December 6, 2010

Mr. Scott Head, Manager
Regulatory Affairs
STP Nuclear Operating Company
P. O. Box 289
Wadsworth, TX 77483

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 366 RELATED TO SRP SECTION 3.7.2 FOR THE SOUTH TEXAS PROJECT COMBINED LICENSE APPLICATION

Dear Mr. Head

By letter dated September 20, 2007, STP Nuclear Operating Company (STP) submitted for approval a combined license application pursuant to 10 CFR Part 52. The U. S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter.

To support the review schedule, you are requested to respond within **30** days of the date of this letter. If changes are needed to the safety analysis report, the staff requests that the RAI response include the proposed wording changes.

If you have any questions or comments concerning this matter, I can be reached at 301-415-8484 or by e-mail at Tom.Tai@nrc.gov or you may contact George Wunder at 301-415-1494 or George.Wunder@nrc.gov.

Sincerely,

/RA/

Tom M. Tai, Senior Project Manager
ABWR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-012
52-013

eRAI Tracking No. 5226

Enclosure:
Request for Additional Information

cc: William Mookhoek
John Price
Loree Elton

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NAME	MChakravorty	KHawkins	TTai	GWunder
DATE	11/3/2010	11/17/2010	12/6/2010	11/29/2010

*Approval captured electronically in the electronic RAI system.

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Request for Additional Information No. 5226 Revision 4

12/6/2010

South Texas Project Units 3 and 4
South Texas Project Nuclear Operating Co
Docket No. 52-012 and 52-013
SRP Section: 03.07.02 - Seismic System Analysis
Application Section: 03.07.02

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

03.07.02-29

RAI from Section 3.7 Audit, October 2010

For SSE ground motions, 10 CFR Part 50, Appendix S requires that SSCs will remain functional and within applicable stress, strain, and deformation limits and the evaluation must take into account soil-structure interaction (SSI) effects. Criterion III, "Design Control," of Appendix B to 10 CFR Part 50 states, in part, that "measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety related functions of the structures, systems and components." Additionally, Criterion III states in part that, "the design control measures shall provide for verifying or checking the adequacy of design,…" SRP Review guideline 3.8.1.II.4.F specifies that computer programs used in the design and analysis should be described and validated.

During the STP audit of Section 3.7, the verification and validation (V&V) documents of computer programs SASSI2000, SAP2000, and SHAKE2000 used in the seismic analysis of Category I structures were reviewed. The following issues were identified regarding these V&V documents:

SASSI2000 Version 3.0:

The SSI analysis performed with SASSI2000 is used to obtain the maximum accelerations, acceleration response spectra, and dynamic soil pressures that are used for seismic evaluation and design of the RB, CB, UHS Basin, RSW Pump House, and other seismic Category I structures. The dynamic forces, moments, and stresses are also calculated from the SASSI2000 analysis but are not used as design basis.

The V&V of three SASSI codes were reviewed. These codes are S&L SASSI2000-v3.0, SGH SASSI2000-v3.0 and SGH SASSI2000-v3.0-SGH. All three program V&V documentations do not adequately address all the program features that are used to calculate and obtain maximum accelerations, acceleration response spectra, and dynamic soil pressures. In particular, the scope of the test problems does not address the adequacy of the following program features that may be used in STP applications:

- General direction of load application in the model
- General orientation of elements in the model
- Accuracy of triangular elements (solid, shell and plane-strain) that may be used
- Acceptable aspect ratio of rectangular elements (solid, shell and plane-strain) to obtain accurate results, as used in the models
- Required mesh refinement to output out-of-plane responses in shell elements

- Accuracy of the subtraction method for calculating foundation impedance

In addition, potential numerical instabilities with the use of high Poisson's ratio for modeling the saturated soil behavior in SASSI2000 may be of concern, as the Poisson's ratio approaches 0.5. As a result, the SASSI2000-v3.0 limitations with respect to capping the Poisson's ratio to avoid possible stability problems should be validated and stated.

Significant differences in the out-of-plane acceleration response of thick versus thin shell element models have also been observed in the analysis results with the thick shell model producing lower responses. This also needs to be further evaluated for SASSI2000-v3.0 as to the adequacy and limitations of the specific shell element type.

Without further demonstration that encompasses validation of the program features discussed above for STP applications, the staff cannot make a determination in the SER that the programs used in the seismic analysis will not adversely affect the SSI analysis result and meet the applicable regulations. As such, the applicant is requested to further demonstrate acceptability of SASSI2000 with additional test problems addressing the issues discussed above.

SAP2000 Version 10.1 and 14.1:

SAP2000 is used to calculate forces, moments and stresses for design of the site-specific seismic Category I structures such as UHS Basin, RSW Pump House, and RSW tunnel. The forces and moments are calculated by integrating stresses across design sections. It also appears that the thick shell element is used for modeling and design of slabs. Mesh sensitivity studies are also performed using time-history modal superposition method of fixed-base structure to assess the adequacy of the structural mesh refinement for calculation of accelerations and acceleration response spectra. To that extent, the SAP2000 V&V does not provide adequate validations for the following items:

- Accuracy of forces and moments calculated from section cuts in shell models
- Accuracy of thick shell element for calculating out-of-plane dynamic responses
- Accuracy of time-history modal analysis of fixed-base structures modeled using shell elements

As such, the applicant is requested to supplement the SAP2000 V&V with additional test problems to address the items discussed above. The staff needs this information to be able to conclude in the SER that the use of SAP2000 in STP applications will not adversely affect calculation of seismic forces and moments and the evaluation of SSI effects for Category I structures.

SHAKE2000 Version 3.5:

SHAKE2000 is used to calculate SSE-based foundation motions for SSI analysis of UHS Basin, RSW Pump House, and other Seismic Category I structures. The SHAKE2000 V&V has only tested soil models with up to 8 soil layers while the STP profile is a deep soil site that is modeled using large number of soil layers.

As such, the applicant is requested to further demonstrate acceptability of SHAKE2000 with additional test problems that check the use of large number of soil layers to encompass STP soil site. The staff needs this information to be able to conclude that the SSE-based foundation motion determined using SHAKE2000 computer program is adequate for STP application and meets the requirement of Appendix S to 10 CFR Part 50.

Enclosure