UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 8, 2012

LICENSEE: STP Nuclear Operating Company

FACILITY: South Texas Project, Units 1 and 2

SUBJECT: SUMMARY OF OCTOBER 10, 2012, PRE-LICENSING PUBLIC MEETING WITH STP NUCLEAR OPERATING COMPANY HELD VIA CONFERENCE CALL TO DISCUSS THE PROPOSED RISK-INFORMED APPROACH TO THE RESOLUTION OF GSI-191, "ASSESSMENT OF DEBRIS ACCUMULATION ON PWR SUMP PERFORMANCE" (TAC NOS. ME7735 AND ME7736)

On October 10, 2012, a public meeting was held via conference call between the U.S. Nuclear Regulatory Commission (NRC) and representatives of STP Nuclear Operating Company (STPNOC, the licensee), at NRC Headquarters, Rockville, Maryland. The meeting notice and agenda, dated September 21, 2012, is located in the Agencywide Documents Access and Management System (ADAMS) at Accession No. ML12261A301. The purpose of the meeting was to discuss the proposed risk-informed approach to the resolution of Generic Safety Issue (GSI)-191, "Assessment of Debris Accumulation on PWR [Pressurized-Water Reactor] Sump Performance." South Texas Project (STP) is the lead plant and STPNOC plans to submit a license amendment request before the end of the year. The licensee previously provided an overview of its proposed approach during the public meetings held on June 2, July 7, July 26, August 22, October 3, November 1, November 2, and December 1, 2011, and February 9, March 1, March 8, March 29, June 11, and September 6, 2012[1]. The purpose of this conference call was to discuss the outstanding chemical effects phenomena identification, strainer pass through and vertical loop head loss experiments, and the methodology for evaluating the probabilistic risk assessment and containment accident stochastic analysis (CASA) Grande applications.

A list of meeting attendees is provided in the Enclosure to this meeting summary.

Meeting Summary

No additional presentation materials were provided by STPNOC for the purposes of this meeting. The discussion was based on the materials provided in the previous public meetings held on the topic between June 2, 2011, and September 6, 2012.

[1] Summaries of the meetings held on June 2, July 7, July 26, August 22, October 3, November 1, November 2, and December 1, 2011, and February 9, March 1, March 8, March 29, June 11, and September 6, 2012, are available in ADAMS at Accession Nos. ML111640160, ML111950094, ML112130165, ML112411419, ML112840114, ML113120129, ML113180196, ML113430087, ML120620541, ML120830103, ML120830086, ML121380522, ML12187A081, and ML12270A055, respectively.

Results of Discussions

General Approach

STPNOC provided a high level summary on the similarities and differences between its risk-informed evaluation and the NRC-endorsed Nuclear Energy Institute (NEI) guidance and other NRC-accepted methodologies. STPNOC and the NRC staff agreed that sensitivity studies should be performed in areas where unknown or potentially substantial effects exist due to significant deviations from approved guidance. Areas of potential significant deviations are listed below.

- *Coatings:* STPNOC is considering deviation from the guidance for unqualified coatings by using a fraction of the full amount assumed to fail by current guidance and using a realistic size distribution for the failed coatings.

- *Transport:* Potential deviations include use of a more realistic debris distribution prior to recirculation, basing erosion values on test results instead of the NRC staff-approved values, application of credit for time-dependent bypass and erosion, and application of alternate debris fractions captured on gratings.

- *Chemical effects:* STPNOC is developing a new model based on plant-specific conditions.

- *Strainer head loss:* STPNOC is using a correlation based on NUREG/CR-6224[2] and plant-specific testing.

- *Chemical effects head loss:* Use of a bump-up factor for chemical effects based on results of testing.

- *Net positive suction head (NPSH) margin:* Margin will be determined using time-dependent strainer head loss and NPSH values.

- *Strainer bypass:* STPNOC will use a plant-specific correlation based on testing results.

- *In-vessel evaluation:* The effects of blockage on the core will be evaluated with thermal-hydraulic analyses.

- *Boron precipitation:* STPNOC is working to determine an acceptable methodology to evaluate the issue. The methodology used to evaluate the potential for boron precipitation may be associated with the in-vessel evaluation.

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[2] Science and Engineering Associates, Inc., "Parametric Study of the Potential for BWR [Boiling-Water Reactor] ECCS [Emergency Core Cooling System] Strainer Blockage Due to LOCA [Loss-of-Coolant Accident] Generated Debris, Final Report," October 1995, NUREG/CR-6224 (ADAMS Accession No. ML083290498).

Chemical Effects

The NRC staff expressed disagreement with the use of the NEI-protocol prepared fiber beds as a means of detecting the formation of precipitates during the chemical effects testing. As stated previously in the December 1, 2011, meeting summary, the NRC staff considers the debris bed to be a critical aspect of the chemical effects testing. The NRC staff reiterated its views expressed during the public meeting on September 6, 2012, that there is insufficient confidence that Corrosion Head Loss Experiments (CHLE) loop beds comprised of fiber prepared according to the NEI protocol can detect chemical precipitates. This view is based on testing performed by the licensee that showed that NEI bed head loss did not respond to precipitates. Although the licensee agrees that the NEI protocol beds were insensitive to detecting precipitates, licensee representatives stated that it is relying on an alternate parameter (turbidity measurement) as a detection tool for precipitate formation. The NRC staff has reviewed CHLE loop test data that shows a correlation between turbidity and aluminum additions that caused precipitation in the bulk solution, however, the NRC staff noted that the relationship between turbidity and precipitates in solution was tested for limited conditions and that the relationship was not well established. Moreover, the NRC staff noted that turbidity would not detect precipitation if it occurs on the fiber surfaces within a debris bed rather than in the bulk solution.

STPNOC representatives stated that it was not using fiber prepared by blending since it was not representative for the plant. In addition, the licensee indicated that the inconsistent baseline head loss behavior with the blended fiber beds was a primary reason that the 30-day tests were performed using the NEI-protocol prepared beds.

The NRC staff noted that the beds were not intended to be representative because they did not include all debris that is expected to be present in a bed in the plant. Furthermore, according to the licensee's test plan, "the fiber bed used in testing was designed to be an indicator bed used to detect chemical effects head loss and is not reflective of a fiber bed formed under plant conditions." The NRC staff noted that the blended beds performed consistently when installed in the loop at the end of the medium break loss-of-coolant accident (MBLOCA) test, and staff is aware of reproducible testing in other test facilities that used blended beds. The inconsistent behavior in the CHLE test loop appeared to be limited to a single occurrence and was likely due to particulate contamination from earlier shake-down tests in the test facility. After extended discussion on this topic, the NRC staff stated that due to the aforementioned reasons, it has significant concerns about the ability of the current test method to meet the test objective of chemical precipitate detection and that the licensee was proceeding at risk by using debris beds that have been shown to be insensitive to the presence of chemical precipitates.

Additional discussions regarding chemical effects testing are highlighted below:

- STPNOC provided an update on the status of chemical effects testing. STPNOC completed a 30-day test intended to model MBLOCA conditions for the plant. This test included aluminum and Nukon Fiberglass. The aluminum source was a piece of scaffolding from the plant and oxides present on the scaffolding were left intact for the test. The Nukon Fiberglass was prepared using the NEI-protocol preparation method. The MBLOCA test is intended to model a 6-inch break and the temperature was varied from about 185 degrees Fahrenheit (°F) to 100 °F over the course of the test. The aluminum level in solution measured less than 1

milligram per liter (mg/L) over the course of the test. There was no increase in turbidity or head loss during the test. At the end of the test, the NEI-prepared beds were replaced with blended fiber beds. These beds were recirculated for 2 days while isolated from the test solution. After 2 days, the bed loops were connected to the tank and run for an additional 2 days. No changes in head loss were noted during this time. Post-test analysis of the debris beds and aluminum coupon are planned, but have not been completed.

- Since the 30-day integrated tests are intended to be representative of the post-loss-of-coolant accident (LOCA) environment, the NRC staff questioned why the MBLOCA test included only two materials, Nukon Fiberglass and aluminum, as debris sources. STPNOC stated that it had not determined the required zinc and concrete amounts at the time the test commenced and that it wanted to be able to compare the results to earlier tests that had been conducted without additional debris types. In addition, the licensee did not want to complicate the evaluation of causes of precipitate formation.

- STPNOC started a large break LOCA (LBLOCA) test the first week in October 2012. The test included zinc and concrete, in addition to Nukon and aluminum. When asked how much zinc and concrete were included in the test, STPNOC stated the concrete was represented by a block and not particulate. The concrete amount was based on areas exposed to the jet and areas under unqualified coatings. STPNOC does not have uncoated concrete and that ablation of concrete is considered to be insignificant. Zinc was added in granular form to represent the amount of inorganic zinc coatings that could be exposed by the LBLOCA conditions. Since calcium could be an important contributor to chemical effects for plants with trisodium phosphate buffer, the NRC staff asked whether grout, either degraded or damaged during the LOCA, could add to the calcium source term. STPNOC plans to investigate the potential effects of grout. The NRC staff expressed interest in visiting the test facility and observing the ongoing chemical testing in November.

- The NRC staff asked whether the computational fluid dynamic (CFD) analysis, which was performed to show mixing within the chemical test facility test tank, was valid for conditions with coupons and other materials in the tank, particularly for the tests with the greatest amounts of coupons or other debris. STPNOC representatives stated that they intended to perform an additional CFD modeling run with the materials simulated in the tank.

- The NRC staff noted that it had further internal discussions related to the potential for moisture to be present on structures and components above the pool level following a LOCA and that it was likely that surfaces above the pool level would remain wet for a significant time following the LOCA. STPNOC had observed the coupons above the water level in the chemical effects testing and there was moisture on them several days into the test. The licensee indicated it will monitor the condition of the coupons above the water level to determine if they remain wet.

- The NRC staff asked whether STPNOC planned to perform sensitivity tests to determine the margin, if any, exists between the anticipated plant conditions, and the onset of precipitation. STP representatives stated that the 3000 and 3100 series tests were intended to investigate this issue, but it was unclear when these tests would be performed. The bench tests are also intended to investigate the range of possibilities of chemical behavior.

- The NRC staff and licensee discussed some of the results presented in "CHLE Tank Test Results for Blended and NEI Fiber Beds with Aluminum Addition," Revision 2. The staff noted that during shakedown testing, the aluminum oxyhydroxide prepared by the WCAP-16530-NP-A[3] method had significantly smaller particle sizes than those same precipitates formed during testing at Argonne National Laboratory (ANL). Precipitate size measurements at the licensee's test facility at the University of New Mexico were performed with a dual instrument that measured both particle size and zeta potential. The ANL particle size measurements were performed 4 hours after precipitates were formed and used a light scattering technique. The NRC staff is uncertain if the difference in particle sizing between the two facilities is related to differences in timing of the measurement relative to forming the precipitate, differences in the measurement technique, or some other factor.

- The NRC staff questioned how the overall STPNOC chemical effects evaluation accounted for items that are difficult to simulate in testing, such as radiation effects or the presence of activated crud particles. STPNOC stated that the unknowns had been discussed as phenomena identification and ranking table (PIRT) issues and specifically stated that it had provided information previously that radiation effects were not problematic for chemical effects. As summarized in the September 6, 2012, meeting summary, closure had not been reached on this PIRT item. The NRC staff noted that unknowns could be addressed by testing, by consideration in the potential distributions of chemical effects, or by adding margin to the evaluation. One of the methods that STPNOC planned to use to deal with uncertainties was to use prototypical plant materials in the chemical effects testing. Some tests to date (e.g., MBLOCA) have included only limited materials, which does not address the potential for unanticipated interactions between other materials that may be present in the plant. The staff stated it would revisit the PIRT issues and clarify those items that it felt had not yet been addressed adequately by the licensee.

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[3] Westinghouse Electric Company, LLC, WCAP-16530-NP, Revision 0, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191" dated February 2006 (ADAMS Accession No. ML060890509).

High-Temperature Vertical Loop Tests

STPNOC provided an update on high-temperature vertical loop testing being conducted to validate the correlation to be used to determine head loss for the risk-informed model. The testing includes only conventional debris (no chemical debris). The following items regarding testing were discussed:

- Consistent debris beds that capture the particulate were formed using the NEI fiber preparation method (pressure washed fiber). These beds resulted in little increase in head loss.
- Debris bed head loss did not change as much as expected with changes in temperature. Temperature was decreased from 200-100 °F.
- Similar tests with iron oxide instead of silicon carbide particulate were run to examine the NUREG/CR-6224 head loss correlation. The iron oxide results were similar to those from the NUREG/CR-6224 testing.
- All tests were performed in buffered, borated reverse-osmosis water.
- Beds were formed at 0.1 feet per second (ft/s) and 0.02 ft/s.
- The NRC staff asked for the particulate size distributions for both the silicon carbide and iron oxide. STPNOC stated that the silicon carbide was the typical industry, 10 micron size, used in many head loss tests and that the iron oxide was similar in size distribution to that used in the testing for NUREG/CR-6224. Later testing will provide accurate sizing of the particulate materials used.
- The test will be modified to form the beds at a lower flow rate and use particulate surrogates (zinc and other coatings) more prototypical of the plant to investigate sensitivity to these parameters.
- For the initial quantification, STPNOC will use the NUREG/CR-6224 correlation which currently appears to be relatively accurate for iron oxide as a particulate, but conservative with respect to silicon carbide.

STPNOC discussed testing that had been completed to determine the effects of water chemistry on fiber bypass. The test loop consisted of a 40-gallon tank, and a 4-inch diameter perforated plate, with hole sizes and spacing that match the STPNOC strainer, in a pipe. The testing used fiber prepared by pressure washing. The test controlled the velocity through the perforated plate and the concentration of fiber in the test loop. The water types used were tap water and buffered borated water. There were four repeat tests done with each type of water for a total of eight tests. No statistically significant differences in bypass quantities were measured between tests. The tests were allowed to run for one tank turnover which took about 2 hours and 10 minutes. By the end of one turnover, the perforated plate had collected a fiber bed greater than 1-inch thick.

The NRC staff stated that it was concerned the large amount of fiber added in the single batch may affect the testing non-conservatively. In addition, a single turnover may not allow all of the

fiber to be captured. The NRC staff expressed the view that the licensee may be able to demonstrate that the fiber bed on the perforated plate collected slowly enough to show that the effects between tap water and de-mineralized water on fiber bypass were inconsequential for the conditions tested.

STPNOC provided an update on fiber bypass testing being conducted at Alden Labs. The following characteristics of the testing were provided:

- A prototypical strainer module is being used.
- The design ensures full transport of the debris to the strainer.
- The tests use pressure washed fiber.
- Tap water is used.
- Flow velocity is set to match the strainer maximum approach velocity.
- Tests with lower velocities are planned to simulate other scenarios.
- Three sensitivity tests have been conducted using single 1/8-inch fiber additions and one sensitivity test was conducted using 10 fiber additions to reach a total of 1/8 inch of fiber.
- The tests had filter changes at 5, 10, 30, and 50 turnovers.
- Isokinetic samples were taken at every turnover.
- The results of these tests appear to indicate that it is not necessary to use less than 1/8-inch batches of fiber.
- STPNOC plans to perform full load tests of 1/2-inch with 1/8-inch additions.
- The NRC staff expressed the view that the test should validate that the strainer is fully covered when 1/2-inch of fiber added to the test in order to ensure that some open bed area did not exist which could allow bypass with additional fiber additions.

CASA Grande and Probabilistic Risk Assessment

- STPNOC discussed the probabilistic risk assessment (PRA) and CASA Grande interface and stated that it is changing the LOCA scenarios in its PRA to more precisely model the timing of operator actions and subsequent operation with different numbers of trains. Changes in these scenarios will, in turn, affect the transport of debris and other parameters. The NRC staff indicated that review of these PRA scenarios would be part of any license amendment request review.

- STPNOC stated that it added some failure modes to the PRA. These failure modes include: strainer structural strength, boric acid precipitation, and air ingestion into the pumps taking suction from the sump.

- STPNOC initially had a default value of 10^{-5} for failure of the recirculation function in the PRA. After the initial quantification was completed, this value was removed from the PRA and set to zero. STPNOC is considering putting the default value back into the PRA to account for potential unknown failure mechanisms and other unknown conditions.

- The NRC staff requested that an estimate of the values and distributions that are going to be used in the models be provided. The NRC staff expressed concern that the initial quantification showed zero probability of recirculation failure due to strainer issues which appears to be non-conservative. The NRC staff requested an opportunity to review any preliminary values and distributions that have been developed. The NRC staff acknowledged that the final values and distributions may be different from what is submitted in the license amendment request. STPNOC stated that it would not have any quantification numbers until mid-November and that it would take some time after that to have numbers ready to submit to the NRC.

- The use of the geometric mean versus arithmetic mean is discussed in NUREG-1829, "Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process," April 2008 (ADAMS Accession No. ML082250436). The NRC staff stated that the NUREG noted that the different methods can lead to significantly different results and recommended that the purpose and context of the application must be considered when selecting a method. The NRC staff indicated that this issue remains to be addressed and suggested a sensitivity analysis using arithmetic mean as one viable approach.

In-vessel Effects

STP discussed its use of thermal-hydraulics to evaluate in-vessel effects including:

- MELCOR is used to predict the containment parameters including pressure, temperature, and sump temperature.

- RELAP5 is used to model the response of the reactor coolant system (RCS), including cooling of the fuel.

- The simulations had all three trains of ECCS operating.

- The licensee stated that the bottom of the core fully blocked for 2-inch, 6-inch, and the largest double-ended guillotine break in an RCS pipe, the simulations showed that the fuel would be adequately cooled for all breaks except medium and large cold-leg breaks.

- The licensee stated that simulation of all the fuel assemblies blocked except one (one assembly was completely unblocked) validated adequate cooling could be maintained.

- The licensee stated that simulation of alternate flow paths through the core baffle with the core inlet completely blocked showed adequate cooling

- The NRC staff asked whether the model being used for the simulations was a quality assurance code for STPNOC. STPNOC responded that the code was not its code of record, but that it had run several transients to benchmark the new code and the results were in agreement.

STPNOC is considering the best methodology to address boric acid precipitation. The licensee stated that it had to determine fiber bypass amounts prior to deciding on the best methodology for evaluation of boric acid precipitation. The licensee hopes to show that fiber bypassing the strainer will be limited to 15 grams per fuel assembly.

Summary of Action Items

- STPNOC will work with the NRC Project Manager on a future public meeting to discuss chemical effects.

- NRC staff will provide clarifying information concerning unknowns that STPNOC should address in its chemical effects evaluations. Most of these issues have previously been discussed as PIRT items, but the NRC staff does not consider that all of the items have been adequately addressed by the licensee.

- STPNOC will evaluate the effects of using the arithmetic mean versus the geometric mean in the LOCA frequency evaluation.

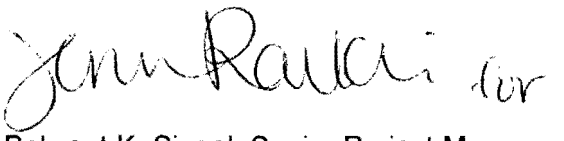
- STPNOC will provide a discussion of conservatisms and margins that are included in its evaluation.

- STPNOC will evaluate providing the results of modeling including estimated values and distributions or uncertainties associated with the estimates.

No Public Meeting Feedback Forms were received for this meeting.

Please direct any inquiries to me at (301) 415-3016, or balwant.singal@nrc.gov.

Sincerely,



Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

Enclosure:
List of Attendees

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LIST OF ATTENDEES

OCTOBER 10, 2012, MEETING WITH STP NUCLEAR OPERATING COMPANY

REGARDING RISK-INFORMED APPROACH TO RESOLUTION OF GSI-191 ISSUE

SOUTH TEXAS PROJECT, UNITS 1 AND 2

DOCKET NOS. 50-498 AND 50-499

NAME	TITLE	ORGANIZATION
Steve Blossom**	Project Manager	STPNOC
Rick Grantom**	Manager Risk Project	STPNOC
Ernie Kee**	Risk Management – Technical	STPNOC
Coley Chappell**	Engineering Licensing Consult	STPNOC
Wes Schulz**	Design Engineer	STPNOC
Zahra Mohaghegh**	Principal Research Scientist	Soteria
Seyed Reheni**	Research Scientist	Soteria
Rodolfo Vaghetto**	Graduate Research Assistant	Texas A&M University
David Morton**	Professor Mechanical Engineering	University of Texas
Bruce Letellier**	Probabilistic Risk Analysis	Los Alamos National Laboratory
Kerry Howe**	Professor Civil Engineering	University of New Mexico
Janet Leavitt**	Research Engineering	University of New Mexico
Tim Sande**	Principal Engineer	Alion Science and Technology
Craig Sellers**	Consultant	Alion Science and Technology
Gil Zigler**	Senior Scientist/Engineer	Alion Science and Technology
David Johnson**	VP Quantitative Risk Analysis	ABS Consulting
William Cross***	Projects Nuclear Licensing Manager	NEXTERA Energy
Craig Sellers***	Senior Project Manager	Enercon Services, Inc.
Justin Hiller***	Consulting Engineer	Ameren Missouri
Philip Grissom***	Principal Engineer	Southern Nuclear Company
Owen Scott***	Risk Informed Engineering	Southern Nuclear Company
Jonathan Nevins***	Design Analysis	Southern Nuclear Company
Kip Walker***	Mechanical Engineering Lead	Enercon Services, Inc.
Mark Richter***	Senior Project Manager	Nuclear Energy Institute
Michael Snodderly	Senior Reliability and Risk Engineer	U.S. Nuclear Regulatory Commission (NRC)
Stephen Dinsmore	Senior Reliability and Risk Engineer	NRC
Bruce Heida	Reactor Systems Engineer	NRC
Matt Yoder***	Senior Chemical Engineer	NRC

**Partcipated via phone and represented STPNOC
***Participated via phone

Enclosure

NAME	TITLE	ORGANIZATION
Steve Smith	Reactor Systems Engineer	NRC
Paul Klein	Senior Materials Engineer	NRC
Stewart Bailey	Branch Chief	NRC
Gloria Kulesa	Branch Chief	NRC
Donnie Harrison	Branch Chief	NRC
Ervin Geiger	Senior reactor Engineer	NRC
Jennie Rankin	Project Manager	NRC

Please direct any inquiries to me at (301) 415-3016, or balwant.singal@nrc.gov.

Sincerely,

/RA by Jennivine Rankin for/

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

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List of Attendees

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ADAMS Accession No.: ML12300A297 ***Via E-mail**

OFFICE	NRR/LPL4/PM	NRR/LPL4/PM	NRR/LPL4/LA	NRR/DRA/APLA/BC
NAME	JRankin	BSingal (LGibson for)	JBurkhardt	DHarrison *
DATE	11/5/12	11/6/12	11/5/12	10/23/12
OFFICE	NRR/DE/ESGB	NRR/DSS/SSIB/BC	NRR/LPL4/BC	NRR/LPL4/PM
NAME	GKulesa *	SBailey	MMarkley	BSingal (JRankin for)
DATE	10/25/12	10/23/12	11/8/12	11/8/12

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