PMSTPCOL PEmails

From: Joseph, Stacy
Sent: Tuesday, January 25, 2011 12:30 PM
To: 'jeprice@stpegs.com'
Cc: Tai, Tom; STPCOL
Subject: Advanced Copy of Seismic Audit Report
Attachments: ML1101101042.docx

John,

Tom Tai ask that I send you an advanced copy of the Audit Summary for the October Seismic Audit. The subject summary is attached.

Sincerely,

Stacy Joseph
Project Manager
U. S. Nuclear Regulatory Commission
Office of New Reactors
Division of New Reactor Licensing

(Office) 301-415-2849
Mail Stop T6-D04
Washington DC 20555-0001

Hearing Identifier: SouthTexas34Public_EX
Email Number: 2575

Mail Envelope Properties (BBC4D3C29CD0E64E9FD6CE1AF26D84D54DBE8A38F9)

Subject: Advanced Copy of Seismic Audit Report
Sent Date: 1/25/2011 12:30:25 PM
Received Date: 1/25/2011 12:30:27 PM
From: Joseph, Stacy

Created By: Stacy.Joseph@nrc.gov

Recipients:
"Tai, Tom" <Tom.Tai@nrc.gov>
Tracking Status: None
"STPCOL" <STP.COL@nrc.gov>
Tracking Status: None
"'jeprice@stpegs.com'" <jeprice@stpegs.com>
Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	365	1/25/2011 12:30:27 PM
ML1101101042.docx	64380	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Mr. Mark McBurnett, Vice President
Regulatory Affairs
STP Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

SUBJECT: REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION – SEISMIC DESIGN AND ANALYSES

Dear Mr. McBurnett:

By letter dated September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Combined License (COL) application to construct and operate two reactor units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification at the South Texas Project Nuclear Power Plant. The NRC Office of New Reactors (NRO) is reviewing the South Texas Project (STP) COL application that incorporates by reference the ABWR Design Control Document (DCD). As part of this review, the NRO Structural Engineering Branch 2 (SEB2) conducted an audit of the documentation supporting the seismic design of the STP COL application in Chapters 3.7 and 3.8. The audit was conducted at the Sargent & Lundy office in Chicago, Illinois, from October 18, 2010 to October 22, 2010. The NRC staff followed the guidance in NRO Office Instruction NRO-REG-108, “Regulatory Audits,” in performing this audit. Enclosure 1 is a list of the NRC and STPNOC team participating in the audit. Enclosure 2 is the detailed results of the audit.

Please contact Tom Tai at (301) 415-8484 or Tom.Tai@nrc.gov if you have any questions related to the audit.

Sincerely,

Mark Tonacci, Chief
BWR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-012
52-013

cc: See next page

Mr. Mark McBurnett, Vice President
Regulatory Affairs
South Texas Project Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

SUBJECT: REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION – SEISMIC DESIGN AND ANALYSES

Dear Mr. McBurnett:

By letter dated September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Combined License (COL) application to construct and operate two reactor units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification at the South Texas Project Nuclear Power Plant. The NRC Office of New Reactors (NRO) is reviewing the South Texas Project (STP) COL application that incorporates by reference the ABWR Design Control Document (DCD). As part of this review, the NRO Structural Engineering Branch 2 (SEB2) conducted an audit of the documentation supporting the seismic design of the STP COL application in Chapters 3.7 and 3.8. The audit was conducted at the Sargent & Lundy office in Chicago, Illinois, from October 18, 2010 to October 22, 2010. The NRC staff followed the guidance in NRO Office Instruction NRO-REG-108, “Regulatory Audits,” in performing this audit. Enclosure 1 is a list of the NRC and STPNOC team participating in the audit. Enclosure 2 is the detailed results of the audit.

Please contact Tom Tai at (301) 415-8484 or Tom.Tai@nrc.gov if you have any questions related to the audit.

Sincerely,

Mark Tonacci, Chief
BWR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos.: 52-012
52-013

DISTRIBUTION:

ADAMS ACCESSION NO.: ML110110104 **NRO-002**

OFFICE	PM: NRO/DNRL/BWR	LA:NRO/DNRL/BWR	BC:NRO/DE/SEB2	BC:NRO/DNRL/BWR
NAME	TTai	BAbeywickrama (w/edits)	KHawkins	MTonacci
DATE		1/11/11		

OFFICIAL RECORD COPY

Letter to M. McBurnett from Mark Tonacci dated

SUBJECT: REGULATORY AUDIT SUMMARY OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION – SEISMIC DESIGN AND ANALYSES

DISTRIBUTION:
PUBLIC
RidsNroDnrlNge2
KHawkins, NRO
SChakrabarti, NRO
MChakravorty, NRO
RidsNroDeSeb2
SKirkwood, OGC
RidsOgcMailCenter
MTonacci, NRO
TTai, NRO
BAbeywickrama, NRO
GWunder, NRO
RidsNroDnrl
RidsRgnMailCenter

LIST OF PARTICIPANTS
REGULATORY AUDIT OF SOUTH TEXAS PROJECT, UNITS 3 AND 4 COMBINED LICENSE APPLICATION – SEISMIC DESIGN AND ANALYSES

Name	Organization
Steve Thomas	STPNOC
Scott Head	STPNOC
P. K. Agraval	Sargent & Lundy
Javad Moslemian	Sargent & Lundy
Robert Hooks	Sargent & Lundy
Surendra Singh	Sargent & Lundy
James Fiskar	TANE
Dick Scheide	STPNOC
Kenneth Looper	Fluor
David Dyke	STPNOC
Brian McDonald	EXPONENT
Pascal Hayes	Fluor
John E. Price	STPNOC – Licensing
Dan Howard	Fluor
Ming Yang	S&L
Lauren Zavadsky	S&L
C. H. Ko	S&L
Robert E. Smith, Jr.	MACTEC
James R. Starnes, Jr.	MACTEC
Said Bolourchi	SGH
Dan Eggers	SGH
John McLean	S&L
Patrick Sheppard	S&L
Lisa Cleveland	S&L
Sara Walsh	S&L
Tomokazu Higuchi	Toshiba
Hiro Sugita	Toshiba
Delfo Blanchini	S&L
Mike Eudy	NRC
Kim Hawkins	NRC
Tom Tai	NRC

Name	Organization
Manas Chakravorty	NRC
Samir Chakrabarti	NRC
M. K. Ravindra	NRC/ERI
Basilio Sumodobila	NRC/SC Solution
Mansour Tabatabaie	NRC/SC Solution
Peter Arnold	NRC/Astral Engineering

DETAILED AUDIT RESULTS FOR SEISMIC DESIGN AND ANALYSES

October 18 - 22, 2010

1. Introduction

On September 20, 2007, STP Nuclear Operating Company (STPNOC) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Combined License (COL) application to construct and operate two reactor units (Units 3 and 4) based on the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification at the South Texas Project Nuclear Power Plant. The NRC Office of New Reactors (NRO) is reviewing the South Texas Project (STP) COL application that incorporates by reference the ABWR Design Control Document (DCD). As part of this review, the NRO Structural Engineering Branch 2 (SEB2) conducted an audit of the documentation supporting the seismic design of the STP COL application in Chapters 3.7 and 3.8. The audit was conducted at the Sargent & Lundy office in Chicago, Illinois, from October 18, 2010 to October 22, 2010.

Representatives from the NRC, key technical personnel representing STP Units 3 and 4, Sargent & Lundy (S&L), Fluor Corporation, Bechtel Corporation, Simpson, Gumpertz & Heger (SGH) and MACTEC were present during the audit.

The NRC staff followed the guidance in NRO Office Instruction NRO-REG-108, "Regulatory Audits," in performing this audit.

2. Objectives and Approach

The purpose of this audit is to review analyses performed to support the seismic design and analyses for the STP Units 3 and 4 COL application. Some of these calculations are proprietary. In addition, the background and supporting documents for the request for additional information (RAI) responses, including verification and validation (V&V) of computer codes, were also audited. The scope of the audit included both standard plant structures and site-specific structures and their foundations. Any significant findings during the audit will be documented in this audit report and RAIs may be issued, if necessary.

3. Technical Review

The following is a detailed description of the audit for Chapter 3.7, followed by Chapter 3.8:

Chapter 3.7: October 18, 2010

Technical Presentation:

A brief presentation was made by the applicant in regards to the on-going studies to address the effects of high Poisson's ratio, passing frequency, and foundation and structure mesh refinement on the soil structure interaction (SSI) response of the site-specific Category I Ultimate Heat Sink (UHS) Basin and Reactor Service Water (RSW) Pump House. An approach for incorporating the above effects in the final analysis and design was discussed by the Applicant. The draft response to RAI 03.07.01-25, Supplement 1 provides preliminary results of the SSI analysis that caps the Poisson's ratio at 0.495 for saturated soils. These preliminary results were discussed with the Applicant during the audit. The Applicant indicated that because of the increase in the structural response as a result of using a high Poisson's ratio in saturated soils, the SSI analyses of DGFSOV, RSW Piping Tunnel, DGFOST and all SSSI analyses plus any future SSI analysis will cap Poisson's ratio at 0.495 rather than 0.48 for saturated soils.

Calc Document U7-CB-C-CALC-DESN-6004, Rev B, "Soil-Structure Interaction Analysis of Control Building, STP 3 & 4 Site Specific (COLA Rev. 3)"

This calculation documents the results of confirmatory SSI analyses for the Control Building (CB) using site-specific Lower Bound (LB), Mean and Upper Bound (UB) soil properties. The results reviewed included transfer functions, forces, maximum accelerations, relative displacements and envelopes of acceleration response spectra. It is noted that the mesh may not have sufficient refinement to extract forces on the walls. However, this is not a significant concern because of the large margin in the standard design wall pressure envelopes.

Calc Document U7-SITE-C-CALC-DESN-6012, Rev A, "Soil Pressure Profiles between Reactor, Control and Turbine Buildings (Licensing)"

This calculation documents the 2-D SASSI2000 SSI analysis of RB+CB+TB for 4 site-specific soil cases: LB, Mean, UB and Mean with different half space thickness. The soil model uses 100 layers. The Calc document provides details of structural model and properties, and checks of structural modes against those of SAP2000 for fixed-base structure. Dynamic soil pressure calculations were reviewed. The criteria described in Eq. A-3.1 for passing frequency only refers to soil layer thicknesses and not the horizontal soil element dimension. Nonetheless, the 2-D mesh horizontal element dimensions were found to be okay for the passing frequency.

Calc U7-RB-C-CALC-DESN-6004 Rev. B, Soil-Structure Interaction Analysis of Reactor Building, STP 3&4 Site Specific (COLA Rev3)

This calculation documents the site-specific SSI analysis of the Reactor Building (RB). Results are compared to DCD. The following are noted:

- Poisson's ratio of 0.47 is incorrect in Section 5.1.1. S&L will correct to 0.48.
- Structure dimension on figure in page 31 does not match text on page 11. Page 11 is the correct DCD dimension. Page 31 is site specific. S&L will correct page 31 to be consistent with DCD.

Results are enveloped by DCD. Although the Applicant had committed to a Poisson's ratio of 0.495, the analysis was only done for 0.48. Since the DCD envelopes the analysis by a large margin, analysis for 0.495 is expected to be enveloped by DCD.

Calc U7-CB-C-CALC-DESN-6014, Rev. A, “Crane Wall Effect on Control Building SSI Analysis (Licensing)”

This calculation documents the results of site-specific structure-soil-structure (SSSI) analysis of the Control Building (CB) incorporating the effects of Crane Wall. The results in terms of the dynamic soil pressures on the CB wall are compared with the DCD design values. This is a 2D Analysis performed using SASSI2000. There was no comment on this calculation.

Calc U7-RB-C-CALC-DESN-6020, Rev. B, “Crane Wall Effect on Reactor Building SSI Analysis (Licensing)”

This calculation documents the wall pressures on the RB due to interaction with Crane wall. The calculated wall pressures are compared with the DCD design values for the site-specific soil condition. This is a 2D Analysis performed using SASSI2000. There was no comment on this calculation.

<u>October 19, 2010</u>

Calc Document U7-SITE-S-CALC-DESN-6002, Rev B, “Effect of Crane Wall on Seismic lateral Pressure on RB and CB Walls)”

This document was reviewed. The Poisson’s ratio of the backfill is 0.47. The Applicant stated that in the new revised calculation for the Crane Wall effects on the RB and CB walls, the Poisson’s ratio is changed to 0.495. The SASSI model is not shown in this Calc and is referenced to other Calc document.

Calc Document U7-UHS-C-CALC-DESN-6005, Rev A, “Effect of Finer Mesh in UHS-Pump House SSI Analysis (Licensing)”

This calculation documents the effect of mesh refinement on the SSI response on the UHS Basin/RSW Pump House. The passing SSI frequencies for the horizontal and vertical input for the SSI model are discussed. The passing frequencies for the horizontal and vertical input are stated to be about 23.5 Hz and 40.4 Hz, respectively. The passing frequency for the vertical input should be based on minimum Vs. This will result in a passing frequency of 23.5 as opposed to 40.4 Hz stated in the Calc for the vertical input. The applicant will provide the basis that the passing frequency of 23.5 Hz is sufficient for the SSI analysis of UHS Basin/RSW Pump House in response to RAI 03.07.02-24.

MACTEC Calc Document CALC-EORA-001, Rev A, “Foundation Springs (Seismic) for Category I and Other Structures”

This Calculation documents development of foundation spring parameters using simple procedures. The shear wave velocity (Vs) and other properties used for the backfill are estimated and have not been confirmed by laboratory and/or field testing. The backfill properties will be verified during construction through ITAAC.

Calc U7-SITE-C-CALC-DESN-6021, Rev. B, "RB + DGFOSV/DGFOSV Tunnel + Crane Wall SSSI"

This calculation documents the site-specific SSSI analysis of the RB + DGFOSV Tunnel + Crane Wall and DGFOSV (DG Fuel Oil Storage Vault) + DGFOSV Tunnel + Crane Wall. This analysis generates the soil pressure between these structures. The following are noted:

- Tunnel FEM only has 1 layer of solid elements thru the thickness. Clarified with SGH and agreed that the model is conservative and will give higher soil pressure.
- Vertical excitation not considered. S&L presented results and soil pressure effect is minimal.

Calc U7-CB-C-CALC-DESN-6004, Rev. B, "Soil-Structure Interaction Analysis of Control Building STP 3&4 Site Specific (COLA Rev3)"

This calculation documents the site-specific SSI analysis of the CB. Results are compared to DCD.

Results are enveloped by DCD. Although they had committed to a Poisson's ratio of 0.495, the analysis was done only for 0.48. Since the DCD envelopes the analysis by a large margin, analysis for 0.495 is expected to be enveloped by DCD.

<u>October 20, 2010</u>

Calc Document U7-SITE-C-CALC-DESN-6018, Rev A, "Effect of Soil Poisson's Ratio 0.495 Limit using Control Building 3D SSI Model RAI 03.07.01-25 (Licensing)"

This Calculation documents the results of the SSI analyses of CB using Poisson's ratio capped at 0.48 and 0.495 for saturated backfill. The results show significant increase in the calculated spectra in the Z-direction for the LB case. Because of that, S&L went ahead and repeated the same study for the UB case. The maximum vertical acceleration on the CB stick resulting from the LB and UB soil cases with Poisson's ratio capped at 0.495 increased by a maximum of 7.45% when compared with the original enveloped maximum vertical accelerations that capped Poisson's ratio at 0.48.

The calculated transfer functions may indicate numerical issues at some frequencies as Poisson's ratio approaches 0.5. For example, the number of both calculated and interpolated peaks in the transfer function increased as a result of using a high Poisson's ratio. The applicant will address this issue in their final response to RAI 03.07.01-25.

Calc Document U7-UHS-C-CALC-DESN-6005, Rev A, "Effect of Finer Mesh in UHS-Pump House SSI Analysis, RAI 03.07.02-24 and -26 (Licensing)" (Cont'd)

This Calculation document was reviewed in regards to development of factors for adjusting the results of SSI analysis of UHS Basin/RSW Pump House for using a coarse FE mesh of the foundation with Poisson's ratio capped at 0.48 versus a refined foundation mesh with Poisson's ratio capped at 0.495 This comparison is only done for one soil case with full basin. The idea is to apply the above factor(s) (>1) to adjust upward the results of current SSI analyses that caps Poisson's ratio at 0.48.

Two different factors are calculated for adjusting the acceleration response spectra for frequency ranges of 1-30 Hz and 30-33 Hz. The factors are found to be conservative in the way they are applied to the spectra. However, the following concerns remain for which the applicant will perform additional analysis related to RAI 03.07.02-24:

- No factors have been developed for maximum accelerations that control structural design
- The effect of empty basin on the calculated factors above has not been considered
- The interaction of the factors developed above from structural mesh study refinement and SSI model refinement, is not clear.

Calc U7-SITE-S-CALC-DESN-6003, Rev A, "Enveloping Seismic Soil Pressure between Buildings (Licensing)"

This calculation summarizes the soil pressures from the SSSI calculations. There was no comment on this calculation.

Calc U7-YARD-C-DESN-6001, Rev B, "SSI of Emergency Diesel Generator Fuel Oil Storage Vault"

This calculation documents the site-specific SSI analysis of the Diesel Generator Fuel Oil Storage Vault (DGFOSV). This structure is fully embedded, with soil on top of the roof except for a small portion that extends above ground providing access to the vault. Two saddle mounted horizontal tanks, 22' in diameter and about 50' long, are inside the vault to store fuel oil. The vault was analyzed for eight soil analysis cases: 1) LB in-situ, 2) BE in-situ, 3) UB in-situ, 4) LB in-situ with LB backfill, 5) BE in-situ with BE backfill, 6) UB in-situ with BE backfill, 7) UB with separation and 8) UB with cracked concrete. The following are noted:

- The analysis considered only full tanks and not empty or partially filled tanks. The applicant will justify in the calculation and RAI 03.07.01-27 response adequacy of this assumption. .
- The passing frequency is >33 Hz based on the vertical layer thicknesses. In the horizontal direction, the passing frequency is 20 Hz. due to some large elements in the basemat. The transfer function at the basemat in the horizontal direction has a calculated peak at 25 Hz. The accuracy of this peak is questionable as it is beyond the passing frequency of 20 Hz. The source of this peak is not identified. S&L was asked to plot transfer function of the walls in the out-of-plane direction to show that the presence of this peak will not affect the calculated wall responses.

Soil separation and cracked concrete was not reviewed due to time constraint. Because this work is on-going, the above items need to be reviewed again for resolution of these comments.

October 21, 2010

Three validation and verification documents (V&V) for SASSI2000 were reviewed.

- SASSI2000 S&L V&V, Software Verification and Validation Report Certification, Form GAG-0204-01-04, Revision 9
- SGH SASSI2000 V&V, Version 3.0, 030007.98, 29 Oct 2003
- SGH SASSI2000, Version V3-SGH

All three V&V documentations need to adequately address the program features that are used to calculate and output maximum accelerations, acceleration response spectra and dynamic soil pressures. These include:

- General loading orientations in the model
- General element orientations in the model
- Accuracy of low-order triangular and other irregular shell elements
- Acceptable aspect ratio of rectangular elements to produce accurate results
- Required mesh refinement to output out-of-plane responses in shell elements

In addition, the accuracy of subtraction method and possible numerical instabilities with high Poisson's ratio (0.495) for modeling soil behavior should be investigated. Significant differences in the response of thick versus thin shell element models were also observed with thick shell model producing lower responses. This also needs to be further evaluated.

A teleconference with Rick Rasmussen, NRC QA Chief, was held to discuss the commercial grade software QA requirements for STP Units 3 and 4.

V&V for SAP2000, S&L Document VVR 03.7.224-10.1 & SVVR 03.7.224-14.1

This program is used for a) static analysis to calculate forces and moments for design and b) dynamic analysis for mesh refinement studies.

- 25% tolerance is too high for accepting the accuracy of results in the V&V. S&L explained that this is only for out-of-plane shear in plate elements and not used. The Applicant stated that project uses nodal forces for calculating shear. S&L needs to clarify/provide basis for acceptance of 25%.
- Thick shell verification was not in V&V. This is used for static and dynamic analysis.
- Modal time history analysis of shell not covered in V&V.
- Section cut method for generating section forces and moments not validated in V&V.

V&V for SHAKE2000, S&L Document SVVR 03.7.402-3.50

- 3 problems are included in V&V. Problem 1 and 2 have 8 layers. Problem 3 has 3 layers. V&V need to show software adequacy for deep soil site with a number of layers as in STP. S&L was notified.

V&V for DYNAS, S&L Document SVVR 03.7.412-2.0

This software generates a stick model from input wall stiffness and lumped masses. This software was used only for generating the Radwaste Building model. No further comment in this V&V.

<u>October 22, 2010</u>

Calc Document U7-UHS-C-CALC-DESN-6002, Rev B, "UHS Structural Model Input for Soil-Structure Interaction analysis)"

This Calculation documents development of the structural model for the UHS Basin and RSW Pump House. The impulsive and convective hydrodynamic masses are calculated and distributed to the walls. The vertical mass of the water is lumped to the basemat. The depth of water in the basin is about 71 ft. This column of water has a predominant mode of about 17 Hz in the vertical direction. No amplification of hydrodynamic pressures on the basemat and walls due to the frequency of the water column has been considered for the vertical input motion. The issue will be further addressed in RAI 03.07.02-28 response.

Attachment A-14, "Structural Mesh Sensitivity Study in Response to RAI 03.07.02-25 (Ref. A-14 7.1)"

In general, refined mesh shows higher responses including maximum accelerations in the Pump House roof, Cooling Tower walls and Basin walls. The Applicant is evaluating how this increase due to structural mesh refinement will be considered in the results of the SSI analysis of UHS Basin and RSW Pump House using coarse structural mesh model for final design.

Chapter 3.8:

The staff conducted a detailed review of selected portions of the calculations made available by the applicant (see Table 1). As a result of the review, several issues were identified as needing further clarification and, possibly, additional analysis/design work. These issues were discussed with the applicant. In all instances, a path forward for the resolution of these issues was identified and agreed upon with applicant. Various issues discussed with the applicant during the audit were captured in a list at the end of the audit (see attached audit list). Details of the discussions are given in the following section.

The audit concluded with an exit meeting that summarized the discussions and the disposition of the issues raised during the audit. It was agreed in the Exit Meeting that review of design of various site-specific structures could not be completed since the calculations were not updated with the latest design loads considering SSSI effects. Also, it was not possible to accomplish all reviews during the time. The remaining review activity will be done in a follow-up audit after the applicant has addressed the issues brought up in this audit, and progressed sufficiently updating design calculations with final loadings considering the SSSI effects

Discussion

A. Use of newer Code Versions after Certification

A1. IBC 2006

In FSAR Section 3.8, page 3.8-1, the applicant references the departure STD DEP 1.8-1, "Tier 2* Codes, Standards, and Regulatory Guide Edition Changes." One of the changes included in this departure updates Tier 2 to refer to the 2006 International Building Code (IBC) in place of the 1991 Uniform Building Code (UBC). The staff had previously evaluated only the use of 1991 UBC for the ABWR standard design, and use of IBC 2006 has not been endorsed by the staff. Therefore, the applicant was requested (RAI 03.08.01-1) to provide a detailed comparison of the differences between these two codes as they apply to the ABWR standard design, and provide justification for any differences in order for the staff to evaluate the use of the 2006 IBC. In its response to RAI 03.08.01-1, the applicant stated that based on a detailed comparison of the two codes, it has determined that the requirements of IBC 2006, taken as a whole, provides a margin of safety that is substantially similar to, and in many cases greater than, that provided by the earlier UBC 1991.

During the audit, the staff reviewed the **Validation Package responding to RAI 3.8.1-1 "Use of newer codes"**, that presented a detailed comparison between the current IBC 2006 code, and the UBC 1991 code. The package included reproduced text passages from the two code versions, a comparison of each specific topic, and conclusions for the application in STP 3 and 4. The staff reviewed the detailed code comparison for all applicable loadings and load combinations included in the package. Based on its review the staff concluded that the comparison demonstrated that the provisions of IBC 2006 for various loadings and load combinations are either equivalent to or more thorough and comprehensive than the corresponding UBC 1991 provisions. For non-category I buildings required to withstand SSE, seismic input is based on SSE ground acceleration instead of the provisions of the IBC 2006, which is considered acceptable. ***Therefore, the confirmatory action per RAI 03.08.01-1 is complete.***

A.2: ACI 349 and ASME Code Section III

In STD DEP 1.8-1, the applicant had proposed to use the 1997 edition of ACI 349 in place of 1980 edition of ACI 349 which was the basis for the ABWR design certification. Similarly, ASME Code Section III Division 2 Edition 2001 with 2003 addenda is referenced in the FSAR in lieu of ASME code version 1989 which is the basis for design certification. RAI 03.08.04-33 asked for comparison of ACI 349 and ASME Code Section III newer versions with those in the original design. The basis for the response to this RAI is the document: "**STP Audit FSAR Chapter 3.8 A - Use of Newer Code Versions after Certification".** Our audit focused on the detailed comparison given in this document.

ACI 349 comparison

It is noted that R.G. 1.142 Revision 2 endorses the 1997 edition of ACI 349 with some restrictions. STP 3&4 is committed to following the requirements of R.G. 1.142 Rev. 2 as applied to ACI 349-97. It was shown that the code changes do not either apply to ABWR standard design or reduce the design margins for the ABWR standard design. However, it was noted that in certain instances the newer code may be more restrictive, and result in a more robust design. This will be followed up with the applicant for clarification regarding how the existing design will accommodate these provisions of the newer code.

ASME Code for Concrete Containment:

It is noted that Revision 3 of R.G. 1.136 endorses ASME Code, Section III, Division 2 edition 2001 with 2003 addenda with some restrictions. STP 3 and 4 will comply with R.G. 1.136. It was also noted that the use of the above version of the ASME Code meets Article NCA-1140(a)(2)(b), since it is the latest edition and addenda endorsed by the staff. However, it was noted during the review that certain provisions of the newer code are more restrictive than those in the earlier code, or enhancements to the code. This will be followed up with the applicant for clarification regarding how the existing design will accommodate these provisions of the newer code.

B. Flood Design Issues

The flood design issues included calculation of flood loading, design of water tight doors and evaluation of leakage through seals after an earthquake. The staff had raised a number of RAIs on these topics and the applicant had provided responses and proposed markups to the FSAR. In the audit, the staff focused on the calculations and background material for the responses to RAIs.

Sargent & Lundy had prepared a validation package containing the above items identified by the corresponding RAI. The loads and load combinations, the provisions of AISC N690 to be used in design, and the testing requirements for the watertight doors and seismic gap seals were presented in this package. Our review confirmed that for the design basis extreme flood loads arising from the breach of Main Cooling Reservoir dike, the applicant considered hydrostatic load, associated drag effects, hydrodynamic load to due to wind-generated wave action and impact due to floating debris. However, there was inconsistency in considering the design basis flood level and density of sediment laden water. This was discussed with the applicant during the audit, and was captured in the audit item 3.8-7. The applicant agreed to revise the affected RAI responses, including RAI 03.08.01-10, and use design basis flood level of 40 ft and density of sediment laden water of 63.85 pcf for all calculations.

Acceptability of flood loading on standard plant structures was demonstrated by comparing the effects due to hydrostatic and hydrodynamic loads due to flood with the seismic loads, and comparing the effects of debris impact with the tornado loads. It was pointed out during the audit that comparison of effects due to all components of flood should be performed either with seismic loads, or with tornado loads. This was captured in audit item 3.8-6. The applicant agreed to revise response to RAI 03.08.01-4, Rev.1, and modify FSAR Section 3.8 or 3H, as required to address the issue.

Seismic category and qualification of the seals used to protect the safety-related buildings against external water entry was discussed with the applicant. The applicant stated that an in-service inspection program will ensure that the seals do not significantly degrade. The seals will also be tested to withstand +/- 25% movement in all directions. In addition, the applicant confirmed that the redundant water-stops that are provided to retain the leakage from the seal filler material will be seismic category I component. This was captured in audit items 3.8-1, 3.8-4 and 3.8-5. The applicant agreed to revise responses to RAI 03.08.01-9, 03.04.02-6, Rev.1 (including COLA mark-up for 03.08.01-9) to address the issue.

U7-Site-C-CALC-DESN-6016 Rev A: Calculation of Water Forces on SSCs Due to MCR Breach Flood (Licensing).

This document describes the wind generated waves per response to RAI 3.4.2-11 and presents the calculations made to determine water wave loadings on structures. This portion of the audit was to verify that the wave loading used by the applicant is adequate.

The wind speed is taken from Reference 6 (ANSI/ANS 2.8-1992). Wave force calculations follow the procedures in Coastal Engineering Manual (CEM) for non-breaking waves. Wave height, period and loading diagram on a vertical wall are presented. Calculations include parameter variations, estimated fetch distance, estimated wind speed (fastest mile), wave height and still water height. It was noted that these calculations result in lesser wave loadings than provided by ASCE7-05 for breaking waves. Also it was noted that Reference 6 is outdated and classified as historical technical reference in SRP 2.4.4. Since this reference was only used to determine the wind velocity of 50mph (two year recurrence period, fastest mile), it was deemed adequate. To further verify the adequacy of the proposed wave loading, the applicant was asked during the audit to present comparative calculations showing the relationship between wind speed and wave height. The study confirmed that a wind speed of about 70 mph (fastest mile) is required to generate a breaking wave. **This additional margin in wind speeds was deemed adequate to justify the load diagram which is based on the existence of non-breaking waves**. (Audit item 3.8-2)

C. Structural Design Issues for Standard Plant Structures

The issues included calculation of foundation stability factors of safety, and evaluation of lateral earth pressures and foundation settlement.

Factors of safety against overturning, sliding and floatation

The following calculations were reviewed:

U7-RB-C-CALC-DESN-6024, Rev. A, “Reactor Building Stability Evaluations (Licensing)”

U7-RB-C-CALC-DESN-6016, Rev. A, “Control Building Stability Evaluations (Licensing)”

CALC-EORA-002 Rev. 4 (MACTEC), “Ultimate Static and Dynamic Coefficients of Sliding Friction”

The floatation factor of safety for the reactor building and control building were calculated in the DCD based on the height of flood level above bottom of basement of 1 ft below the grade. Since the DBF at STP is now at 6 ft above grade, the floatation factor of safety was evaluated using the buoyancy from the DBF and the dead load derived from the DCD floatation factor of safety. In these calculations, the floatation factors of safety were shown to be 2.24 and 1.27 for the Reactor Building and Control Building, respectively. These exceed the minimum factor of safety of 1.1 required in the SRP.

The calculation of sliding factor of safety for RB considered two cases of zero live load and 25 percent live load. Unit 4 RB is on clay; the friction coefficient and the cohesion value given in the MACTEC report were used after reduction for dynamic loading. Unit RB is partly on clay and the rest on sandy soil; the sliding resistance is estimated as a combination of frictional resistance and cohesive resistance. The load combinations included dead load, live load, buoyancy, earth pressure and SSE. For the CB, the sliding factor of safety calculation considered different cases of voids and mudmat in order to vary the frictional and cohesive resistance. The sliding factors of safety for RB and CB were shown to be larger than 1.11 (specified in DCD).

The overturning factors of safety for CB were calculated for design basis wind, site-specific tornado and SSE and shown to be higher than 1.53 (exceeds the SRP criteria of 1.1); further the overturning factor of safety calculated using the energy method was shown be much larger.

The staff concluded that the calculations appropriately treated the loads and load combinations for stability evaluations of standard plant structures. The factors of safety for sliding, overturning and floatation are calculated using site soil properties and meet the SRP criteria.

Lateral Earth Pressures

RAI Response Validation Package by S&L: Reactor Building & Control Building, DCD and STP 3&4 Comparison of Lateral Soil Pressures, Attachment 2, February 2010, p. 1-43

This document was prepared in response to RAI 3.8.4-1 and 3.8.4-17. The site-specific dynamic soil pressure calculation is based on the recent technical paper by Ostadan (2004). It was shown that the lateral earth pressures given in DCD envelope the STP site-specific values.

However, it was noted that the site-specific lateral soil pressure diagrams provided in response to RAI 03.08.04-17 did not include structure-soil-structure interaction (SSSI) effects. This was captured in audit item 3.8-9. The applicant agreed to follow up on this issue by revising the responses to RAI 03.07.01-17, 03.07.02-24 and 03.08.04-30.

Foundation Settlement

Validation Package

- **Reactor Building Settlement, October 2010**
- **Control Building FE Analysis for Foundation Settlement Monitoring**

Documents were prepared in conjunction with RAI 3.8.5-3 and 3.8.5-5, which requested the applicant to provide a quantitative evaluation to demonstrate that the maximum differential settlements for the ABWR standard plant structures at the STP site would be within the values accounted for in the design of these structures. The ABWR DCD did not have any information on differential settlements or tilting considered in the design. The applicant performed analysis to determine differential settlements within the foundation footprint of the Reactor Building (RB) and the Control Building (CB). The validation package prepared for the audit showed that SAP 2000 models were used to determine differential settlement (s/d) ratios of the foundation mat under operating loads. Winkler and pseudo-coupled springs were used and the corresponding s/d ratios calculated and shown for all nodes of the basemat. The maximum s/d ratios for the RB and the CB were 1/1697 and 1/928 respectively. Based on review of the validation package, the staff concluded that the applicant followed acceptable industry practice to determine differential foundation settlements. However, the applicant stated that the current settlement monitoring plan does not include monitoring of differential settlement within the footprint of the basemat of the RB and CB. The established values of differential settlements may be used in future, if needed.

The validation package also included supporting calculations for the acceptable angular tilt of 1/500 established for RB and CB. The staff found that the calculation adequately considered the effect of additional stresses in the RB and CB structures, and that the effects were not significant.

D. Structural Design Issues for Site-Specific Seismic Category I Structures

The site-specific Seismic Category I structures include Reactor Service Water (RSW) Piping Tunnel, Ultimate Heat Sink/RSW Pump House Structure, Diesel Generator Fuel Oil Storage Vaults and Fuel Oil Tunnel.

Reactor Service Water Tunnel (U7-RSW-S-CALC-DESN -6001, Rev. C and DESN-6002 Rev. B)

RSW tunnel is in three sections. It is a reinforced concrete structure that is typically 17 feet wide and 40 feet high; it extends from the Pump House to the Control Building. The tunnel can be accessed from three locations for inspection and maintenance activities. Tornado loads (Region II DBT and load combinations, and missiles per SRP) and site-specific SSE loads were used in the design. Design basis flood from MCR dike break was used. Load combinations used follow ACI 349-97 and SRP Sec, 3.8.4 (including steel) and stability evaluation was done per SRP 3.8.5. The calculated floatation factor of safety of 1.19 exceeds the SRP minimum value.

It was noted that the seismic lateral earth pressures resulting from the recent SSSI analysis (SGH calculation DESN 6019) are not yet linked into this design. Also, the stability calculation (Volume 8 DESN -6002) does not take the results of seismic soil pressures calculated using SSSI results. The design calculations for the RSW Tunnels will be reviewed again after calculations are updated with SSSI effects along with review of how wave propagations effects were considered in design.

Ultimate Heat Sink and RSW Pump House (U7-UHS-S-CALC-DESN-6003 Rev. A)

Note: Rev. B of this report exists as draft.

This document presents the calculations to ensure the overturning and sliding stability of the UHS/PH building. Generally load combinations are according to FSAR sections. The 100-40-40 rule is applied for stability calculations only. The review of this document is pending and scheduled for the next audit.

Ultimate Heat Sink and RSW Pump House (U7-UHS-S-CALC-DESN-6002 Rev. A Structural Evaluation)
Note: Rev. B of this report exists as draft.

The analyses are based on different SAP2000 models (i.e., linear soil springs; compression only soil springs; uniformly distributed springs and pseudo coupled springs). Attachment (U) describes the application of ACI349-97 for the design of reinforced concrete sections. Internal forces are obtained from the SAP 2000 model. Shell forces from every element for every load combination in the finite element analysis were evaluated for calculation of reinforcement in each reinforcement zone. However, it was noted that in-plane and out of plane shears were averaged along selected cut lines. Cut lines are vertical or horizontal sections i.e. through the wall or slab. Thus reinforcing is computed for the averaged value. Averaging of out of plane shear along the entire cut line of a slab or wall could lead to non-conservative estimate of shear reinforcement. The applicant explained the procedure by referencing to ACI 349-97, Section 11.12, “Special provisions for walls.” The staff was not convinced regarding interpretation of the provision of the ACI code presented by the applicant. The subject was captured in audit item 3.8-14. A new RAI will be issued to ask the applicant to provide detailed technical basis for procedure used.

It was noted in the above calculation that the Importance Factor (I) used to determine wind pressures on the building was set to I=1 instead of I=1.15 as specified in the FSAR. I=1.15 was used for tornado wind loads. Use of I=1.15 in addition to a 100 year return period wind is recommended in SRP 3.3.1. This topic was captured in audit item 3.8-12. In a conference call after the audit, the applicant agreed to provide technical basis for the value of Importance Factor used in design.

It was also noted that some load combinations including lateral loads would result in tension loads in the base springs representing the soil subgrade, thus indicating a mat uplift from the soil. To model these effects more realistically a non-linear analysis with compression-only springs would be required. To address the issue, the applicant performed sample non-linear analysis along with analysis considering tension springs to determine amplification factors for moments and shears for load combinations that produced the largest uplift. Subsequently, the factors were used to amplify the internal forces and displacements obtained from the linear solutions that ignore the uplift effects. Since the uplift in question affects only a small foundation area, the procedure was deemed conservative and adequate.

STP also provided the design results considering pseudo-coupled soil springs which are documented in Rev B of this report. Results obtained using both assumptions - Winkler and pseudo-coupled springs- are considered in the final design. Further review of the calculation using pseudo-coupled soil springs documented in Rev. B will be done at the next audit.

U7-Proj-S-GDD-6007, Rev. B, Dec 16, 2009, S&L
STP Units 3&4: Structural design Criteria for UHS, RSW PH and Tunnels.

This document summarizes the procedures, data, parameters, codes and standards and other specifications relevant to the structural design of the site specific structures. The staff did not have any additional questions or comments.

DIT-STP34-09-0026-03
Input Data for Soil Bearing Check at the UHS and PH.

This transmittal document is used to transfer global gravity and earthquake loading to the Geotech Company (MACTEC) to determine the soil bearing pressures. The information is grouped in different load combinations and uses accelerations and masses from the SAP model. We did not have any additional questions or comments.

(1) CALC-EORA-006 (MACTEC) Rev. 1-Static BC
Bearing Capacity Analysis (Static) and

(2) CALC-EORA-007 (MACTEC) Rev. 0-DyBC-UHS-PH Dynamic Bearing Capacity Analysis for the UHS and RSW Pump Houses (Dynamic)

The review concentrated on the second report regarding the dynamic bearing capacity. Soil bearing pressures under the UHS/PH building are evaluated in this (MACTEC) report, and are based on equivalent static global overturning moments, operational and gravity loads which are derived from the SAP model. Based on the eccentricity of the applied loads a reduced bearing area is determined under which the bearing soil pressures are assumed to be uniformly distributed. A factor of safety (FOS) is then calculated as the quotient between the total ultimate soil bearing capacity and the actual bearing pressure. Since the slab elevation of UHS and PH are at different elevations, an equivalent flat foundation mat was used for the evaluation of bearing pressures.

It was noted that, the actual dynamic soil bearing pressures are calculated as uniform pressure under the (effective, reduced) foundation mat. This assumption was said to be realistic under earthquake excitation. The staff was not convinced with the technical basis for computing maximum dynamic bearing pressure as an equivalent uniform pressure over a reduced area instead of calculating the maximum toe pressure. The issue was captured in audit item 3.8-22. A new RAI will be issued.

It was also noted that no soil bearing pressures were determined for load cases involving wind or tornado loads, as those are considered static load cases that are enveloped by the higher seismic loads. Wind or tornado loads are low frequency loadings and should not be compared with seismic loads. Discussions of this topic were not conclusive during the Audit. Per audit action item 3.8-24, the applicant agreed to perform the corresponding calculations following the procedures used for seismic loading. However, staff believes that the maximum bearing pressure due to wind and tornado loads should be treated as static bearing pressure, and the maximum soil toe pressure should be within the allowable bearing pressure. A new RAI will be issued to ask the applicant to provide detailed technical basis for the approach used.

E. Design of SSC with II/I Interaction Potential

The staff reviewed the design calculations for non-seismic Category I structures that have a potential to impact Seismic Category I structures. The global stability factors of safety for floatation, sliding and overturning for each such structure were examined.

Radwaste Building (U7-UHS-C-CALC-DESN 6003)

Stability Calculation U7-UHS-C-CALC-DESN 6003 evaluates the factors of safety against floatation, sliding and overturning taking the seismic load (SSE of 0.13g with the SSI analysis), design wind and tornado loading (200 mph). Minimum factors are 4.23 (overturning), 1.92 (sliding) and 1.51 (floatation). These exceed the factors specified in the SRP.

SSE lateral dynamic soil pressure is calculated using the ASCE 4-98 Elastic Solution Method for retaining walls. It was noted that stability calculation does not take into account the results of seismic soil pressures calculated using SSSI. STP expressed during the audit that the calculation will be revised using soil pressures considering SSSI effects. Stability evaluation and design of Radwaste building will be reviewed again in a future audit.

Control Building Annex (U7-CBA-C-CALC-DESN-6001 Rev. A)

Stability analysis is done for site-specific tornado and SSE (0.13g) and shown to exceed the minimum factors specified in the SRP.

Turbine Building (U7-TB-C-CALC-DESN-21001 Rev. B)

Stability analysis is done for site-specific tornado and SSE (0.13g) and shown to exceed the minimum factors specified in the SRP

Note: In response to RAI 03.07-02-13 (Validation Package 4.1) STP stated that “we believe since the stability of buildings is always site-dependent, the stability evaluations of these buildings, design of commodities running between the adjacent buildings and the design of seismic gaps between the adjacent buildings should be based on consideration of Site-specific SSE. Note that for some light structures such as CBA, SB, and RWB, the site-specific SSE may be amplified due to their close proximity to heavy structures such as RB and CB”.

The staff considers this to be acceptable. However, the FSAR needs to clearly state the design basis used for stability evaluation of non-seismic category I buildings adjacent to seismic category I buildings. This was captured in audit item 3.8-19. The applicant agreed to consolidate the II/I requirements in one place in the COLA. However, no RAI has been referenced to track the issue. Therefore, a new RAI will be issued to track this item.

U7-PROJ-S-GDD-2914, Rev C

General Design Document: Structural Engineering Criteria Fire Water Pump House.

This document describes the procedures, parameters, load combinations, codes and standards and other specifications to perform the structural analyses for the FW pump house that contains the ACIWA system. ACIWA is a non-Category I but an emergency backup system that is required to be functional under all GDC-2 external events, i.e. seismic, wind, hurricane, flood and tornado. As such the FW pump house cannot collapse onto the ACIWA equipment. The ACIWA system is included in the plant specific PRA. This document was presented by the responsible engineering team. The staff has issued RAI 19-22 asking the applicant to elaborate on the site-specific external events to be included in the plant specific PRA. Therefore, this issue will be pursued in Chapter 19.

Disposition of issues raised during the audit

A. While comparing the ACI 349-97 provisions with ACI 349-80, the applicant has stated that the newer code is more conservative in certain areas. This may not mean that the original design of standard plant structures using the earlier code will meet the new code requirements. The applicant has not proposed to check the original design against the new code requirement. The staff wants to know the extent of detailed design of standard plant structures already performed during the design certification. A conference call with STP is planned to explore this issue. Similar concern exists for the use of newer version of ASME code.

B. There was inconsistency in considering the design basis flood level and density of sediment laden water. This was discussed with the applicant during the audit, and was captured in the audit item 3.8-7. The applicant agreed to revise the affected RAI responses, including RAI 03.08.01-10, and use design basis flood level of 40 ft and density of sediment laden water of 63.85 pcf for all calculations. Further, the applicant confirmed that the redundant water-stops that are provided to retain the leakage from the seal filler material will be a seismic category I component.

C. It was noted that the site-specific lateral soil pressure diagrams provided in response to RAI 03.08.04-17 did not include structure-soil-structure interaction (SSSI) effects. This was captured in audit item 3.8-9. The applicant agreed to follow up on this issue by revising the responses to RAI 03.07.01-17, 03.07.02-24 and 03.08.04-30.

D. It was noted that the seismic lateral earth pressures resulting from the recent SSSI analysis (SGH calculation DESN 6019) are not yet linked into this design. Also, the stability calculation (Volume 8 DESN -6002) does not take the results of seismic soil pressures calculated using SSSI results. The design calculations for the RSW Tunnels will be reviewed again after calculations are updated with SSSI effects along with review of how wave propagations effects were considered in design.

E. The staff was not convinced regarding the averaging of out of plane shear along the entire cut line of a slab or wall in the calculation of shear reinforcement. A new RAI will be issued to ask the applicant to provide detailed technical basis for the procedure used.

F. Importance Factor (I) used to determine wind pressures on buildings was set to I=1 instead of I=1.15 as specified in the FSAR. I=1.15 was used for tornado wind loads. Use of I=1.15 in addition to a 100 year return period wind is recommended in SRP 3.3.1. In a conference call after the audit, the applicant agreed to provide technical basis for the value of Importance Factor used in design.

G. The staff questioned the technical basis for computing maximum dynamic bearing pressure as an equivalent uniform pressure over a reduced area instead of calculating the maximum toe pressure. The issue was captured in audit item 3.8-22. A new RAI will be issued.

H. It was noted that the applicant had considered wind and tornado loadings as transient and plans to treat the bearing pressures similar to the seismic loading. The technical basis for this assumption will be discussed with STP on a conference call.

Table 1: List of calculations or documents reviewed in the audit

Subject	Summary Title/Description
U7-Site-C-Calc-DESN-6016 Rev A:	: Calculation of Water Forces on SSCs Due to MCR Breach Flood (Licensing).
U7-RB-C-CALC-DESN-6024, Rev. A,	"Reactor Building Stability Evaluations (Licensing)"
U7-RB-C-CALC-DESN-6016, Rev. A,	"Control Building Stability Evaluations (Licensing)"
CALC-EORA-002 Rev. 4 (MACTEC),	"Ultimate Static and Dynamic Coefficients of Sliding Friction"
RAI Response Validation Package by S&L	Reactor Building & Control Building, DCD and STP 3&4 Comparison of Lateral Soil Pressures, Attachment 2, February 2010, p. 1-43
RAI Response Validation Package by S&L	• Reactor Building Settlement, October 2010 • Control Building FE Analysis for Foundation Settlement Monitoring
U7-RSW-S-CALC-DESN -6001, Rev. C and DESN-6002 Rev. B)	Reactor Service Water Tunnel
U7-UHS-S-CALC-DESN-6003 Rev. A	Ultimate Heat Sink and RSW Pump House
U7-UHS-S-CALC-DESN-6002 Rev. A Structural Evaluation	Ultimate Heat Sink and RSW Pump House
U7-Proj-S-GDD-6007, Rev. B, Dec 16, 2009, S&L	STP Units 3&4: Structural design Criteria for UHS, RSW, PH and Tunnels
DIT-STP34-09-0026-03	Input Data for Soil Bearing Check at the UHS and PH.
CALC-EORA-007 (MACTEC) Rev. 0-DyBC-UHS-PH	Dynamic Bearing Capacity Analysis for the UHS and RSW Pump Houses (Dynamic)
CALC-EORA-006 (MACTEC) Rev. 1-Static BC	Bearing Capacity Analysis (Static)
U7-UHS-C-CALC-DESN 6003	Radwaste Building
U7-CBA-C-CALC-DESN-6001 Rev. A	Control Building Annex
U7-TB-C-CALC-DESN-21001 Rev. B	Turbine Building

4. Conclusion

The October 18 to 21, 2010, audit provided the NRC staff an opportunity to review the design analyses that will be used to support the STP Units 3 and 4 that will be used to support Chapters 3.7 and 3.8 of the STP Units 3 and 4 FSAR. There were no findings, but several RAIs will be issued, some existing RAI responses will be either revised or supplemented, and there were several observations listed below:

a. In Calculation U7-UHS-C-CALC-DESN-6005, Rev A, the applicant was requested to provide the basis that the passing frequency of 23.5 Hz is sufficient for the SSI analysis. This will be part of the response to RAI 03.07.02-24.

b. In the audit of the computer code V&V documents for SASSI-2000, there are questions on the qualification and training of the users. This is an open item and the NRC will determine if future inspection of the engineering procedures is necessary.

c. In Calculation U7-SITE-C-CALC-DESN-6018, Rev A, the applicant will clarify the results of the control building analysis with different Poisson ratios. This will be part of the response to RAI 03.07.01-25.

d. In Calculation U7-UHS-C-CALC-DESN-6002, Rev A, the applicant was requested to evaluate mesh refinement is considered in the results of the SSI analysis of UHS basin and RSW pumphouse using coarse structural mesh model. This will be addressed in the response to RAI 03.07.02-28.

e. In the audit of the use of ACI 349 in the design, STP was requested to clarify how the existing design accommodates ACI 349 – 97.

f. In the audit of the use of ASME Section III in the design, STP was requested to clarify how the existing design accommodates the later version of Section III, Division 2 (2001 Edition with 2003 Addenda).

g. In the audit associated with flood design, STP was requested to clarify the design basis flood level and the density of the sediment laden water. This will be part of the response to RAI 03.08.01-10.

h. In the audit associated with the consideration of flood loading on standard plant structures, STP was requested to provide a comparision of the effects due to all components of flooding. This will be part of the response to RAI 03.08.01-4, and FSAR Section 3.8 and/or Appendix 3H may be affected.

i. A future audit will be scheduled to complete the review of analyses not addressed in this audit.