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

April 29, 2010

Vice President, Operations
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, NY 10511-0249

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3 - REQUEST FOR ADDITIONAL INFORMATION REGARDING GENERIC LETTER 2004-02 (TAC NOS. MC4689 AND MC4690)

Dear Sir or Madam:

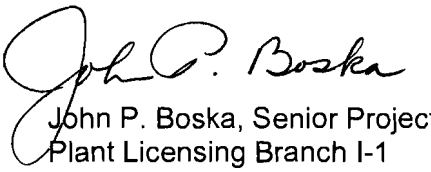
By letter dated November 19, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093290316), Entergy (the licensee) submitted a response to a request for additional information (RAI) from the Nuclear Regulatory Commission (NRC) staff concerning Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," for Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3).

The NRC staff has reviewed this submittal. The process involved a 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. ML07311 0389). 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 IP2 and IP3. The specific questions are found in the enclosed RAI.

The NRC requests that the licensee discuss the proposed responses to this RAI in a teleconference or meeting with the NRC prior to June 11, 2010. This teleconference or meeting will be open to public observation, except for the discussion of proprietary information.

Please contact me at (301) 415-2901 if you have any questions on this issue.

Sincerely,



John P. Boska, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-247 and 50-286

Enclosure:
RAI

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING GENERIC LETTER 2004-02

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3

DOCKET NOS. 50-247 AND 50-286

By letter dated November 19, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093290316), Entergy (the licensee) submitted a response to a request for additional information (RAI) from the Nuclear Regulatory Commission (NRC) staff concerning Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," for Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3).

The NRC staff has reviewed this submittal. The process involved a 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 IP2 and IP3. The specific questions are listed below:

Head Loss and Vortexing

1. In RAI 12 of the NRC staff's letter dated November 19, 2008 (ADAMS Accession No. ML083230054), the staff requested information that provides traceability between the test results presented as final values in the supplemental response and the raw test data. The RAI requested that the licensee provide the methodology for deriving the final values and the assumptions used in the evaluation. In its response letter dated November 19, 2009, the licensee provided descriptions of the tests that linked each break case to one or more tests that were used to evaluate the strainer performance for each particular scenario. This answered the staff's question regarding the ability to determine how each break was covered by the test program. However, the staff could not determine how the test cases were extrapolated to the plant conditions listed in Tables 3f.10-13 and 14. Please provide the methodology (the equations used) and the assumptions used to extrapolate the test cases to each plant case listed in Tables 3f.10-13 and 14.

2. Please provide the results of an evaluation of the potential effect of voids (possibly resulting from deaeration of coolant) on the pumps' net positive suction head required (NPSHR) values as discussed in Regulatory Guide 1.82, Appendix A, and adjust the NPSHR values as described in that guidance. Please explain how the results of the evaluation affect the NPSH margin calculation.

Coatings

3. In RAI 20 of the NRC staff's letter dated November 19, 2008, the staff asked the licensee to provide the rationale for using a 4.28 diameter (D) zone of influence (ZOI) for inorganic zinc (IOZ). In Attachment 3 of the response, the licensee response noted the 4.28D ZOI has been evaluated, design verified, and the data (new data presented in the response) conservatively applied. However, in Section 3h.5, the licensee response noted that due to the applied thicknesses and densities of the various Indian Point coating systems, the current approach of 100 percent epoxy at 4D is bounding with respect to the IOZ 5D cases. It is unclear to the staff which approach the licensee is using (4.28D for IOZ or a bounding 4D epoxy case). In addition, the staff has become aware of issues with the testing intended to support a 5D ZOI for IOZ (WCAP-16568P). Westinghouse provided revised ZOI analyses for both epoxy and untopcoated inorganic zinc coatings in a letter dated March 24, 2010 (Accession No. ML100880023). The staff has not accepted the Westinghouse-sponsored confirmatory testing and analysis for untopcoated inorganic zinc coatings. Therefore, the NRC staff no longer finds a 5D ZOI acceptable for untopcoated inorganic zinc. This conclusion was documented in a revision to the staff's review guidance on this subject (see ADAMS Accession No. ML100960495, dated April 6, 2010). Instead, licensees may rely on the staff's prior acceptance of a 10D ZOI for untopcoated inorganic zinc as documented in its Safety Evaluation (SE) for NEI 04-07. Please clarify and justify the ZOI for untopcoated IOZ without the use of the WCAP-16568P reduction, or describe impacts on strainer performance as a result of a decision to use a larger ZOI.

Chemical Effects

4. In RAI 23, the NRC staff asked the licensee to submit the revised chemical effects test results and analyses. The licensee responded that chemical precipitates would not occur for the first 7 hours following a loss-of-coolant accident (LOCA) at IP2 and IP3. This conclusion is based, in part, on the following statements from the licensee's letter (page 200 of 243):

> Based on plant-specific aluminum concentrations and pH, aluminum is predicted to precipitate at 118°F for IP-2 and 121 °F for IP-3. The minimum possible temperature at 7 hours after a LOCA is 122°F and 123°F for IP-2 and IP-3, respectively. While the temperatures shown above for the minimum containment temperature and the predicted precipitation temperature indicate that there is only a small amount of margin, both values contain significant conservatisms that make the actual margin larger than the calculated margin. The minimum containment temperature is based on a model which used simplifying assumptions to minimize temperature rather than a model using refined inputs to achieve an exact result.

Since the minimum containment temperatures are lower than the calculated threshold temperature for precipitation based on an equation developed by Argonne National Laboratory, the NRC staff does not understand how the temperatures shown above demonstrate any margin. Additional statements indicated that the post-LOCA temperatures will not reach the stated minimum values; however, there is no discussion to quantify how these assumptions result in unreasonably low calculated minimum

temperatures. Please justify the conclusion of no precipitation during the first 7 hours following a LOCA.

Debris Transport

5. In RAI 1, the NRC staff asked the licensee to provide an adequate technical basis to support the assumption that some percentage of small pieces of fibrous debris will be captured on gratings in the upper containment. The licensee's response stated that the retention percentage assumed 50 percent holdup of small pieces on grating as an input. This assumption in turn was based on drywell debris transport study information (NUREG/CR 6369) which showed for each test case the washdown fraction was less than 50 percent. The response continued with a detailed discussion of associated assumptions, testing, and plant-specific information. The staff considers the licensee response did not adequately address this issue for the following reasons:

   a. For boiling-water reactors (BWRs), most debris may be blown downward to the suppression pool and captured on the upper surface of gratings, whereas in pressurized-water reactors (PWRs), most debris may be blown upward and captured on the underside of gratings. Washdown occurs more readily when debris is captured on the underside of gratings. Thus, the BWR washdown capture data likely overestimates the PWR condition.

   b. A substantial fraction of the debris blown to the upper containment may be blown through gratings. This is unlike the BWR configuration, wherein debris subject to washdown may be blown downward and trapped on the upper side of grating without having first passed through other grating. The licensee stated that this effect is conservatively accounted for by assuming debris trapped on the underside of gratings would fall back to the containment pool. However, there are additional considerations. The staff would expect that full consideration of this design difference would have resulted in significantly fewer small pieces being blown to upper containment than assumed by the licensee (59 percent). In addition, NUREG/CR-6369 shows that debris that passes through one or more levels of grating during blowdown is more like fines that would tend not to be retained by gratings than like small pieces. Thus, the BWR retention data cited by the licensee for the small pieces in the upper containment of a PWR would not be applicable to a significant fraction of these pieces that would be significantly smaller. The staff expects that washdown for PWR debris would be significantly higher than the BWR washdown data, due to the fact that the pieces that reached upper containment would likely be smaller and more like fines.

   c. Blowdown testing has shown that substantially less capture is observed on the second grating in a series due to the smaller debris size distribution. The licensee's model lacked consideration of this factor when crediting the second grating in series, instead having a capture fraction equal to the first.

   d. Debris in the NUREG/CR-6369 washdown and erosion testing was piled up and packed together much more than the NRC staff would expect for the PWR case, which would not blow down directly onto gratings to the same extent. It is not clear that such packing would exist for the PWR configuration, except at boundaries where debris is washed off of solid floors or surfaces and is exposed

to concentrated flow. More washdown will occur for a less-packed debris configuration or with the presence of concentrated flow.

e. Concentrated drainage was not considered in the Indian Point evaluation. The licensee determined a flow flux of 0.4 gpm/ft^2, apparently assuming uniform drainage across the containment cross section. This value is significantly lower than the value used in the BWR testing. However, the Indian Point containment drainage would likely be more concentrated at locations where large debris masses are trapped on gratings, since water and debris typically transport together during washdown. Solid flooring and obstacles will lead to significant non-uniformity in the debris and water drainage distribution that includes flow through gratings. The staff questions the conservatism of the licensee's assumption of 50 percent pass through of small pieces through grating since neither testing nor evaluation has adequately considered the effect of non-uniform drainage. It is unclear that a low uniform dispersed flow represents potential plant conditions in that local conditions where washdown and erosion would occur are not accounted for.

f. Of all the tests done with sprays, only tests of 30 minutes were done for small pieces, with one 60-minute test for medium pieces. NUREG/CR-6369 concludes that a transport fraction of 1.0 is appropriate for debris smaller than gratings for either break or spray flows. The licensee's assumption of 50 percent small piece retention on gratings is inconsistent with the conclusions of the document from which the data is taken.

g. Although the licensee correctly stated that NUREG/CR-6369 indicates that the majority of washdown occurred during the first 15 minutes of testing, it is clear that the NUREG did not conclude that washdown ceases after this time. Without having run tests prototypical of plant conditions (finer debris that is more spread out and potentially lower spray flows), the staff does not agree with the licensee's determination that washdown will effectively cease after 15 or 30 minutes.

h. The Utility Resolution Guidance indicates transport fractions of 1.0 for Mark I and Mark III BWR containments; the corresponding SE modified the Utility Resolution Guidance position to recommend a 1.0 transport fraction for Mark II containments as well. Therefore, no hold up credit for gratings was permitted by the approved analysis methodology used by the BWRs. The NRC staff notes that the licensee's discussion (response Page 80) using the BWR Owners Group washdown data relied on a method the staff did not consider acceptable for BWRs. The staff did not consider the BWR Owners Group washdown testing conservative for its intended use. This also supports the staff's interpretation that NUREG/CR-6369 concluded that no retention should be credited under spray-only conditions.

i. The licensee's discussion on gratings in series does not appear to account for the reason the debris was washed down. The staff considers that debris in the washdown tests did not pass through the gratings because it lined up correctly with the openings in the grating; the debris was piled up on top of the gratings more or less randomly. The more likely reason it passed through the gratings was due to the flow interacting with, or breaking up, or realigning, or forcing the

debris through the openings. Therefore, the staff does not consider it appropriate to credit multiple gratings in series with the same capture fraction based on a simplified geometric argument that does not address the size distribution changes discussed above, nor the associated mechanisms by which the debris could pass through the initial grating.

j. The licensee considered debris retention on solid floors an uncredited conservatism. Although the predicted flow velocities on such floors typically would exceed the incipient tumbling velocity for certain fibrous small pieces, the licensee considers that the debris pieces would be saturated with water and thus transport via partially submerged tumbling. However, the NRC staff's view is that, at more than several linear L/D from the break, debris pieces, while wetted, would not likely be fully saturated with water by the jet. The staff does not consider it conservative to assume debris pieces will be soaked when determining transport across containment floors. Pieces of fiber would likely still be partially floating, particularly in cooler spray water that would constitute the water on solid floors in upper containment. This latter effect was not considered by the licensee and could significantly increase transport. Even if the debris were not floating, there would still be no way to assess whether the debris continued to house trapped air that would change significantly the frictional force felt by the tumbling debris per the licensee's analytical methodology. The staff considers it appropriate for the licensee to consider limiting fluid thermodynamic conditions when assessing debris wetting and saturation with water. The staff considers the licensee's analytical derivation of transport metrics for fully liquid saturated debris transporting under partially submerged conditions to lack adequate justification. The licensee took significant credit for this unvalidated methodology, deriving incipient tumbling metrics 20 times higher than the accepted measured values for submerged conditions. Measurements of actual debris transport velocities would be needed to validate the licensee's analytical methodology. Therefore, the staff did not consider this analysis to show a significant conservatism.

k. The licensee stated that retention of inertially captured debris would realistically occur but was conservatively not credited. The staff considers it unlikely that a significant mass of inertially captured debris will be retained in the long term. Whether by sprays, condensate, or gravity, much of this debris will release from vertical surfaces or the underside of horizontal surfaces.

l. The uncertainty with blowdown and washdown transport is very high due to a lack of testing. The behavior of debris in response to these mechanisms is not well understood, as is discussed in NUREG/CR-6369.

Please address the above issues to justify the holdup credited, or otherwise consider the impact of reduced holdup of small debris on gratings and other features above the containment pool.

6. In RAI 2, the NRC staff asked the licensee to provide an adequate technical basis to support its assumption of 10 percent fibrous debris erosion in the containment pool. The response stated that this was a reasonable assumption and provided justification. To further support the assumption, the licensee is participating in an industry program to generate additional erosion test results, with a report expected in April 2010. Please

provide a description of the test and the test results once completed in order to demonstrate the adequacy of the assumed erosion percentage.

7. The licensee is crediting time-dependent debris transport for qualification of the vapor containment (VC) sump. In RAI 5, the NRC staff asked the licensee to provide adequate technical justification that the time-dependent model is conservative. The response provided an analysis that noted the effect of each staff concern was quite small, and that only a small fraction of the debris would remain in the pool after one day (0.5 percent for IP2 and 0.7 percent for IP3). After reviewing this information, the staff still has questions concerning the adequacy of the head loss test assumption of less than 5 percent fiber transport to the VC sump. The staff considers that the licensee's response did not adequately address this issue for the following reasons:

   a. The licensee assumed debris all washed down prior to switchover, minimizing transport to the VC sump. The RAI response stated if washdown were delayed to 4 hours, the transport of fines to the VC sump would be about 4 percent. The NRC staff finds this response inadequate in that, when a realistic delay is assumed, in conjunction with the other items noted below, it could lead to greater than 5 percent transport to the VC sump.

   b. The NRC staff noted that the fiberglass erosion curve presented by the licensee was based on data from Alion that anomalously showed significantly less cumulative erosion for long-term tests than for short-term tests. The staff also noted that the curve fit is not consistent with data seen from tests better suited to assessing time-dependence, and does not seem consistent with the most recent test data that Alion is collecting concerning erosion and its time dependence.

   c. The licensee indicated that the strainers have bypass eliminator mesh installed, which would significantly reduce the quantity of fibers and some other types of debris that may pass through the strainers. The staff questions, however, whether the 100 percent capture assumption for fine particulate (e.g., 10-micron diameter) is realistic, as simulations have shown that 10-15 pool turnovers are needed to filter out fine particulate for a debris bed of representative porosity. The staff does not agree with the licensee that after 24 hours for a single-train case less than 5 percent of the fine particulate debris would remain in suspension based on the times associated with forming a debris bed with high filtration efficiency and subsequently to achieve 10-15 pool turnovers.

   d. The licensee stated little debris bed movement was observed during Indian Point plant-specific testing, that check valves would prevent significant reverse flow into the internal recirculation strainers, and the debris bed would not be easily broken down due to agglomeration of constituent debris pieces. The licensee stated that released debris would not easily transport due to being in a pit that is physically separated from the VC sump. The NRC staff did not fully agree with these statements. The staff has observed that accumulated air could result in significant debris release; has seen considerable debris bed movement following pump stoppage; and if only the top row of top hats releases debris, and only a tenth of this debris is released and transported, about 1 percent of the total internal recirculation sump debris load could be on the VC sump strainer.

e. The licensee stated that debris would not be directed toward the VC sump during blowdown. The NRC staff generally agrees that significant transport would not occur during blowdown based on the barriers the licensee installed that were described as preventing blowdown transport. However, for pool-fill, although a significant part of the fines may still be in upper containment, blowdown transport is chaotic and difficult to predict. Therefore, the staff expects that pool-fill would result in the transport of a fraction of the fine debris to the VC sump. Although difficult to predict accurately, it is not clear to the staff that a non-recirculation transport (i.e., primarily through pool-fill) fraction less than a percent or two can be justified for fines (as an order of magnitude), which would pass through the perforated barriers.

The NRC staff questions the 5 percent assumption given the items identified above. Please justify the assumption in light of the items above, or else please provide a description and results of an evaluation of how the plant's system response would be affected by potentially greater debris transport to the VC strainer based on these considerations.

Please contact me at (301) 415-2901 if you have any questions on this issue.

Sincerely,

/ra/

John P. Boska, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-247 and 50-286

Enclosure:
RAI

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