

June 30, 2010

Mr. Robert Choromokos  
Manager, Energy Services Division  
Alion Science and Technology  
4525 Weaver Parkway  
Suite 230  
Warrenville, IL 60555

SUBJECT: PROPRIETARY EROSION TESTING OF SUBMERGED NUKON LOW-DENSITY FIBERGLASS INSULATION IN SUPPORT OF GENERIC SAFETY ISSUE 191 STRAINER PERFORMANCE ANALYSES

Dear Mr. Choromokos:

By letter dated April 8, 2010 (ADAMS Accession No. ML101090490), Alion Science and Technology transmitted to the U.S. Nuclear Regulatory Commission (NRC) staff a proprietary report documenting erosion testing conducted in early 2010 for submerged small pieces of Nukon low-density fiberglass insulation exposed to water flows representative of a pressurized-water reactor (PWR) containment pool following a loss-of-coolant accident (LOCA). Based on the results of the testing Alion conducted, the proprietary report concluded that a cumulative erosion percentage of ten percent over a 30-day period following a LOCA is justified.

Alion had previously conducted erosion testing for Nukon low-density fiberglass in the 2006-2007 timeframe to generate data that would demonstrate that the conservative position regarding erosion in the NRC staff's safety evaluation on the Nuclear Energy Institute (NEI) 04-07 guidance report could be relaxed. On the basis of the previous test results, Alion concluded that ten percent erosion over a 30-day period was justified, and a number of PWR licensees incorporated this conclusion into the strainer performance analyses they performed in response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors."

However, in the process of conducting reviews of PWR licensees' supplemental responses to Generic Letter 2004-02, the NRC staff identified concerns with Alion's 2006-2007 erosion testing for Nukon low-density fiberglass. One of the staff's main concerns was that the short-term erosion data (0-48 hours) exhibited significantly different behavior than the long-term data (60-737 hours). Specifically, the long-term data unexpectedly showed lower cumulative erosion percentages and a slightly decreasing trend with increasing test duration, whereas the short-term data exhibited higher cumulative erosion percentages and a strongly increasing trend with increasing test duration. Based on this observation and other concerns with the test protocol and setup, the NRC staff did not have confidence that the previous Alion testing provided an adequate basis to support the assumption of ten percent erosion of Nukon low-density fiberglass in PWR licensees' responses to Generic Letter 2004-02.

To address the NRC staff's concerns, Alion proposed additional erosion testing for Nukon low-density fiberglass using a more rigorously controlled test protocol and setup to minimize the

potential for various external factors to influence the test results. Alion discussed its approach with the NRC staff and further provided a proprietary test plan for the staff's review. A publicly available summary (ADAMS Accession No. ML093090161) of a phone call that occurred on October 26, 2009, provides further detail regarding the status of the NRC staff's discussions with Alion at that juncture.

Based on the NRC staff's interactions with Alion described above, as well as the staff's review of Alion's proprietary test report regarding the 2010 erosion testing that was transmitted on April 8th, the staff has made the following key observations:

- The test protocol used by Alion for the 2010 erosion tests was responsive to the NRC staff's concerns with previous tests, and further incorporated feedback from the staff's review of the draft test protocol.
- Alion's 2010 erosion test protocol rigorously minimized potential sources of external contamination and carefully accounted for residual losses of material during the debris processing and preparation stages.
- Alion's 2010 erosion testing was supported by a detailed evaluation of the velocity and turbulence conditions within the test flume relative to corresponding conditions within PWR post-LOCA containment pools based on computational fluid dynamics simulations.
- The results of Alion's 2010 erosion tests generally appeared coherent and in accordance with theoretical expectations. In particular, the trend of the erosion test data as a function of time demonstrated asymptotic behavior approaching a value of less than ten percent over 30 days.
- Major adverse impacts were not observed to result from downstream samples being shadowed by upstream samples or capturing eroded fines from upstream samples (these potential concerns are discussed in greater detail in the October 26, 2009, phone call summary).

Overall, the NRC staff considered Alion's 2010 erosion test results to be of high quality, and the staff further agrees with many of the observations made by Alion in the proprietary test report concerning the behavior of the test data. However, the staff did not fully review all of Alion's observations and conclusions regarding the test results, inasmuch as they were not necessary to demonstrate the acceptability of the assumption of 10% erosion for Nukon low-density fiberglass. The review did identify two particular points regarding which the NRC staff does not fully agree with Alion's conclusions. First, the staff does not agree that Alion's data provides adequate basis to conclude that turbulence does not affect the erosion of fibrous debris. Second, although not considering shadowing or capture of fines on downstream samples to have had a major effect on the test results, the staff could not conclude that these effects were demonstrably negligible.

However, the staff considers any impacts from these minor points of disagreement to be outweighed by a number of more-significant conservatisms included in the testing, such as the specification of conservative flow conditions in the test flume, the orientation of the debris samples in the flume flow stream, and above all, the recommendation that licensees assume ten percent erosion over a 30-day period to conservatively bound the measured test results. Considering the results of the full set of erosion tests conducted by Alion for Nukon low-density fiberglass, relative to the number of data points obtained using the revised 2010 test protocol,

the staff considers it appropriate that the proprietary erosion test report does not recommend a 30-day erosion percentage less than ten percent.

Therefore, based upon the interactions and review summarized above, the NRC staff concludes that it would be acceptable for PWR licensees to reference appropriately the Alion proprietary erosion test report for Nukon low-density fiberglass in their responses to Generic Letter 2004-02. Specifically, the NRC staff believes that these generic test results provide confidence in the assumption that erosion of small and large pieces of Nukon low-density fiberglass submerged in a post-LOCA containment pool would be limited to ten percent over a 30-day period, provided that the generic test results are applicable to a licensee's plant-specific conditions.

Prior to plant-specific application of the Alion proprietary erosion test results, PWR licensees should verify that the test conditions (e.g., velocity and turbulence levels, debris material properties) are applicable to their plant-specific conditions. For example, the staff considers it a licensee's responsibility to justify the application of Nukon low-density fiberglass erosion test data to other types of low-density fiberglass substantially different than Nukon. The staff also considers the Alion test conditions to be applicable for simulating the erosion of fiberglass determined to settle onto a containment pool floor using approved incipient tumbling transport metrics. It is not clear to the staff that the Alion testing addresses all plant-specific conditions under which erosion may be significant, such as an analysis using alternate transport metrics that exceed the approved incipient tumbling velocity, for debris captured at curbs or interceptors, or for debris that settled during strainer head loss testing. Additional plant-specific analysis or testing may be necessary for conditions such as these.

Sincerely,

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William H. Ruland, Division Director  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

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