October 30, 2007

MEMORANDUM TO: Michael L. Scott, Chief
Safety Issues Resolution Branch
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Office of Nuclear Reactor Regulation

FROM: Joseph A. Golla, Project Manager ***/RA/***
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SUBJECT: PHONE CALL SUMMARY WITH ALION ON SEPTEMBER 6, 2007, TO DISCUSS SUMP STRAINER HEAD LOSS TEST SPECIFICATION

On September 6, 2007, a phone call was held with representatives of Alion Science and Technology to discuss the Alion test procedures for determining debris head loss across a sump screen. The discussion encompasses 6 documents as follows:

1. ALION-TS-ALION-1002-01, "30-Day Integrated Chemical Effects Test Specification – VUEZ SEQ#1," Rev. 2 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML072130423)
2. ALION-REP-ALION-1002-01, "Scaling of Materials in the VUEZ Chemical Effects Head Loss Testing," Rev. 0 (ADAMS Accession No. ML072130480)
3. ALION-REP-ALION-1002-02, "Surrogate Materials for the VUEZ Chemical Effects Head Loss Testing," Rev. 1 (ADAMS Accession No. ML072130484)
4. ALION-CAL-SONGS-4194-03, "SONGS Design Input Requirements for the 30 Day Chemical Effects Testing," Rev. 2 (ADAMS Accession No. ML072530017)
5. VUEZ-TP-ALION 01/TP-OTS-1593, TEST PLAN, "30-Day Integrated Chemical Effects Test Plan VUEZ SEQ#1-SONGS," Rev. 0 (ADAMS Accession No. ML072530022)
6. PP-OTS-1593-01, WORK PROCEDURE, "30-day Integrated Chemical Effect Test VUEZ SEQ# 1-SONGS," Rev. 0 (ADAMS Accession No. ML072530862)

The phone call was convened by the NRC GSI-191 project manager. Roll call was taken and then the NRC staff presented a number of questions and concerns for discussion with the industry participants. The purpose of the phone call was to discuss 6 procedures used by Alion to perform 30-day chemical effects head loss tests at the VUEZ test facility. During the phone call, the staff had the opportunity to discuss with Alion the most significant questions and concerns. An additional phone call was proposed to address additional questions and staff comments on the test procedures.

To begin, the staff requested that the licensee describe the criteria used to generate the test matrix for each licensee. In particular, the staff requested that the licensee describe the basis for concluding that the most bounding test conditions had been established, state whether both thin-bed and full-load tests would be conducted, and identify the basis for having confidence that repeat tests would provide similar results. Alion stated that the purpose of the VUEZ testing was to quantify the incremental effect of chemical precipitates. The maximum debris loading case was generally chosen as the bounding case for the VUEZ testing because large-scale array testing had shown that this was the most limiting condition. The issue of repeatability was not discussed in detail by Alion as they had not performed any duplicate experiments.

The staff further questioned whether tests would be performed at VUEZ for any plants with circumscribed debris beds, and if so, how the results of the flat plate strainer testing in the VUEZ loop would be applied to this condition. Alion stated that circumscribed-bed testing had not been performed to date, but stated that future testing for other plants could encompass this condition. No information was provided regarding the application of VUEZ results to this condition.

The staff raised a general question about how licensees conclude that their plant-specific test conditions in the VUEZ test program provide a conservative technical basis. For example, with respect to temperature, one plant uses higher temperatures early in the test to be conservative with respect to material dissolution. Later in the test, this plant uses the the lower end of the possible temperature range to be conservative with respect to precipitate formation. The staff thinks this hybrid temperature profile approach is acceptable. The staff questioned whether a similar type approach should be used for the pH profile during a test. For instance, the staff noted that the corrosion of some materials, such as aluminum, would occur more readily at higher pH, but that the precipitation of some dissolved materials, such as aluminum, occurs more readily at lower pH. Based on the information available at the time of the call, a single, conservative pH test value was not apparent to the staff. Alion responded that there is additional information based on bench testing that will be provided to the staff that will provide a basis for the conservatism of their pH modeling. In general, the staff expects licensees to have a sound technical basis for understanding effects of changes in plant environments (e.g., temperature, pH) and the repeatability of test results.

The next major issue raised by the staff was the formation of the debris bed at the beginning of the test. Alion described the debris bed formation process as follows: Shredded fibers and other debris are mixed with water from the test loop in a beaker with a paddle stirrer to achieve homogeneity of the debris. This debris is then poured slowly onto the test strainer with a funnel placed slightly below the surface of the water. The funnel is moved around the test strainer in an attempt to achieve uniformity. In response, the staff stated that pouring a debris bed onto a test strainer would result in a lumpier and less uniform bed than a debris bed formed by allowing suspended debris to slowly accumulate due to the flow through the strainer. The staff proceeded to emphasize this point through two examples gleaned from the results of completed testing.

The staff recalled that during a public meeting on August 23, 2007 (ADAMS Accession No. ML0725308853), Alion had stated that the VUEZ Loop 3 test had lacked sufficient debris to achieve a measurable head loss. This test was intended to model a break in the reactor cavity; and debris sources included latent fiber, Microtherm, and other materials. However, the staff noted that the quantity of latent fibrous debris used in this test was sufficient to exceed the $1/8^{th}$-inch threshold typically associated with thin-bed formation, and an informal staff simulation using the NUREG/CR-6224 correlation further suggested that a measurable

head loss might be expected. Alion responded that developing a uniform debris layer was difficult with a relatively small amount of fiber. Alion further stated that even after twice the design loading of Microtherm was added, the debris bed still did not cause significant head loss. Based upon this response, the staff questioned whether the surrogate fibrous debris used to represent latent fibrous debris had been prepared with sufficient fineness. Alion's response indicated that the fibrous debris had been prepared according to a size category classification in NUREG/CR-6224 that is associated with fibrous debris that is damaged by a pipe rupture. The staff stated that the size distribution representative of fibrous insulation debris generated from a pipe rupture is not representative of individual strands of latent fibrous debris. In addition, the staff considered each plant's fibrous debris size distribution to be unique, since the transportability of each size category of fibrous debris will depend upon plant-specific characteristics. Thus, the use of a generic size distribution based upon the quantity of debris initially destroyed into each size category would generally be non-conservative because such a method does not account for the fact that finer debris is generally more transportable than larger debris pieces.

The next topic discussed was the potential for boreholes to affect the scaling of the test results with temperature. The staff was particularly concerned about the effects of boreholes and void formation during the VUEZ tests since the release of accumulated gas was observed to result in significant bed disruptions and disturbances in the measured head loss traces during some of the tests. Alion stated that visual checks were performed for boreholes and stated that boreholes had not generally been observed. The staff responded that developing a means of venting accumulated gas from the test apparatus without disrupting the debris bed and head loss traces would reduce uncertainties associated with the test results.

The staff then requested that Alion discuss the basis for the flow velocity and turbulence in the VUEZ test loop. Alion stated that a loop flow rate of approximately 1 L/min creates velocity and turbulence conditions in the test tank that are sufficient to cause 10-micron particles and individual pieces of fiber to transport to the test strainer. Alion added that this statement was based upon informal experiments rather than analytical modeling. The vendor also stated that discharge flow from the test pump is directed toward the bottom of the test tank, which tends to stir any debris that is settled onto the tank floor.

Next, the staff noted that Alion's test procedure does not consider chemical precipitation that may result from a sudden drop in fluid temperature, as might occur for post-accident sump fluid passing through a heat exchanger. The staff indicated that the effects of cooling the solution for a relatively short period and then returning the solution to a reactor vessel or to sump temperature (assuming the fluid spills out a pipe break) are unknown. Alion acknowledged that this effect is not a part of the current test procedure, and stated that the impact of this phenomenon could not be assessed at the time of the call. The staff plans to follow-up on this issue during a future phone call with Alion.

The last major topic discussed on the call was the bump-up factor approach proposed by Alion to scale up the head loss results from large-scale strainer array testing without chemical precipitates by a multiplier derived from the ratio of the head loss with chemical precipitates in the VUEZ loop to the head loss without chemical precipitates in the VUEZ loop. The staff questioned Alion's technical basis for this bump-up factor approach and requested that Alion provide evidence that the approach is reasonable. Alion explained that the bump-up approach is based upon the assumption that the incremental head loss associated with chemical precipitation is separable from other differences, such as geometric differences, between the large-scale array testing and the VUEZ testing. The staff felt that the technical basis for the

bump-up approach presented during the call was not robust and that significant uncertainties remain. In particular, the staff stated that if the non-chemical debris beds in the large-scale array and the VUEZ loop are sufficiently different, the same quantity of added chemical precipitates would likely result in different bump-up factors. As a result of the lack of detail presented concerning the bump-up approach and its technical basis, the staff requested that Alion provide a document describing the bump-up factor methodology and technical basis.

The staff asked one further question on the methodology used to scale head loss results from the VUEZ loop by temperature. Based upon staff calculations, the scaling factor Alion used to scale the results was not based strictly upon viscosity, and the staff requested that the vendor provide an explanation of its temperature scaling methodology. Due to the detailed nature of the question, the staff suggested that Alion respond during a future phone call scheduled with the staff. Alion agreed to address the issue at that time.

At the end of the call, Alion requested that the staff identify any “outstanding issues” on the VUEZ test procedure. The staff agreed to inform Alion of any outstanding issues after the issues discussed in the call had been discussed internally. Alion further requested general feedback as to whether the staff considered the VUEZ testing a viable approach. The staff responded that challenges remain in formulating a technical basis for some aspects of the test procedure and scaling methodology; however, the staff did not consider these challenges to be insurmountable and thus did not discourage licensees from pursuing the Alion/VUEZ testing.

NRC Participants:	**Industry Participants:**	
John Lehning	Rob Choromokos (Alion)	Ed Kimoto (SONGS)
Mike Scott	Jeff Posca (Alion)	Adi Irani (First Energy)
Paul Klein	Paul Leonard (DC Cook)	Pete Mast (Alion)
Matt Yoder	Gil Zigler (Alion)	
Steve Smith	Roger Waters (First Energy)	
Joe Golla	Jan Bostleman (Alion)	
Clint Shaffer (ARES)	Eric Mori (Alion)	
Bob Litman (RLB)	Pete Wilkens (SONGS)	

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