

June 26, 2007

MEMORANDUM TO: Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Michael L. Scott, Chief LW for MS **/RA/**
Safety Issue Resolution Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

SUBJECT: WATERFORD UNIT 3 DRAFT OPEN ITEMS FROM STAFF AUDIT OF
CORRECTIVE ACTIONS TO ADDRESS GENERIC LETTER 2004-02

Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors" (GL 2004-02), requested that all pressurized-water reactor (PWR) licensees (1) evaluate the adequacy of the emergency sump recirculation function with respect to potentially adverse effects associated with post-accident debris, and (2) implement any plant modifications determined to be necessary. Entergy Operations, Inc. (Entergy), the licensee, has conducted an evaluation of recirculation sump performance for Waterford, Unit No. 3, and is conducting significant modifications, including installation of new recirculation sump strainers.

The staff conducted a detailed audit of the new sump design and associated analyses, evaluations, testing and modifications for Waterford 3 the week of June 4, 2007. This audit was an in-process "snapshot" of Entergy's GL 2004-02 corrective actions, which are to be completed by December 31, 2007. This is one of several audits to be conducted over an approximate two-year period to establish a sample basis to assist in verifying the adequacy of PWR licensee corrective actions to address GL 2004-02.

This memorandum transmits the draft open items from the audit. These draft open items are subject to change as the audit report is developed, finalized and issued. Please note that the audit report will contain no conclusion as to the overall adequacy of Entergy GL 2004-02 corrective actions. That conclusion will be reached when the licensee's final GL 2004-02 response (expected by December 31, 2007) is reviewed. That response will address the audit report open items as well as generic requests for additional information issued to the licensee in 2006, and will describe the finalized GL 2004-02 corrective actions for Waterford Unit 3.

Docket No: 50-382

Enclosure:
As stated

CONTACT: Leon Whitney, SSIB/DSS (301) 415-3081 Joe Golla, PGCB/DPR (301) 415-1002_

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NAME	LWhitney	MScott LW for MS
DATE	06/26/07	06/26/07

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DRAFT OPEN ITEMS FOR JUNE 2007 AUDIT OF WATERFORD UNIT 3
CORRECTIVE ACTIONS FOR GENERIC LETTER 2004-02

June 20, 2007

Open Item: Justification of 2D zone of influence (ZOI) for metal encapsulated fiberglass

The licensee did not adequately justify the use of a 2D ZOI for metal encapsulated fiberglass, a value that was adapted from a tested ZOI for metal encapsulated RMI.

Open Item: Documentation of debris characteristics for fibrous debris

The licensee's analysis did not comprehensively document the characteristics for all fibrous debris postulated to be generated following a loss-of-coolant accident (LOCA). The debris properties for which the licensee largely did not provide adequate information included macroscopic density (i.e., bulk density or as-fabricated density), microscopic density (i.e., material density without consideration of internal voids), and characteristic debris size (i.e., the physical dimensions of a debris particle or fiber).

Open Item: Justification for 5D ZOI for qualified coatings in containment

The licensee did not provide an adequate justification for the use of a 5D ZOI for qualified coatings in containment. This item will remain open pending NRC review of a Westinghouse test report provided by the licensee.

Open Item: American Society of Mechanical Engineer (ASME) visual assessment method to assess long-term coatings degradation

The licensee's use of the ASME visual assessment method to test for long-term degradation of qualified coatings will remain an open item until the Electric Power Research Institute (EPRI)/Nuclear Utility Coatings Council (NUCC) actual plant coatings pull test report is available.

Open Item: Impact of chemicals on unqualified coatings

The impact of chemicals on unqualified coatings will remain an open item pending Pressurized Water Reactor Owners Group (PWROG) resolution of the NRC's question regarding the potential for unqualified coatings to become physically altered in a manner that may have a detrimental effect on head loss.

Open Item: Use of qualified coatings debris characteristics for unqualified coatings

The licensee did not justify using qualified coatings debris characteristics for unqualified coatings. The test data cited by the licensee is specific to (qualified) Carboline Phenoline 305 coating, which would perform differently than the various unqualified coatings in the containment. The licensee should treat the unqualified coatings debris per the NRC safety evaluation on NEI 04-07 (that is, as particulate), or justify treatment in the same manner as degraded qualified coatings, or use (and justify use of) available debris characteristics data (e.g., the EPRI OEM test data) for the unqualified coatings in the containment.

Open Item: Blockage of refueling cavity drains

The licensee did not demonstrate that blockage of the refueling cavity drains would not occur due to debris blown into the cavity. Blockage of these drains would result in reduced containment pool level prior to recirculation.

Open Item: Update of debris transport calculation

The licensee had not updated the debris transport calculation report to fully reflect revised computational fluid dynamics (CFD) runs, the new strainer configuration, and some revised analytical assumptions. For example:

- The licensee did not provide a technical basis to demonstrate that the transport fractions derived from the original CFD calculations for the old sump screen remain bounding for the replacement strainer.
- The licensee had not fully updated the debris transport calculation to reflect a revision to the assumptions concerning the properties of failed unqualified coatings (i.e., the revised assumption that these coatings fail as chips instead of particulate), in that in some places the calculation refers to the debris as being in the form of particulates, and in some places the calculation refers to the debris as being in the form of chips.

Open Item: Coating chips landing in the containment pool near the strainers

In the coating chips transport analysis the licensee had not accounted for coating chips that may land in the containment pool near the strainers and be drawn onto the strainers while suspended in the containment pool fluid.

Open Item: Comparison of properties of postulated failed coatings chips versus tested chips

In the licensee's analysis of coating chip transport the licensee had not rigorously compared the properties of the coating chips postulated to fail at Waterford 3 with the properties of the chips that were tested in experiments. The licensee had used the experimental results to justify that a fraction of the Waterford 3 failed coating chips would not transport to the sump.

Open Item: Minimum containment pool water level holdup mechanisms

The licensee did not include the following holdup mechanisms in the analysis of the minimum containment pool water level: water holdup due to condensation films; water holdup due to spray droplet holdup in containment atmosphere; and refill of reactor pressure vessel with cold water. Further, in that analysis the refueling water storage pool (RWSP) water temperature should be assumed closer to the initial containment temperature.

Open Item: Justification for as-manufactured net positive suction head (NPSH) required values for high pressure safety injection (HPSI) B pump

The licensee did not provide justification for the use of as-manufactured NPSH required values for the HPSI B pump.

Open Item: Strainer minimum submergence less than maximum head loss

The licensee had not addressed the fact that the minimum submergence of the strainer was calculated to be less than maximum head loss through the strainer. In such a situation, with fluid near saturation temperature, flashing (steam voiding) may occur in the debris bed or as the fluid passes through the strainer. This two-phase flow may increase strainer head loss, deaerate the sump fluid, and/or reduce NPSH available by entraining vapor or air to the pump suction.

Open Item: Low pressure safety injection (LPSI) pump failure to trip

The licensee had not adequately considered the single failure of a LPSI pump failure to trip. Review of the plant emergency operating procedures (EOPs) showed that the operator is directed only to verify that the pump is tripped. Further discussion with Operations personnel indicated that their training had in fact prepared them to conduct multiple, varied actions to attempt to trip the pump breaker, including local manual actuation. However, the licensee had not analyzed the worst-case time to open the breaker nor the possible effects, during that time, of the additional flow that would result from the high flow rate due to LPSI pump operation (high head loss through the strainer, higher quantities of debris bypassing the strainer, higher debris transport potential, etc.).

Open Item: Preparation of surrogate fibrous debris

The licensee did not demonstrate that the preparation of the surrogate fibrous debris used in head loss testing was fine enough to prototypically represent the debris postulated in the debris generation and transport analyses. Debris size can have a significant effect on transport and debris bed formation, and therefore head loss.

Open Item: Inaccurate test flume mockup

The licensee did not demonstrate that the tri-sodium phosphate (TSP) basket mockups in the test flume resulted in conservative debris loading during testing. The mockup configuration may have blocked the debris from reaching the strainer. The TSP baskets in the plant have been permanently relocated to an area away from the strainer and therefore should not be included in the test mockup.

Open Item: High concentration of fibrous debris in test flume leading to excessive settling

The licensee did not demonstrate that the concentration of fibrous debris in the test flume provided prototypical or conservative head loss results. The concentration of fibrous debris in the flume was much higher than that predicted for the plant. This high concentration may have resulted in agglomeration of fibrous debris and excessive settling, thereby causing reduced fibrous debris to arrive at the strainer.

Open Item: High concentration of fibrous debris in test flume leading to bulky bed formation

The licensee did not demonstrate that the introduction of all fibrous debris into the test tank prior to operating the test rig recirculation pump resulted in prototypical or conservative head

loss results during testing. The fibrous debris introduction procedure caused debris to approach the strainer much more rapidly than would occur following a postulated LOCA. This appears to have resulted in a bulkier bed formation and therefore lower head losses than would be expected in an actual LOCA.

Open Item: Test procedure inadequate to identify thin-bed thickness for peak head loss

An adequate spectrum of thin-bed thickness cases was not tested to provide high confidence that peak head loss would be noted. It also was noted that, in the one thin-bed case tested, the distribution of fiber across the strainer was not even.

Open Item: Incorporation of WCAP-16204P Revision 1 into downstream effects evaluation

The licensee had not incorporated the issues in WCAP-16406P Revision 1 into the plant's downstream effects evaluation (Revision 1 is an extensive revision based on NRC RAIs).

Open Item: Basis for assumption that ECCS pumps are "as-good-as-new"

The licensee did not provide a basis for the assumption that the ECCS pumps are "as-good-as-new" regarding their evaluation of pump internal wear and operating characteristics.

Open Item: Use of design pump curves for flow and NPSH Required calculations

The licensee did not validate the use of design (versus degraded, actual, or modified) pump curves for flow and NPSH Required calculations.

Open Item: Evaluation of HPSI pump stage-to-stage degradation

The licensee did not evaluate HPSI pump stage-to-stage degradation and its effects on hydraulic performance (change to total dynamic head and flow).

Open Item: Evaluation of pump bearing loads

The licensee did not include pump bearing loads as part of its pump internals abrasive wear calculations.

Open Item: WCAP-16406P similitude evaluation

The licensee did not perform a similitude evaluation demonstrating that the equations and assumptions used in WCAP-16406P bound or are applicable for use at Waterford 3.

Open Item: Minimum and maximum system flow assumptions for downstream evaluations

The licensee assumptions regarding minimum and maximum system flows for downstream evaluations were not complete and were not consistent with conservative component evaluations.

Open Item: ECCS and Containment Spray pump seal leakage evaluations

The licensee did not evaluate ECCS and Containment Spray pump seal leakage, which could affect Safeguards Room environmental conditions.

Open Item: HPSI throttle valve limit switch failure

The licensee did not address the failure of HPSI throttle valves to open to their pre-set positions (limit switch failure).

Open Item: HPSI System flow analysis using full range of recirculation throttle valve positions

The licensee did not perform a HPSI System flow analysis considering the full range of possible recirculation throttle valve positions around the pre-set position.

Open Item: Operational procedure incorporation into downstream effects evaluation

The licensee could not explain how operational procedures were incorporated into the downstream effects evaluation.

Open Item: Consideration of orifice wear on ECCS System flow indications

The licensee did not consider the effect of orifice wear on ECCS System flow indications.

Open Item: Overall system flow evaluation considering various component wear evaluations

The licensee did not perform overall system flow evaluations considering the results of the various component wear evaluations that were conducted.

Open Item: Conduct of downstream effects evaluations for debris and chemicals

The licensee has not yet conducted evaluations for the downstream effects of post-LOCA debris and chemicals on reactor vessel internal components including the reactor core. The NRC staff requires that such evaluations be provided to demonstrate that long-term core cooling is maintained in accordance with CFR 50.46.

Open Item: Identification and testing for potential chemical effects

The staff was not able to draw any conclusions concerning the Waterford 3 chemical effects evaluation since the licensee has made little progress identifying potential chemical effects and testing has not yet been performed.