



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

January 15, 2015

Mr. Dennis L. Koehl
President and CEO/CNO
STP Nuclear Operating Company
South Texas Project
P.O. Box 289
Wadsworth, TX 77483

SUBJECT: SOUTH TEXAS PROJECT, UNITS 1 AND 2 – STAFF AUDIT REPORT RELATED TO REQUEST FOR EXEMPTIONS AND LICENSE AMENDMENT FOR USE OF A RISK-INFORMED APPROACH TO RESOLVE THE ISSUE OF POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN-BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS (TAC NOS. MF2400, MF2401, MF2402, MF2403, MF2404, MF2405, MF2406, MF2407, MF2408, AND MF2409)

Dear Mr. Koehl:

By letter dated June 19, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML131750250), as supplemented by letters dated October 3, October 31, November 13, November 21, and December 23, 2013 (two letters); and January 9, February 13, February 27, March 17, March 18, May 15 (two letters), May 22, June 25, and July 15, 2014 (ADAMS Accession Nos. ML13295A222, ML13323A673, ML13323A128, ML13338A165, ML14015A312, ML14015A311, ML14029A533, ML14052A053, ML14072A076, ML14086A383, ML14087A126, ML14149A353, ML14149A354, ML14149A434, ML14178A481, and ML14202A045, respectively), STP Nuclear Operating Company (the licensee) submitted exemption requests accompanied by a license amendment request (LAR) for a risk-informed approach to resolve the issue of potential impact of debris blockage on emergency recirculation during design-basis accidents Generic Safety Issue 191 for South Texas Project, Units 1 and 2.

The U.S. Nuclear Regulatory Commission (NRC) staff conducted a regulatory audit at University of New Mexico in Albuquerque, New Mexico, on September 16 and 17, 2014, for gaining a better understanding of the licensee's approach to implement a risk-informed evaluation of the effects of debris on Emergency Core Cooling System and the Containment Spray System operation following a loss-of-coolant accident. A specific goal was to better understand the analysis and testing being performed in support of the responses to request for additional information in several areas critical to the NRC review of the LAR.

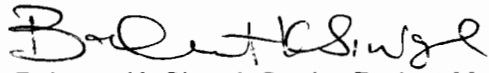
The Enclosure to this letter describes the results of the NRC staff's audit and some of the key technical issues highlighted by the staff during the audit. The NRC staff and the licensee will continue discussions for resolution of the unresolved technical issues during the future interactions.

D. Koehl

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If you have any questions, please contact me at 301-415-3016 or via e-mail at Balwant.Singal@nrc.gov.

Sincerely,



Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

Enclosure:
Staff Audit Report

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

STAFF AUDIT REPORT

RISK-INFORMED APPROACH TO RESOLUTION OF
GENERIC SAFETY ISSUE 191, "ASSESSMENT OF ACCUMULATION ON
PRESSURIZED-WATER REACTOR SUMP PERFORMANCE"

STP NUCLEAR OPERATING COMPANY

SOUTH TEXAS PROJECT, UNITS 1 AND 2

DOCKET NOS. 50-498 AND 50-499

1.0 Background

By letter dated June 19, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML131750250), as supplemented by letters dated October 3 and 31, 2013 (ADAMS Accession Nos. ML13295A222 and ML13323A673, respectively), STP Nuclear Operating Company (STPNOC, the licensee) submitted exemption requests accompanied by a license amendment request (LAR) for a risk-informed approach to resolve the issue of potential impact of debris blockage on emergency recirculation during design-basis accidents Generic Safety Issue (GSI)-191 for South Texas Project (STP), Units 1 and 2. This initial submittal was superseded in its entirety by a revised version provided by letter dated November 13, 2013 (ADAMS Accession No. ML13323A128). In addition, the licensee provided additional information by letters dated November 21 and December 23, 2013 (two letters); and January 9, February 13, February 27, March 17, March 18, May 15 (two letters), May 22, June 25, and July 15, 2014 (ADAMS Accession Nos. ML13338A165, ML14015A312, ML14015A311, ML14029A533, ML14052A053, ML14072A076, ML14086A383, ML14087A126, ML14149A353, ML14149A354, ML14149A434, ML14178A481, and ML14202A045, respectively). The U.S. Nuclear Regulatory Commission (NRC) staff issued a Request for Additional Information (RAI) by letter dated April 15, 2014 (ADAMS Accession No. ML14087A075). The licensee provided responses to the RAIs by letters dated May 22, June 25, and July 15, 2014.

The NRC staff conducted a regulatory audit at University of New Mexico in Albuquerque, New Mexico, on September 16 and 17, 2014, for gaining a better understanding of the licensee's approach to implement a risk-informed evaluation of the effects of debris on Emergency Core Cooling System and the Containment Spray System operation following a loss-of-coolant accident (LOCA).

The following NRC staff members participated in the audit:

- Victor Cusumano
- Christopher Fong

Enclosure

- Stephen Smith
- Matthew Yoder
- Osvaldo Pensado – NRC Contractor from Southwest Research Institute (SRI)

STPNOC was represented by the following personnel:

- Mike Murray
- Steve Blossom
- Wayne Harrison
- Wes Schultz
- Ernie Key – Contractor
- Dave Johnson – ABS Consulting
- Bruce Letellier – Alion Science and Technology
- Janet Leavitt – Alion Science and Technology
- John J. Hasenbein – University of Texas at Austin

2.0 Audit Report

During the review of the LAR, the NRC staff identified several technical issues and generated RAIs. The RAIs were transmitted to the licensee by letter dated April 15, 2014. The licensee provided its response to the NRC staff RAIs by letters dated May 22, June 25, and July 15, 2014. To facilitate an expedited review and to develop a clear understanding of the information provided by the licensee, a regulatory audit, consistent with the audit plan dated September 4, 2014 (ADAMS Accession No. ML14247A490), was conducted on September 16 and 17, 2014.

2.1 Technical Issues Discussed During the Audit

Probabilistic Risk Assessment (PRA)

- The NRC staff and the licensee discussed STPNOC methodologies to define LOCA frequencies in the PRA and Containment Accident Stochastic Analysis (CASA) Grande model. The staff noted the use of different LOCA frequency distributions between these two models. The licensee stated that it understood the technical issue and would work to implement consistent treatment and perform correlated sampling of the CASA Grande output distributions and the PRA initiating event frequency distributions during the evaluation of parametric uncertainty.
- A major discussion point in the PRA area was the existence of unanalyzed plant states in the combined PRA and CASA Grande models. Some of the unanalyzed plant states could arise from operator failure (i.e., human error) to implement actions, or timing inconsistencies between the model and actual operator actions. The licensee stated that it would consider further work to identify relevant plant states for STPNOC and either explicitly evaluate those states in the PRA or CASA Grande models or conservatively assume core damage for those plant states.
- Key sources of uncertainty and assumptions were also discussed during the audit. The NRC staff clarified its expectations, as set forth in Regulatory Guide (RG) 1.200, Revision 2,

“An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities,” March 2009 (ADAMS Accession No. ML090410014), that key assumptions and parameter and model uncertainties of the risk-informed assessment should be properly identified and adequately evaluated. Uncertainties arise, for example, due to test conditions not matching those in the plant or the existence of unknown phenomena. The NRC staff stated that these uncertainties are considered key if they clearly affect the risk results in a manner that could affect the regulatory decision. The licensee provided examples of conservatism built into the model and the NRC staff and the licensee agreed to continue discussions for resolution of the unresolved technical issue during the future interactions.

- The NRC clarified that a transparent risk-informed assessment should be implemented allowing for a clear understanding of the relevance of the key uncertainties. NRC guidance, standards, codes, and approved methodologies should be adopted, when possible, to reduce the number of key assumptions that must be evaluated.
- The NRC staff sought to understand the method the licensee is using to define mean LOCA frequencies and how the methodology chosen by the licensee may be identified as an assumption and evaluated to determine whether it is a key assumption, and therefore a key source of uncertainty, and justified accordingly.

Debris Transport

- The NRC staff and the licensee discussed licensee’s responses to the RAIs in the area of debris transport. The licensee and NRC staff both agreed to review the existing industry and staff guidance for debris transport to determine whether the RAI responses properly considered the guidance.

Treatment of Chemical Effects and Protective Coatings

- The licensee provided clarifying information relative to the treatment of chemical effects in the licensee’s LAR. The licensee stated that it will be changing from the “bump-up factor” chemical effects evaluation methodology described in the LAR to an alternate methodology that was referred to in an enclosure to its RAI response letter dated July 15, 2014. The NRC staff stated that it intends to review the alternate chemical effects method, referred to as L*, in greater detail to develop a more complete understanding of this method. The staff will need to review the existing RAI responses to determine which questions are no longer relevant given a change in the evaluation methodology. Other areas of uncertainty evaluated included the plant-specific chemical effects evaluation (e.g., the aluminum corrosion rate, the effect of zinc corrosion, and the actual head loss value for a test shutdown to protect the test loop). The staff intends to perform a review to determine how the licensee bounds the uncertainty in its chemical effects evaluation.
- In the area of protective coatings, the only new concept presented by the licensee was to use a random sampling of unqualified epoxy coating debris. This sampling would assume between 50 and 100 percent failure of the unqualified epoxy compared to the 100 percent failure assumed in the existing submittal. This is aligned with the previous staff guidance for unqualified coatings based on the Electric Power Research Institute Original Equipment

Manufacturer coatings tests. The licensee is expected to supplement the original submittal with the new analysis.

- The NRC staff reiterated its concerns in several areas of discussion in the original LAR and RAI responses with respect to coatings. These concerns have previously been discussed in a public meeting. The licensee was informed that the staff intends to issue additional RAIs regarding the licensee's current analyses for the inorganic zinc zone of influence, unqualified coatings in upper containment, and size distribution for unqualified epoxy debris.

Strainer Head Loss, Strainer Debris, and In-Vessel Debris

- During the audit, the NRC staff discussed proposed responses to several RAIs. The NRC staff stated that consistent with existing guidance, correlations are not acceptable for use in determining strainer head loss unless they are validated under plant-specific conditions for the range of conditions to which they are applied. The NRC staff provided examples of strainer tests of very thin beds that resulted in measureable head loss and results provided from STPNOC's use of a correlation were not consistent with these examples. Further, the licensee described that the CASA Grande Model accounted for flashing in the deaeration portion of the model, and stated that if flashing occurs, a failure of the strainer is assumed.
- The licensee provided information regarding apparently non-physical results for debris predictions related to a wide range of fiber penetration, or bypass. The licensee described the way uncertainty is treated in the model; demonstrating that test results were relatively consistent and indicated that values in the middle of the range of those predicted by the model would be expected to penetrate the strainer. The NRC staff and the licensee agreed to continue discussions for resolution of the unresolved technical issue during the future interactions.
- The licensee stated that it did not credit the lower plenum volume to calculate boric acid precipitation times and the debris limit chosen for cold-leg breaks was simply an amount of debris above which flow was assumed not to enter the core.

Quality Assurance Program

- The licensee presented its plan to include the CASA Grande program under a Software Quality Assurance (SQA) program, with a goal of completing this effort in spring of 2015. The licensee indicated that the STP engineering QA program had been applied to analyses and calculations performed by the various vendors and contractors supporting STPNOC; however, the licensee implied that it had not been used by the vendors and contractors for the submittal under review. Further evaluation of STP QA is required and will be addressed as necessary in future RAIs.

CASA Grande Model

- Several issues were discussed in the area of the CASA Grande Model. It appears from NRC confirmatory calculations using CASA Grande that changes to the time stepping resulted in different amounts of fiber accumulated in the core. STPNOC stated that the extent of fiber accumulation decreases with decrease in the time steps in CASA Grande.

The NRC staff also asked why head loss and the amount of particulate debris in the debris bed slowly increased over time. STPNOC stated that all debris was added to the post-LOCA pool within 10 minutes of the LOCA due to a coding error in CASA Grande. STPNOC pointed out that there are a number of user-selectable options within CASA Grande that are implemented via various flag settings. STPNOC identified that the NRC had not changed an option in the CASA Grande code to reproduce this error. After the NRC enabled the option in the software, as expected, the amount of debris in the bed exhibited a plateau after a short time. However, the head loss continued to increase slowly over time. This increasing trend was determined by the NRC staff to be due to cooling of the water and a commensurate increase in viscosity. The NRC staff noted that this was an important parameter due to the fact that if head loss trends upward toward failure, and the simulations are stopped prematurely, the results may underestimate the probability of strainer failure. Understanding the causes of trends will allow NRC staff to better evaluate their importance. The NRC staff and the licensee agreed to continue discussions for resolution of the unresolved technical issue during the future interactions.

During the audit, the NRC staff also visited the chemical effects testing laboratory at the University of New Mexico. The stainless steel tank used in current testing is the same tank used for the jointly sponsored NRC-nuclear industry Integrated Chemical Effects Testing Program. The staff observed changes that had been made to the facility to enable and improve chemical effects testing with debris beds in vertical head loss loops.

During the exit meeting on September 17, 2014, the NRC staff stated that the audit was very helpful for the staff to understand some areas of the licensee's submittal with open communication throughout the audit and helped in resolution of the pending NRC staff concerns. Due to some apparently conflicting information received from the licensee and its contractors, attributed to different understanding of the questions and information requested, the NRC staff suggested that STPNOC might improve communication and overall project integration between STPNOC and various contractors supporting the project. STPNOC stated that it understood the staff's concern and would work to improve in this area.

There were no additional open items identified during the audit. The NRC staff is in the process of developing a second round of RAIs and some of these RAIs are likely to be influenced by the discussions and reviews conducted during the audit. The audit also helped eliminate some of the potential RAIs the NRC staff was planning to issue before the audit. The audit was conducted in accordance with the audit plan and there are no known deviations.

Based on the information provided during the call, the NRC staff provided feedback to the licensee in the following areas.

- 1) Schedule for the proposed testing relative to the LAR review process.
- 2) The ability of the test program described by the licensee to provide adequate data to validate the chemical and head loss models or determine the uncertainties associated with the testing.
- 3) The chemical effects portion of the testing. The NRC staff requested additional background on how the new tests would provide the data needed to support the new

chemical model, L*, since the current L* model data used WCAP-16530-NP-A, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191," March 2008 (ADAMS Accession No. ML081150379), precipitate and the new testing plans to use a different surrogate.

- 4) The licensee's decision to use the Viscous Inertial Shear-Transition-Adaptive (VISTA) correlation for head loss was new information that had not previously been provided to the NRC staff.

3.0 Follow-Up Call

The NRC staff conducted a call with STPNOC on October 15, 2014, as an addendum to the audit, and to clarify that we understood what STP's analysis and testing plans were to address our existing and proposed RAIs. A copy of the slides used by the licensee during the presentation is located at ADAMS Accession No. ML14294A278. STPNOC described its plan to conduct testing to validate the VISTA head loss correlation and the L* chemical model. STPNOC discussed the purpose of the testing and provided a high level perspective on how the testing may be conducted. Detailed discussions of the proposed tests will be conducted in a public meeting in early 2015.

D. Koehl

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If you have any questions, please contact me at 301-415-3016 or via e-mail at Balwant.Singal@nrc.gov.

Sincerely,

/RA/

Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

Enclosure:
Staff Audit Report

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