasses liberated from the sump fluid as it passes through the debris bed are considered. If deaeration occurs, the effects on net positive suction head (NPSH) required should be evaluated as described in Regulatory Guide 1.82, Rev. 3, Appendix A.

2. The supplemental response provided a debris head loss value stated to be 0.99 feet when corrected to a "minimum sump temperature" of 195 °F. It was not clear what head loss value was applied at colder sump temperatures that would occur later in the event or whether the value was corrected further for hotter conditions. The staff did not understand what was meant by "minimum sump temperature" as used in this context. The licensee should either calculate the head loss at the minimum sump temperature predicted for the event and apply this value to the NPSH margin calculation, or provide a time/temperature dependent NPSH margin evaluation that justifies that adequate NPSH margin is available for all pumps taking suction from the containment sump for the plant's potential range of post-LOCA conditions.

3. The supplemental response stated that calcium silicate (Cal-Sil) dust and zinc dust were used as a surrogate for Cal-Sil. Approximately 20% by weight of the Cal-Sil was replaced with zinc. The supplemental response did not provide the reason for the partial substitution of Cal-Sil with zinc. The substitution was potentially non-conservative from a head loss testing perspective because Cal-Sil has been shown to be particularly detrimental to strainer head loss. In addition, the zinc powder is likely more dense than Cal-Sil powder. A substitution based on mass without correction for the density difference would result in a reduced volume of debris during the head loss test. Volume is a more important factor than mass when considering debris bed characteristics.

Net Positive Suction Head

The reviewer in the NPSH area considered seven of the eight previous RAIs adequately addressed, however, the reviewer had questions regarding the response for one of the RAIs concerning water level during a small-break LOCA, as detailed below:

RAI 25 The staff requested additional information to support crediting the injection of the accumulators for all break scenarios, including small-break LOCAs. The licensee responded that the potential non-conservatism of assuming accumulator injection for some small-break LOCAs for which injection may not occur (or may not fully occur) is offset by the lack of credit taken for reactor coolant system (RCS) leakage. The staff did not consider this response to be adequate, because there could be small-break LOCAs for which the accumulators may not inject (or may not fully inject), during which flow from the ECCS would result in refilling the RCS to an extent that could make the licensee's assumption non-conservative. Therefore, please provide a basis for concluding that, for all small-break LOCAs (including breaks at elevated locations such as the pressurizer), the water level in containment will be prototypical or conservative with respect to its importance to strainer submergence, deaeration, and vortexing.

December 4, 2009

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Please contact me at 301-415-1364 if you have any questions.

Sincerely,
/RA/
Douglas V. Pickett, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-244

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