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

October 23, 2012

APPLICANT: STP Nuclear Operating Company

FACILITY: South Texas Project, Units 1 and 2

SUBJECT: SUMMARY OF MEETING HELD ON AUGUST 27, 2012, BETWEEN THE U.S. NUCLEAR REGULATORY COMMISSION STAFF AND SOUTH TEXAS PROJECT NUCLEAR OPERATING COMPANY REPRESENTATIVES TO DISCUSS THE SOUTH TEXAS PROJECT, LICENSE RENEWAL APPLICATION (TAC NOS. ME4936 AND ME4937)

On August 27, 2012, the Nuclear Regulatory Commission (NRC or the staff) met with members of South Texas Project Nuclear Operating Company (STPNOC or the applicant) in a public meeting to discuss aspects of the license renewal application (LRA) for the South Texas Project. The meeting was held at NRC Headquarters, Rockville, Maryland. The meeting notice and agenda, dated August 15, 2012, is located in the Agencywide Documents Access and Management System (ADAMS) under Accession No. ML12226A455. The purpose of the meeting was to discuss the applicant's plans for responding to request for additional information (RAI) RAI B2.1.37-4, regarding issues related to selective leaching of aluminum bronze.

A list of attendees is provided in Enclosure 1 and the meeting agenda is provided in Enclosure 2. A copy of the handout diagrams provided by the applicant is provided as Enclosure 3.

Meeting Results: Discussion of STPNOC plans for responding to RAI B2.1.37-4

The discussion was based on the 8 issues, or sub-parts, of RAI B2.1.37-4, which are presented below along with a summary of the discussion for each item.

1) The need for bounding analyses that show internal cracking associated with dealloying will not grow large enough to cause failure of a component.

   The staff is concerned that sufficient bounding analyses have not been presented to demonstrate that internal cracking associated with dealloying remained below the size that would cause failure of the component. The staff believes that volumetric examinations (or destructive examinations if an NDE type of test is not possible) are needed to properly size existing cracks and trend crack growth.

   The staff is also concerned that the applicant has not provided sufficient information to conclude that when external leakage is identified, an external visual examination and crack correlation would be sufficient to detect an internal crack in the dealloyed region and to consistently project its size. The staff is also concerned that cracks in dealloyed regions could result in piping failures during a seismic event. In addition, the staff expressed concern that the applicant has provided only a limited number of samples for crack correlation; the staff is not convinced that an analysis of these limited samples would provide a conservative correlation for estimating internal crack size. The staff also stated that the applicant's responses have not addressed how different heats of

material - with varying extents of dealloy-susceptible phases - might respond differently to the cracks. It was agreed that the staff is not questioning the methodology of the bounding analyses, rather that insufficient data has been provided to justify the applicant's positions. It was agreed that additional testing of material properties of various component sizes is necessary in order to confirm the input parameters for the bounding analysis. The testing protocol would need to include a sufficient number of samples at various sizes and multiple samples for at least two of the sizes tested. Additional discussion took place regarding the material properties to be tested. STPNOC's intent is to provide an additional commitment to perform additional testing considering the discussion points made during the meeting. In addition to the sample examination and testing commitments (Commitments Nos. 39 and 44) already provided to the staff, the applicant stated that it will make a best effort to size flaws by volumetric methods. Also, in order to validate the correlation between the sizes of external indications and internal flaws, STPNOC will examine 100 percent of leaking components, up to a maximum of 10 percent of the current susceptible components, to determine the degree of dealloying and presence of cracking (this task will be referred to as a profile inspection). The applicant will also determine the number of susceptible components; the current estimate is about 350 total for both units, resulting in an initial maximum number of examined components being approximately 35. It was also agreed that the applicant intended to perform profile inspections commencing with its submittal of the RAI response and continuing throughout the period of extended operation. Subsequent to completing 35 profile inspections, the applicant would examine 20 percent of leaking components removed from service, but at least one, to determine the dealloying profile every five years. Finally, the current provision concerning removal of components from service if no leaking components are identified will remain in place.

2) The need for obtaining and trending fracture toughness as a critical parameter and adding this to the applicant's Commitments and updated final safety analysis report (UFSAR) summaries.

The staff expressed concerns that fracture toughness testing was not listed, nor trended, as a parameter to be included as part of the sample testing protocol proposed by the applicant. Since cracking has been observed in dealloyed specimens, the staff was concerned that the method of calculating critical bending stress would be non-conservative if the test results did not include fracture toughness properties.

As a result of the discussions on this issue, the staff and the applicant agreed that, instead of proving the applicant's analyses by calculations, the applicant could demonstrate the conservatisms empirically. The staff and the applicant also agreed that under this scenario, fracture toughness testing of dealloyed materials would not be necessary. Therefore, in place of using dealloyed mechanical properties in the structural integrity calculations, the applicant could continue its approach committed to in Commitments Nos. 39 and 44, and could perform destructive component testing to validate the conservatism of the analyses. The staff and applicant agreed to the following test protocol parameters for this approach: (1) that the applicant will conduct at least nine destructive tests similar to that for the 6-inch component that was tested and documented in AES-C-1964-4, with the intent that at least three sizes of susceptible components will be tested, and at least two tests for each size; (2) that the test specimens will have in-service or lab-induced cracks in the dealloyed region; and (3) that

each of the tested components will also be profiled for the degree of dealloying. Both also agreed that, if it is determined that destructive component testing is not feasible or if the test results challenge the conservatism of the calculations in AES-C-1964-5, then the applicant will institute a program to use dealloyed tensile and fracture toughness properties in its structural integrity calculations.

3) The lack of details on how the percentage of dealloying for tested specimens is identified.

   The staff expressed the concern that no details were included on how the percentage of dealloying has been or will be determined. Since past calculations have described the percentage of dealloying and evaluations of structural integrity have relied, in part, on this measurement, the staff needs to understand how the value is determined.

   During the discussion it was agreed that the "degree of dealloying" referred to in previous RAI responses reflects the percent of wall cross-section affected by dealloying, rather than a percent of degradation experienced by a given area or volume of piping material. The applicant agreed that it will measure this fraction of cross section affected by dealloying in the profile inspections and destructive component testing discussed in this meeting. The staff and the applicant agreed that, when conducting the profile inspections, STPNOC will use a confirmatory test method, such as measuring the percent of aluminum in the dealloyed region or examination of the metallurgical phase(s) of the dealloyed region, to confirm the extent of dealloying. STPNOC also stated that it plans to clarify, on the docket, how terms such as "100% dealloyed" were used in previous RAI responses.

4) Whether extrapolating degradation test results of samples from recently removed aluminum bronze components bounds potentially worst-case dealloying percentages.

   The staff expressed a concern that the six samples from three recently removed aluminum bronze components, which will be tested for chemical composition and mechanical properties, may not be 100 percent dealloyed, and therefore extrapolations of their test results may not reflect the potential worst-case degree of degradation existing in the system.

   During the discussion the applicant stated that strength of dealloyed material is not used in its bounding calculations, and that it would validate the input parameters to the bounding analyses through empirical test data. The staff agreed that, under that approach, dealloyed material properties will not be necessary in the structural integrity analyses of the component testing described in Item 2 above, and that mechanical and chemical property testing can remain as currently proposed by the applicant. In addition, though, it was agreed that the applicant will include testing of fracture toughness properties from non-dealloyed portions of removed inservice components, and that the applicant should destructively examine removed components in order to trend the amount of circumferential dealloying and depth of dealloying. Finally, it was agreed that trending the degree of dealloying should validate the hypothesis that dealloyed components retain sufficient strength after external flaws are detected.

5) Analyses for flooding, reductions in flow, water loss from the essential cooling pond, and break size flaws in regards to identification of maximum tolerable flaw size.

   The staff stated its concern that the applicant had not adequately addressed the issue of maximum tolerable flaw size. In order to adequately respond, the applicant needed to identify the maximum size flaw that would not proceed to failure, or would exhibit only

minor leakage, when a transient occurred. Then, utilizing the transient inputs, the applicant would need to identify the maximum size leak path in the affected component. In addition, it was not apparent to the staff how leakage upstream of an individual component (e.g., diesel generator heat exchanger) has been addressed. The applicant stated that its calculations conclude that a critical crack size from a stress analysis aspect would not result in a flow rate greater than that of the assumed opening size for flooding analyses.

As a result of the discussions, it was agreed that STPNOC would provide a summary of the results of calculations that demonstrates the maximum leak rate from a maximum possible through-wall flaw exposed to design conditions - or from the critical crack size - will not exceed the UFSAR Chapter 9A flooding, reduction in flow, and water loss from the essential cooling pond assumptions. It was also agreed that, if a crack should occur, STPNOC would determine the maximum size flaw for which the affected (downstream) component can still perform its intended function.

6) Whether trending of fracture toughness values, yield strength values, and the degree of dealloying was needed for an adequate program.

The staff expressed the concern that the lack of trending of fracture toughness, yield strength properties, and prevalence of dealloying (since progression of dealloying could vary over time) would prevent the program from being adequate.

As a result of the discussion, it was agreed that for the applicant's approach, fracture toughness and yield strength properties would not need to be trended, but tensile strength and percent dealloying values would be trended in order to project an estimated time that as-found properties would not be supported by existing calculations. It was also agreed that the applicant would trend the extent of dealloying determined from the profile inspections.

7) Acceptance criteria for the fracture toughness and yield strength values; using acceptance criteria for ultimate strength of 30 ksi.

The staff expressed its concern that, since the applicant's current analyses are based on a <u>minimum</u> 30 ksi ultimate tensile strength, an <u>average value</u> equal to or greater than 30 ksi is not acceptable to demonstrate that the intended functions of a susceptible component will be met. The staff stated that the LRA needed revision to reflect that the acceptance criteria of ultimate tensile strength is a minimum of 30 ksi, or a justification as to why, when only a minimum of 12 samples will be tested, utilizing an average value is acceptable.

The applicant stated that it believes the additional testing commitment, to be developed in response to Issue 1, should result in a comparison of limit load stress results with material fracture stress limits to confirm the conclusion of the above-referenced calculations.

As a result of the discussion, the staff and the applicant agreed that the applicant would revise the acceptance criteria of its current analyses to reflect the lowest-bound tensile strength and include the utilization of the analytical output tables from STPNOC calculation AES-C-1964-5, "Evaluation of the Significance of Dealloying and Subsurface Cracks on Flaw Evaluation Method" (or revised calculation). The staff and the applicant also agreed that the applicant would submit calculation AES-C-1964-5 (which complements calculation AES-C-1964-1, "Calculation of Critical Bending Stress for

Dealloyed Aluminum-Bronze Casings in the ECW System" previously submitted to the NRC) to demonstrate that dealloyed material does not fail in a non-ductile manner.

8) Cavitation erosion in the essential cooling water system: does or could it occur in the vicinity of dealloying; and implications.

   Based on the staff's review of plant-specific operating experience associated with the essential cooling water (ECW) system, the ECW system has evidence that cavitation erosion occurs in the system. The staff expressed a concern that cavitation erosion in the vicinity of dealloyed material could potentially change the rate of degradation accounted for in the intervals between inspections of the components. If that is the case, then such a change in the rate of erosion needs to be accounted for in the intervals between inspections of the components. The applicant stated that cavitation erosion in the ECW system was associated with aluminum bronze piping that is not susceptible to dealloying and with carbon steel slip-on flanges, but not in the vicinity of components susceptible to dealloying.

   It was agreed that the applicant's RAI response will document the material and the ECW system locations where cavitation erosion has been observed, and demonstrate that the observed cavitation erosion conditions are in locations not susceptible to dealloying.

No separate meeting handout materials were provided by the applicant other than the diagrams presented in Enclosure 3.

No Public Meeting Feedback Forms were received for this meeting.

Please direct any inquiries to John Daily at 301-415-3873, or by email to John.Daily@nrc.gov.

John Daily, Senior Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos.: 50-498 and 50-499

Enclosures:
1. Attendance List
2. Agenda
3. Meeting Handouts

cc w/encls: Listserv

MEETING BETWEEN THE NRC STAFF AND STP NUCLEAR OPERATING COMPANY
SOUTH TEXAS PROJECT, UNITS 1 AND 2, LICENSE RENEWAL APPLICATION

ROCKVILLE, MD

MEETING ATTENDANCE LIST
AUGUST 27, 2012

PARTICIPANTS	AFFILIATIONS
John Daily	USNRC/NRR/DLR
Dave Rudland	USNRC/RES/DE
John Wise	USNRC/NRR/DLR
William Holston	USNRC/NRR/DLR
Angela Buford	USNRC/NRR/DLR
John Tsao	USNRC/NRR/DE
Dave Alley	USNRC/NRR/DE
Rajender Auluck	USNRC/NRR/DLR
Mike Berg	STPNOC
Arden Aldridge	STPNOC
Ken Taplett	STPNOC
S. B. Patel	STPNOC
Gary Warner	Worley Parsons (STARS COB)
Geoff Egan	Intertek
Russ Cippolla	Intertek/Aptech

ENCLOSURE 1

MEETING BETWEEN THE NRC STAFF AND STP NUCLEAR OPERATING COMPANY
SOUTH TEXAS PROJECT, UNITS 1 AND 2, LICENSE RENEWAL APPLICATION
NRC HEADQUARTERS
ROCKVILLE, MD

AGENDA
AUGUST 27, 2012

	Topic	Time (approximate)
I.	Introduction and Opening Remarks	08:00 – 08:10 a.m.
II.	Discussion of STPNOC plans for responding to RAI B2.1.37-4 a. Bounding analyses for internal cracking. b. Revisions to LRA Sections A2.1.37 and B2.1.37 c. Identifying percentage of dealloying for testing specimens d. Extrapolating test results of samples from recently removed aluminum bronze components to reflect degradation in the system. e. Discussion of analyses for flooding, reduction in flow, water loss from the essential cooling pond, and break size flaws	08:10 – 11:15 a.m.
III.	Public comment	11:15 – 11:30 a.m.
IV.	Break for Lunch	11:30 – 12:30 a.m.
V.	Discussion (continued) a. Revisions to the LRA to trend fracture toughness values, yield strength values, and the degree of dealloying. b. Acceptance criteria for the fracture toughness and yield strength values; using acceptance criteria for ultimate strength of 30 ksi. c. Cavitation erosion in the essential cooling water system: does or could it occur in the vicinity of dealloying; and implications.	12:30 – 1:30 p.m.
VI.	General questions from NRC staff	1:30 – 2:30 p.m.
VII.	Break	2:30 – 3:00 p.m.
VIII.	Public Comments	3:00 – 3:15 p.m.
IX.	Closing Remarks	3:15 – 3:30 p.m.
X.	Adjourn	3:30 p.m.

ENCLOSURE 2

MEETING BETWEEN THE NRC STAFF AND STP NUCLEAR OPERATING COMPANY
SOUTH TEXAS PROJECT, UNITS 1 AND 2
LICENSE RENEWAL APPLICATION

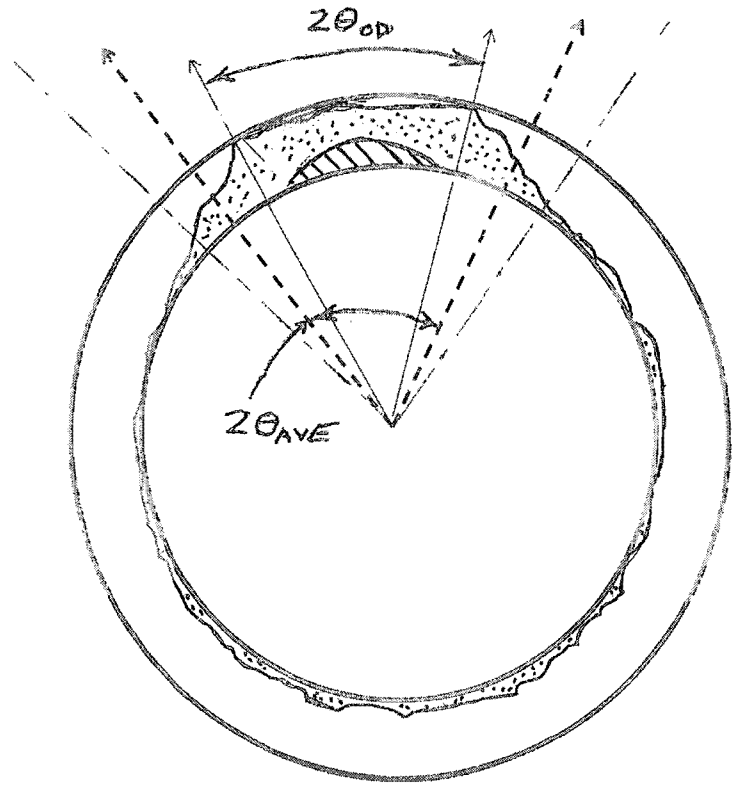
ROCKVILLE, MD

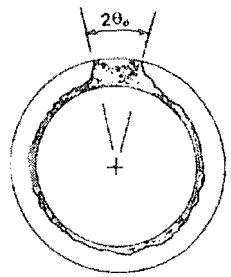
AUGUST 27, 2012

MEETING HANDOUTS AS PROVIDED BY STPNOC

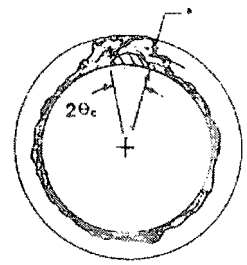
ENCLOSURE 3

Model for Crack in Dealloyed Material

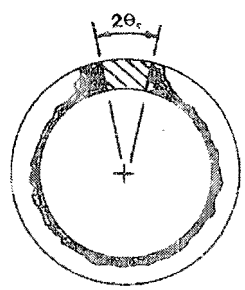




a) Through-Wall Dealloying (No Cracks)



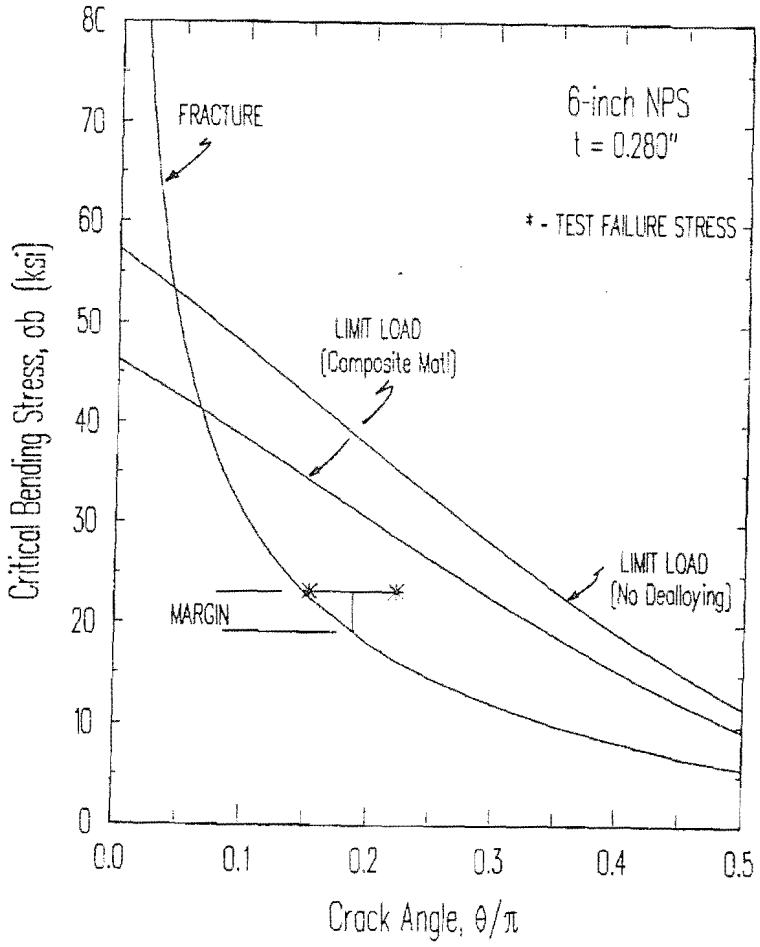
b) Part-Through Crack with Dealloying



c) Through-wall Crack with Dealloying

CRITICAL BENDING STRESS FOR THROUGH-WALL CRACK

Comparison of Model Predicotions with Test Results



Dealloyed Aluminum-Bronze Casings in the ECW System" previously submitted to the NRC) to demonstrate that dealloyed material does not fail in a non-ductile manner.

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/RA/
John Daily, Senior Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-498 and 50-499

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DATE	10/11/12	10/15/12	10/17/12	10/22/12	10/23/12

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Memorandum to STP Nuclear Operating Company from John Daily, dated October 23, 2012

SUBJECT: SUMMARY OF MEETING HELD ON AUGUST 27, 2012, BETWEEN THE U.S. NUCLEAR REGULATORY COMMISSION STAFF AND STP NUCLEAR OPERATING COMPANY REPRESENTATIVES TO DISCUSS THE SOUTH TEXAS PROJECT, LICENSE RENEWAL APPLICATION

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