NRC Staff Questions for October 31, 2007 Phone Call with ALION

(Enclosure 2 to ML080510080 phone call summary of October 31, 2007 and November 29, 2007 phone calls with Alion)

Enclosure 2

Additional Questions for Alion

1. Provide the basis for having confidence that the 30-day VUEZ tests would be repeatable.

2. Follow up on circumscribed/partially circumscribed (e.g., the TMI case) bed configuration. Have any circumscribed/partially circumscribed configurations arisen since the previous phone call? Any more detail on how to address this configuration?

3. Is the dissolution of generated debris a contributor to the inhibition of chemical precipitates (for example, silicate species inhibiting the corrosion of aluminum)? How is this phenomenon factored into the choice of the worst case debris loading? Staff currently understands that worst case loading is predicted based upon the results of previous non-chemical testing.

4. Question on TMI Slides (Aug. 16, 2007). On Slide 9, the bump-up scaling factor example apparently adjusted for viscosity/temperature by multiplying the measured head loss by 1.72. Simply based upon viscosity, should the multiplier not be 1.45? How was the value of 1.72 determined?

5. How are measurement uncertainties factored into / propagated through the analysis? Between the flow rate measurement, flow control, HL, and temperature measurement, there could be a relatively high uncertainty associated with the head loss result. (Variances of independent random variables are additive.) In addition, uncertainties associated with temperature could affect the timing of the corrosion process – as approximated in the test procedure, corrosion rates double about every 18°F – and thus the timing of precipitate induced head loss.

6. Removal of materials from the test tank: (1) By the end of the test, based on the procedures provided, approximately five percent of the loop volume could be removed (including dissolved and suspended species). (2) Small quantities of particulate that is considered non-transportable are not included in the test for its chemical impacts. How much of these materials is it safe to omit without accounting for them somehow?

7. Describe the mesh that is placed on top of the screen and to what extent it is effective in preventing drifting or floatation of debris in the debris bed. Does it have any side effects on the debris bed?

8. Zinc and aluminum coatings are being represented by increasing the surface area of zinc and aluminum coupons. Is the dissolution of large pieces of these metals representative of the dissolution of significantly smaller chips or particles of failed coatings debris (e.g., in terms of surface area to volume ratio)? Could the corrosion rate be different for different sizes of materials?

9. The three-mil thickness NEI 04-07 recommended that licensees assume in lieu of plant-specific detail for coatings was rejected in the SE. (ALION-REP-ALION-I002-02, Pg. 7 of 9). Plants do not need to follow SE, but should have justification for the deviation.

10. Full load versus thin bed testing. During the previous call, Alion made the statement that maximum debris cases are chosen for chemical testing based on their causing higher head loss than the thin bed tests during earlier non-chemical testing. Presuming that the bump up approach is justified, once chemicals are considered, the maximum debris case would

continue to be bounding only as long as the thin-bed bump-up factor is not so severe as to overcome the lower thin-bed head loss without chemicals, or

$$\frac{Thin\ Bed\ Bump-up\ Factor}{Maximum\ Load\ Bump-up\ Factor} \leq \frac{Maximum\ Load\ HL}{Thin\ Bed\ HL}$$

Why is there confidence that this must be the case?

11. The staff requests a copy of the test procedure for the large VUEZ loop and is interested in any experience from this loop with regard to debris bed formation and other issues discussed regarding the small loops, such as a comparison of head loss results to prototype testing, settling, and circumscribed scaling. Staff has seen D.C. Cook trace, which shows very complex dynamic behavior.

12. If the ratio of the test loop screen area to the plant strainer area is greater than the ratio of the test loop volume to the plant pool volume,

$$\frac{A_{loop}}{A_{plant}} \geq \frac{V_{loop}}{V_{plant}}$$

then the quantity of precipitates generated in the loop may be less than in the plant. For the SONGS test, the staff noted that the volume ratio was conservatively greater than the area ratio, but is this always required to be the case? Having these two ratios nearly equal would seem to be the most representative approach.

13. In other tests, the staff has seen that the rate of chemical additions can influence the head loss test results. Discuss any observations concerning how the rate of the buffer addition affects the test results.

14. From ALION-CAL-SONGS-4194-03-R2: Is the 3570 ppm as TSP, Phosphate or TSP dodecahydrate? [p. 11]

15. From ALION-TS-ALION-I002-01-R2: In Figure A1 it shows that the TSP does not take effect at pH control for 7.7 hours. At that time the pH of the solution takes a sharp rise to 8.4. Can you explain how this is representative of the plant condition?

16. From ALION-TS-ALION-I002-01-R2: In the test loop pH buffer is added over 75 minutes (presumably) immediately following the debris bed formation. In the plant profile for Figure A1 this change in pH is shown at 7.7 hours. Why the differences in times for the test loop vs. the plant condition for TSP pH control to take effect?

17. The test plan describes the pH measurements to be made “in-line” and recorded “at temperature”. How will the QC checks of the measuring device be performed; At temperature or at 77°F?

18. The initial target pH for the solution is 4.0-4.5. This pH represents the pH of 2,000 ppm boron (as boric acid) at 77°F. What is the expected pH at 190°F? Wouldn’t it be best to also measure pH at 77°F as well?

Outstanding Issues from Previous Call

1. Poured debris bed formation process and the extent to which it can generate uniform/homogeneous beds (based on unexpected results of tests for SONGS and TMI). The small size of the VUEZ loop implies that non-uniformity in the test debris bed would tend to have a more significant effect than on a prototype module or plant strainer.

2. Bump-up factor technical basis

3. Procedure for preparing fine fibrous debris and consideration of plant-specific size distributions of transported debris

4. Scaling for circumscribed and partially circumscribed beds

5. Ensuring gas release and boreholes do not disrupt debris bed structure. Understand some improvements made to small VUEZ loops, but staff has not seen evidence of their effectiveness yet. Not clear how this effect is being addressed on large VUEZ loop.

6. Addressing the effect of a sudden temperature drop from a heat exchanger

7. Overall conservatism of chemical approach