



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

December 24, 2008

Vice President, Operations  
Entergy Nuclear Operations, Inc.  
Palisades Nuclear Plant  
27780 Blue Star Memorial Highway  
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT – ISSUANCE OF REQUEST FOR ADDITIONAL INFORMATION REGARDING SUPPLEMENTAL RESPONSES TO GL 2004-02 (TAC NO. MC4701)

Dear Sir:

By letter dated February 27, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML080630253), Entergy (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 Palisades Nuclear Plant (Palisades).

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 Palisades. The enclosed document describes these requests for additional information (RAIs). The enclosed RAIs were discussed with your representatives during a teleconference with the NRC staff on December 3, 2008.

The NRC requests that the licensee respond to these RAIs within 90 days of the date of this letter. However, the NRC would like to receive only one response letter for all RAIs with exceptions stated below. If the licensee concludes that more than 90 days are required to respond to the RAIs, 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 NRC staff before formally transmitting an extension request.

The exception to the above response timeline is RAI 16 in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Palisades, 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 Palisades 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 16 by demonstrating, without reference to WCAP-16793 or the NRC staff SE, that in-vessel downstream effects have been addressed at Palisades. The specific issues raised in RAI 16 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's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,



Mahesh L. Chawla, Project Manager  
Plant Licensing Branch III-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure: Request for Additional Information

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REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING SUPPLEMENTAL RESPONSES TO GENERIC LETTER (GL) 2004-02

PALISADES NUCLEAR PLANT

1. If lead blankets were determined to contribute to potential sump blockage debris, please identify the zone of influence (ZOI) size used. Please provide information relative to impact of differences in jet size, target size and geometry used in developing the test report WCAP-16727-P, "Evaluation of Jet Impingement and High Temperature Soak Tests of Lead Blankets For Use Inside Containment of Westinghouse Pressurized Water Reactors," dated February 2007, with that of the jet sizes and lead blankets at Palisades.
2. Section 3.c of the supplemental response does not provide debris characteristics for all of the debris types listed on Page 17 of the response. Therefore, please provide the following information requested by the NRC Content Guide needed by the NRC staff to complete its debris characteristics review:
  - a. The size distribution for calcium silicate debris (both that debris generated within a break ZOI and from containment spray impingement) and the assumed resultant particle size.
  - b. The size distribution for fibrous debris generated by containment spray impingement on fibrous insulation.
  - c. The size distribution for debris generated from Marinite board.
  - d. The form assumed for all types of unqualified coatings (i.e., particulate or chips) and the assumed characteristic sizes for each debris type. Page 59 of the supplemental response states the methodology for determining the form of unqualified coatings debris (it was assumed to be particulate unless supported by specific testing to prove otherwise), but the final result of applying this methodology to the specific quantities of these coatings present at Palisades was not clearly stated.
3. When the final supplemental response is submitted, please include a discussion of any changes that have been made to the analysis that are associated with debris characterization at a level of detail consistent with the NRC supplemental response content guide. The NRC staff will review this information when submitted, and as a result of such review, the NRC staff could request additional information in this subject area if needed.
4. Please provide the physical properties of the Alpha Maritex cloth material and the characteristic form and size of the debris formed from this material (e.g. fines, small pieces). In addition, please provide the technical basis for determining the transportability of debris generated from Alpha Maritex cloth.

Enclosure

5. The February 27, 2008, GL 2004-02 Supplemental Response (ADAMS Accession No. ML080630253) stated that samples were taken for containment latent debris during the 2006 refueling outage. However, sufficient detail was not provided regarding the types of areas sampled, the number of samples taken for each area type, and the containment elevations sampled. Please provide these details, and describe how the sample results were extrapolated in order to estimate a total latent debris amount in the containment.
6. Please provide a description of the methodology used to count the number of tags, signs, tapes and stickers in containment and estimate their total surface area (e.g., walkdown of containment, photographs of containment areas, review of design drawings, etc.).
7. Please specify the types of materials included in the miscellaneous category in the foreign materials section of the "Summary of LOCA Generated Debris" table on page 17 of the February 27, 2008, submittal.
8. Please provide the final results of the analysis of the potential for transport of fragments of the lead blankets and specify whether this material was included as miscellaneous material.
9. The supplemental response states that a computational fluid dynamics analysis is being performed and that the containment debris transport analysis is being revised. When the final supplemental response is submitted, please include a discussion of the computational fluid dynamics analysis and the changes that have been made to the transport calculation at a level of detail consistent with the NRC supplemental response content guide. The NRC staff will review this information when the licensee submits it and, as a result of such review, the NRC staff could request additional information in this subject area if needed.
10. The supplemental response discusses the applicability of Westinghouse letter LTR-SEE-05-172 to the settling of coating chips within the containment pool. In the NRC staff's audit of Waterford 3 (ADAMS Accession No. ML080140318), this letter was reviewed by the NRC staff and was considered to have significant technical deficiencies as a basis for justifying the settling of coating chips in a containment pool. Section 3.5.5.2 of the Waterford 3 audit report states three main NRC staff concerns: (1) the size distribution assumed for the failed chips, (2) the failure to distinguish between chip diameter and chip thickness, and (3) the consideration of vertical flow conditions that are typically inapplicable to containment pools. Please state whether this letter will be credited as a basis for assumptions concerning unqualified coating chip transport in the revised transport analysis, and, if credit is taken, please address the three deficiencies summarized above.
11. Page 25 of the supplemental responses states that no curbs or debris interceptors were credited with inhibiting debris transport. However, Figures 3.e.2 and 3.e.5 in the supplemental response (which are debris transport logic trees) clearly indicate that debris curbs were credited with inhibiting debris transport. Please describe the debris curbs for which credit was taken and clarify whether similar credit will be taken in the revised debris transport analysis.

12. Please describe how the flume velocity was determined for the final strainer head loss testing to be conducted for Palisades based upon the plant computational fluid dynamics calculation, specifically addressing the potential for non-uniform velocities on the approach to the actual strainer installed in the plant.
13. The single failure of a low-pressure safety injection (LPSI) pump to trip at the time of switchover to recirculation was not fully addressed in the supplemental response. The supplemental response also noted that a LPSI pump could be restarted later in the event if necessary. Therefore, please address how the following items related to the potential operation (including failure to trip) of a LPSI pump during recirculation are addressed in the strainer performance analysis:
  - a. Increased flow from an operating LPSI pump could lead to increased debris transport that was not considered in the debris transport calculation or flume testing.
  - b. Increased flow from an operating LPSI pump could lead to a larger clean strainer head loss value than was calculated in the existing analysis.
  - c. Increased flow from an operating LPSI pump could result in higher than analyzed flow through the strainer. Events that would result in higher than analyzed flow through the strainer should be evaluated and shown to result in acceptable NPSH margin.
14. The NRC's June 27, 2008, Generic Letter 2004-02 extension approval letter addressed the following program plan for Palisades:
  - a. Complete chemical effects strainer testing by September 30, 2008.
  - a. Complete strainer debris and chemical effects test report including supporting analyses for testing and inputs by December 31, 2008.
  - c. Complete any necessary modifications prior to restart from the 2009 refueling outage.
  - d. Complete design and license bases updates, and provide final update to GL 2004-02 supplemental response by February 27, 2009, if no modification is required, or 60 days following completion of the 2009 refueling outage if modification is required.

Because the final head loss and vortexing evaluation has not yet been transmitted to the NRC, no actual RAIs could be developed in this area. However, the head loss and vortexing testing subject areas and/or issues listed below should be addressed in the final supplemental response:

- a. Information requested by the content guide that was not previously submitted due to the testing being incomplete or that changed due to the testing results.

- b. Flow rates in the flume.
- c. Scaling factors for testing.
- d. Debris amounts added for testing, including debris size distributions where appropriate.
- e. Debris preparation and introduction methods.
- f. Head loss results – time based chart with significant data included (e.g. flow, temperature, debris addition times).
- g. At the beginning of recirculation for a small-break loss-of-coolant accident (SBLOCA), the strainer stacks are submerged by about 3/4 inch. The supplemental response stated that the vortexing evaluation was performed assuming a submergence of 3 7/8 inches. The licensee should demonstrate that, at the calculated minimum submergence that occurs during a SBLOCA, vortex formation does not occur.
- h. The Palisades sump is vented. If head loss becomes greater than the containment water level elevation minus the elevation of the vent entrance into the sump (about 4.5 feet), air will be drawn into the emergency core cooling system (ECCS) pump suction plenum. In addition, it is likely that air voids will begin to form inside the strainer. These events could lead to increased head loss or air entrainment in the ECCS pump suction. The licensee should demonstrate that head loss will not exceed 4.5 feet or otherwise show that the strainer will not fail to perform its function due to air voids.
- i. The vents to the sump are about 1.5 feet above the minimum water level. It was not stated in the supplemental response what the maximum water level is. If the water level reaches the vent openings, debris could bypass the strainer and enter the ECCS pump suction directly. The licensee should demonstrate that this form of debris bypass does not occur.
- j. A drawing (Attachment 2) included with the supplemental response shows seven 4-inch floor drains with debris screens that bypass the strainer and drain directly into the sump. The licensee should verify that the debris screens will not allow bypass of debris different (larger) from that already included in the bypass evaluation. The licensee should also verify that any bypass through these drains has been included in the downstream evaluation. In addition, it should be demonstrated that these drains will not allow air entrainment into the ECCS pump suction.
- k. The supplemental response did not consider the potential effects of water (from the break or from spray drainage) falling near the strainer. During the period of relatively small submergence, effects from the falling water could entrain air near the strainer resulting in air being drawn through the strainer and into the ECCS

pump suction header. The licensee should demonstrate that this effect either will not occur or will not have a significant effect on ECCS pump net positive suction head (NPSH).

- l. The Performance Contractors Incorporated (PCI) clean strainer head loss (CSHL) calculation is founded on a correlation based on prototype boiling water reactor (BWR) strainer testing. However, the BWR strainers have a significantly different geometry than pressurized-water reactor (PWR) strainers. In the Prairie Island audit report (ADAMS Accession No. ML071070057), the NRC staff stated that the applicability of the BWR prototype correlation to PWR strainers has not been shown to be valid. The NRC staff is awaiting test data from PCI strainer testing for Wolf Creek and Callaway to validate the CSHL assumptions used in the PWR calculations. The licensee referenced a document in the supplemental response that PCI provided to the NRC staff regarding the CSHL, but the NRC staff has not accepted this document's validity. The licensee should resolve this NRC staff concern.
- m. No CSHL value was provided in the supplemental response. The licensee should provide the CSHL value, and discuss the methodology used to derive this value.
- n. The supplemental response did not discuss the ability of the strainer to accommodate the maximum debris load. The response stated that the break selection section (3.b) of the supplemental response addressed the issue. However, no discussion of the strainer was included in section 3.b. The intent of the question in the NRC staff Content Guide is to ensure that the strainer either has a large enough area to prevent a circumscribed bed or that the formation of a circumscribed bed will not result in excessive head loss.
- o. The supplemental response stated in several places that a thin bed would be precluded due to the complex surface design of the Palisades PCI strainer. Based on tests of PCI strainers that resulted in a relatively thin filtering bed (including Palisades and Point Beach), and the Palisades potentially challenging debris loads, the NRC staff believes that the thin bed should be evaluated for the Palisades installation. The licensee should demonstrate either that a thin bed at Palisades can not form, or that if it does form, it does not result in unacceptable strainer head loss.
- p. The supplemental response references 2.86 feet as the maximum allowable head loss. Based on recent Palisades test results it appears that this value may increase. The supplemental response should be revised to reflect the final allowable head loss. This value also can affect the NPSH margin and structural evaluation results.
- q. The supplemental response states that containment accident pressure was not credited in evaluating flashing across the strainer. However, the submergence of the strainer is small when compared to the strainer head loss. In the supplemental response the licensee's discussion of air ingestion into the strainer is questionable. The licensee stated on Page 41 that the NUREG/CR-6224

correlation indicates 0.0% void fraction downstream of the screen. This statement does not appear correct, particularly in light of the statement on Page 46 of the supplemental response that no containment accident pressure was credited in the flashing calculation. The bases for the conclusion that flashing will not occur should be provided.

15. The supplemental response to item (m) "Downstream Effects – Components and Systems" includes a detailed description of the downstream effects evaluations performed by the licensee. However, these evaluations were performed prior to the issuance of the approved WCAP-16406-P, Rev 1, and the NRC safety evaluation (SE) of that document. The Entergy Nuclear Operations Inc. (ENO) supplemental response states that the current evaluations will be revised, applying the guidance provided in the approved WCAP-16406-P, Rev. 1 and data obtained through additional testing. ENO stated that a revised final response will be submitted once the evaluations are completed. The NRC staff requests that ENO provide the final description of the downstream effects evaluations in accordance with the request under item (m) in the Revised Content Guide for Generic Letter 2004-02 Supplemental Response dated November 2007.
16. The NRC staff considers in-vessel downstream effects to not be fully addressed at Palisades Nuclear Plant (Palisades), as well as at other PWRs. The ENO supplemental response for Palisades 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 SE for WCAP-16793-NP. The licensee may demonstrate that in-vessel downstream effects issues are resolved for Palisades by showing that the licensee'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 also resolve this item by demonstrating without reference to WCAP-16793-NP or the NRC staff SE that in-vessel downstream effects have been addressed at Palisades. 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-NP. 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.

Regarding the last two RAIs below, the licensee indicated in its February 27, 2008 supplemental response that additional chemical effects testing will be performed for Palisades and, as a result, the NRC staff has not been able to develop a comprehensive list of chemical effects RAIs. The NRC staff expects that chemical effects information as called for in the NRC Content Guide will be forthcoming in a follow-on Generic Letter 2004-02 supplemental response. The NRC staff will review this information when the licensee submits it, and as a result of such review, the NRC staff could request additional information in this subject area if needed. Nevertheless, at this time the NRC staff has the two chemical effects questions that follow:

17. The February 27, 2008, supplemental response states that the "choice of worst breaks is applicable to the new passive strainers and the new STB [sodium tetraborate] buffer" in part because the impact of trisodium phosphate and calcium silicate was not widely understood at the time the break selection analysis was performed. Please clarify this

statement and confirm that the break location determined to be the "worst case" results in the projected maximum quantity of aluminum containing precipitates being generated.

18. Page 66 of the February 27, 2008, supplemental response indicates that Palisades Technical Specification Surveillance Procedure RT-92 addresses the biological cleanliness of the sump, and specifies that algae and/or slime in the sump that could impede ECCS operation be removed. Please discuss the typical amounts of algae and/or slime that are removed from the sump and justify why this amount of biological material does not need to be considered as an additional debris source after a postulated LOCA.

The exception to the above response timeline is RAI 16 in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Palisades, 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 Palisades 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 16 by demonstrating, without reference to WCAP-16793 or the NRC staff SE, that in-vessel downstream effects have been addressed at Palisades. The specific issues raised in RAI 16 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'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/*

Mahesh L. Chawla, Project Manager  
Plant Licensing Branch III-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure: Request for Additional Information

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