May 2, 2007

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

FROM: Allen L. Hiser, Jr., Chief **/RA/ for Gregory L. Makar**
Steam Generator Tube Integrity and
Chemical Engineering Branch
Division of Component Integrity
Office of Nuclear Reactor Regulation

SUBJECT: STAFF OBSERVATIONS FROM MARCH 8, 2007
TRIP TO FAUSKE & ASSOCIATES, LLC

On March 8, 2007, the U.S. Nuclear Regulatory Commission (NRC) staff traveled to Fauske & Associates in Burr Ridge, Illinois, to observe chemical effects testing associated with the resolution of Generic Safety Issue 191 (GSI-191). The primary objective of the trip was to observe in-progress chemical effects testing being performed for the Pressurized Water Reactor (PWR) Owners Group. The trip was coordinated with a separate visit to the Alion Science and Technology Hydraulics Laboratory to observe plant specific testing of a top-hat strainer array. The participating NRC staff members were Matthew Yoder and Paul Klein of NRR/DCI/CSGB, and John Lehning and Stephen Smith of NRR/DSS/SSIB. Mr. Lehning's and Mr. Smith's participation was limited due to conflicts with the test schedule at the Alion laboratory. The staff interacted with vendor personnel from Westinghouse and Fauske & Associates. In support of the NRC staff visit, a presentation was provided by Westinghouse personnel. The presentation slides are provided in Enclosure 1.

The PWR Owners Group sponsored testing at Fauske is intended to provide a basis for re-evaluating conservative assumptions in the WCAP-16530-NP chemical model. In particular, four potential refinements to the chemical model are being evaluated:

- Silicate inhibition of aluminum corrosion
- Corrosion of aluminum alloys compared to commercially pure aluminum
- Phosphate inhibition of aluminum corrosion
- Evaluation of precipitate solubility limits for certain chemical environments

The PWR Owners Group test plan uses a two-step approach for investigating potential refinements to the existing chemical effects model. Initial scoping tests are performed to assess potential benefits in a given refinement area. If the initial scoping test results suggest a

CONTACT: Paul Klein, NRR/DCI/CSGB
(301) 415-4030

significant benefit in an area, parametric testing is performed to more fully evaluate the refinement. At the time of the staff visit, initial scoping tests had been completed for the first three bulleted items above. Scoping tests to evaluate the solubility limits of key precipitates had not yet been completed. Based on initial test results, parametric testing was pursued for determining silicate inhibition of aluminum corrosion and phosphate inhibition of aluminum corrosion. The reduction in corrosion rates for aluminum alloys compared to commercially pure aluminum was judged to be too low to warrant additional parametric testing. For the overall project, bench scale testing is scheduled from January 2007 through March 2007, and a final report is projected to be available in May 2007.

The NRC staff toured the Fauske laboratory and observed a limited number of tests that were in progress at the time of the staff visit. The staff observed bench top tests that were studying the effects of silica on aluminum corrosion in 2500 ppm borated water that was adjusted to various pH values using either trisodium phosphate or sodium hydroxide. These tests were being performed at 200^{o}F in a temperature controlled oven. Duplicate aluminum coupons were placed on the bottom of flasks containing the test solution. One test coupon was removed after 12 hours and the second coupon was to be removed after 24 hours. After removal, the coupons are rinsed with de-ionized water and dried. The coupon mass is measured before and after the removal of any corrosion product from the coupon surface. Samples of the test solution are collected and analyzed using an inductively coupled plasma (ICP) spectrometry technique to determine the dissolved aluminum concentration.

Following the lab tour, NRC staff spent some time reviewing the laboratory test procedures since they were not available for staff review prior to the visit. Based on NRC staff observations, NRC staff review of test procedures and discussions with the representatives from Westinghouse and Fauske & Associates, the staff provided the following feedback related to these tests.

- The NRC staff raised several questions concerning the test procedures. Since test coupons were placed on the bottom of the test flask instead of being suspended within the test solution, the staff questioned how a potential crevice formed by the coupon surface contacting the flask bottom would affect the test results. For example, the test coupon visually examined by the staff appeared to have more corrosion on the freely exposed surface than on the surface facing towards the flask bottom. Westinghouse personnel indicated that the data from these tests is being used for relative comparison between environments, and not to calculate corrosion rates. It is not clear to the staff if the relative comparison developed during these tests would be different under different test conditions, such as tests with suspended samples or tests under flowing rather than quiescent conditions.

- The NRC staff questioned if the use of abrasive media to re-condition the aluminum test coupons' surfaces to permit multiple tests with the same coupons could contaminate the surface and influence the test results.

- Since the preliminary results presented to the NRC staff were based on weight loss measurements (ICP results were not yet available), the staff asked how potential inconsistencies between release rates based on weight loss and release rates based on ICP measurements would be resolved. Westinghouse personnel indicated that if ICP

data was inconsistent with weight loss data, greater consideration would be given to the ICP test results.

- The NRC staff stressed the importance of the PWR Owners Group developing a sound technical basis that shows why a licensee's analysis implementing potential reductions in the precipitate source term using these results remains conservative (i.e., accounts for uncertainties) in their chemical effects source term. In response, Westinghouse personnel indicated they were considering retaining conservatism by not crediting reductions in aluminum corrosion for some period of time after an accident. The staff also encouraged the PWR Owners Group to provide thorough guidance on how licensees participating in these follow-on tests should interpret the results.

- Based on the current test plans, the NRC staff thinks it will be very challenging for the PWR Owners Group to make a convincing argument that solubility of key precipitates is sufficiently understood to incorporate this phenomenon in the chemical model. For example, evaluation of temperature by continuous cooling and changes to pH during a test may be more representative of post-LOCA pool conditions and may produce different results compared to isothermal, constant pH tests.

- The staff understands that a primary source of silicate in the post-accident containment pool for some plants may be destroyed calcium silicate or other insulations. The staff questioned whether crediting dissolved silicate from these sources is conservative with respect to chemical effects if breaks of concern exist for which sufficient quantities of insulation would not be destroyed to result in passivation of aluminum. Another factor that would need to be considered is if other materials in a post-LOCA containment pool would retard leaching of silica from insulation. The staff suggested including guidance in the test report that consideration be given to ensuring that previously analyzed breaks remain bounding if the inhibition of chemical precipitation is credited based on the assumption that certain types of debris will be destroyed.

- Two additional items were discussed during a follow-up phone call with a representative from Westinghouse on March 22, 2007. During the visit to Fauske, the NRC staff was asked about their position on the use of sodium metaborate as a buffer chemical. Sodium metaborate could potentially be used as a replacement for sodium hydroxide. During the phone call, the NRC staff indicated that the chemical effects knowledge base for sodium metaborate is less developed than for those chemicals currently used in plants. Therefore, some additional work (e.g., an integrated test) may be needed to support use of sodium metaborate. A second item discussed with Westinghouse during a phone call was related to the PWR Owners Group application of immersion test results to plant material that is not immersed in the post-LOCA pool but is located where it may be subject to spray and wetting from condensation. Specifically, the staff is interested in whether the relative timing and the degree of corrosion reduction observed in immersed samples is applicable to atmospheric samples.

ICP measurements would be resolved. Westinghouse personnel indicated that if ICP data was inconsistent with weight loss data, greater consideration would be given to the ICP test results.

- The NRC staff stressed the importance of the PWR Owners Group developing a sound technical basis that shows why a licensee's analysis implementing potential reductions in the precipitate source term using these results remains conservative (i.e., accounts for uncertainties) in their chemical effects source term. In response, Westinghouse personnel indicated they were considering retaining conservatism by not crediting reductions in aluminum corrosion for some period of time after an accident. The staff also encouraged the PWR Owners Group to provide thorough guidance on how licensees participating in these follow-on tests should interpret the results.

- Based on the current test plans, the NRC staff thinks it will be very challenging for the PWR Owners Group to make a convincing argument that solubility of key precipitates is sufficiently understood to incorporate this phenomenon in the chemical model. For example, evaluation of temperature by continuous cooling and changes to pH during a test may be more representative of post-LOCA pool conditions and may produce different results compared to isothermal, constant pH tests.

- The staff understands that a primary source of silicate in the post-accident containment pool for some plants may be destroyed calcium silicate or other insulations. The staff questioned whether crediting dissolved silicate from these sources is conservative with respect to chemical effects if breaks of concern exist for which sufficient quantities of insulation would not be destroyed to result in passivation of aluminum. Another factor that would need to be considered is if other materials in a post-LOCA containment pool would retard leaching of silica from insulation. The staff suggested including guidance in the test report that consideration be given to ensuring that previously analyzed breaks remain bounding if the inhibition of chemical precipitation is credited based on the assumption that certain types of debris will be destroyed.

- Two additional items were discussed during a follow-up phone call with a representative from Westinghouse on March 22, 2007. During the visit to Fauske, the NRC staff was asked about their position on the use of sodium metaborate as a buffer chemical. Sodium metaborate could potentially be used as a replacement for sodium hydroxide. During the phone call, the NRC staff indicated that the chemical effects knowledge base for sodium metaborate is less developed than for those chemicals currently used in plants. Therefore, some additional work (e.g., an integrated test) may be needed to support use of sodium metaborate. A second item discussed with Westinghouse during a phone call was related to the PWR Owners Group application of immersion test results to plant material that is not immersed in the post-LOCA pool but is located where it may be subject to spray and wetting from condensation. Specifically, the staff is interested in whether the relative timing and the degree of corrosion reduction observed in immersed samples is applicable to atmospheric samples.

DISTRIBUTION:

DCI/RF	SSIB/RF	RArchitzel	MLScott	JLenhning	PKlien	SUnikewicz	LWhitney
RReyes	JBurke	SLu	JGolia	MYoder	EGeiger	RTregoning	JWermiel

ADAMS Accession ML071240109 -Package No: ML071240152

OFFICE	CSGB:DCI:NRR	SSIB:DSS:NRR	BC:CSGB:DCI
NAME	PKlein	JLehning	AHiser
DATE	5/1/07	4/30/07	5/2/07

OFFICIAL RECORD COPY