From: Tai, Tom
Sent: Monday, April 04, 2011 4:02 PM
To: Price, John E
Cc: STPCOL; Wunder, George; Tonacci, Mark
Subject: Wed Call - Clarification on March 14 2011 Audit Actions
Attachments: Clarification on March 14 2011 Audit Actions.docx

John,

Attached for your use is a more detailed description of the actions resulting from the March 2011 audit. Please share with S&L staff.

If necessary, we can also discuss these in the Wednesday telephone conference.

Please cal if you have questions.

Regards

Tom Tai
(301) 415-8484

Hearing Identifier: SouthTexas34Public_EX
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From: Tai, Tom

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Issue 1 (Audit Action 3.7-7): Revise Appendix 3A and 3H.6 to reconcile ground water elevation with Chapter 2

Inconsistencies were noted among various Sections of the FSAR concerning the specified design ground water level and the ground water level used in the seismic analysis for Category I structures. For example in FSAR Section 2.4S.12.5, it is stated that *"In summary, based on measured groundwater levels in observation wells and modeled post-construction groundwater levels, the maximum post-construction groundwater elevation at the STP Units 3 and 4 site is estimated to be 28 ft MSL, as reflected in Table 2.0-2. The nominal finished plant grade in the power block area is approximately 34 ft MSL, **six feet** higher than the site characteristic maximum groundwater level."* Appendix 3H.6.4.2.2, Design Ground Water Level, also specified ground water level at 28 MSL establishing the depth of water table at **six feet** below the grade. However, in Section 3A.15, Site Conditions, it is stated that *"Based on the site groundwater conditions described in FSAR Subsection 2.4S.12, the groundwater elevation of approximately **eight feet** below grade was used in the analysis to determine the soil properties."* It is also noted that SSI model for the seismic analysis of Category I structures considered the ground water table to be approximately at **eight feet** below the grade elevation. As such, the applicant is requested to address these inconsistencies among various sections of the FSAR and the seismic analysis model and revise the applicable FSAR sections on groundwater level and structural design criteria. The applicant is specifically requested to demonstrate that the FIRS, GMRS, and the results of seismic analysis of the Category I structures including the results of stability calculations as currently established in the COLA are not adversely affected and include this justification in the applicable FSAR sections.

Issue 2 (Audit Action 3.7-8/3.7-36)**:** Why for SSSI of RSW Tunnel was UB in situ used vs. UB backfill soil?

Review of responses to RAI 03.07.01-27, Supplements 1, Revision 1 indicates that two 2D SSSI models (East-West and North-South Sections) are analyzed to evaluate the effects of nearby structures on the three DGFOSVs and calculate the seismic soil pressures. In the East-West direction 2-D SSSI DGFOSV model (DGFOT 1C + DGFOSV 1A + CFRW), five cases of soil and backfill properties are considered to evaluate the effects of the soil and backfill properties variation. Also response to RAI 03.07.01-27, Supplement 2, Revision 2 indicates that in the East-West direction for DGFOT 1A (RB + DGFOT 1A + CFRW), five cases are run with various combinations of soil and backfill properties. However, in the North-South direction **(UHS/RSWPH + RSW Tunnel + DGFOSV 1B + DGFOSV 1C + RB),** only one case was run with UB soil properties. Also as discussed in response to RAI 03.07.02-24, Supplement 1, Revision 1, in the East-West direction for dynamic soil pressure evaluation for RSW Tunnel and RWB walls, the 2 D SSSI model **(RB + RSW Tunnel + RWB)** included only the UB in situ soil without any evaluation for backfill properties. As such, the applicant is requested to demonstrate that consideration of only UB soil profile instead of using a combination of UB soil and backfill parameters for the cited cases will still be conservative for the wall design of all site specific Category I and RWB structures (UHS/RSWPH, DGFOSV, RSW Tunnel, UHS/and

RWB). The applicant is also requested to include this evaluation in the applicable sections of the FSAR.

Issue 3: Clearly describing in the FSAR how seismic demand for non-seismic II/I structures for stability evaluation is determined

It is not clear from the descriptions in the FSAR as to how the seismic demand is determined for the site-specific stability evaluation of the non-seismic II/I structures considering the influence of nearby heavy structures during SSE. As such, the applicant is requested to describe in sufficient detail in the FSAR the following information:

1. How the FIRS (as outcrop motion) at the foundation level of the non-seismic II/I structures are determined using the site specific SSE input spectra applied at the ground surface
2. How the effects of nearby heavy structures are included in the input response spectra for various soil and backfill conditions
3. Demonstrate that horizontal input response spectra at the foundation level of non-seismic II/I structures is broad band spectra with peak acceleration greater than 0.1g and envelops FIRS
4. Types of seismic analysis performed to determine seismic demand for stability evaluation (i.e., fixed base analysis, equivalent static or dynamic analysis, or SSI analysis) and how the input is specified in the analysis
5. Include 5% damped input response spectra (vertical and horizontal) as amplified by the presence of nearby heavy structures used in the seismic demand evaluation for site-specific stability analysis for non-seismic II/I structures
6. Discuss or refer to appropriate FSAR section of any differences in the method of stability evaluation from that of Category 1 structures

Issue 4: Sliding Friction Coefficients reported in Table 3H.6-14

Designate whether the friction coefficients reported in Table 3H.6-14 are static or dynamic coefficient of friction values.

Issue 5: Referencing Table 3H.6-5

Section 3H.6.6.5 refers to Table 3H.6-5 for factors of safety against sliding and overturning for RSW piping tunnel. However, Table 3H.6-5 provides values for RSW pump house. Please verify the acceptability of this reference Table.

Issue 6: SASSI2000 Subtraction Method Validation

In reviewing the SGH SASSI2000 V&V of the subtraction method, it was found that the test problems (SAS-3C, SAS-4C and SAS-8) are not analyzed to sufficiently high enough frequencies that can validate the stability and accuracy of the subtraction method for passing frequency of V_s/5h, where V_s is the lowest shear wave velocity of the foundation media and h is the largest element size in the soil model. In the case of S&L SASSI2000 V&V Test problems 4 and 8 used in validation of the subtraction method, the analyses were carried out to sufficiently high frequencies to cover the passing frequency requirement of V_s/5h. However, the conclusion does not address the stability and accuracy of the subtraction method used in the context of the calculated results. In both cases, the applicant is requested to revisit the test problems and provide validation that adequately addresses the stability and accuracy of the subtraction method in relation to the acceptable passing frequency of V_s/5h used in the STP 3&4 design.

Issue 7: SAP2000 V&V

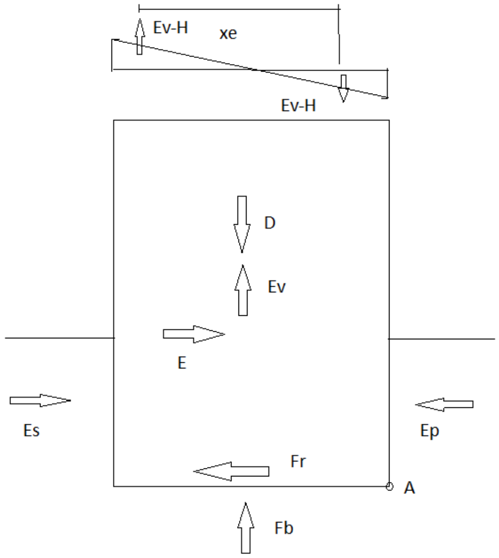
The response to RAI.03.07.02-29, Rev. 1, documents additional validation problems for SAP 2000. The validations include:

1) Section cuts
2) Thick shell out-of-plane response
3) Time history modal superposition with shell elements
4) Spectra calculation using thick shell elements

Validation of item “1” was done by hand calculation. For items “2”, “3” and “4”, the benchmark solutions for validation were developed with ANSYS utilizing “SHELL43 “element, which is well suited to model linear, warped, moderately-thick shell structures according to ANSYS User’s Manual. For items “2”, “3” and “4”, the following acceptance criteria were used: 5% for frequencies, 10% for forces, and 15% for spectra. The 5% difference is considered acceptable within the engineering accuracy, while the 10% and 15% criteria may be excessive. The applicant is requested to assess the impact of the above acceptance criteria on the STP 3&4 design.

Issue 8: Stability Analysis Procedure

A brief presentation of the stability analysis procedure was made by the applicant during the March 14, 2011 audit. The presentation included a rigid body diagram showing the forces acting on the structure for stability calculations. The applicant indicated that the total seismic demand is calculated by summing all the inertia forces and moments acting on the structure. These inertia forces are calculated by multiplying the mass of each node by the absolute value of the maximum acceleration response at that node obtained from the SSI analysis.
The calculation of the seismic overturning moment is based on the horizontal seismic load E and vertical seismic load E_v about tipping point A, as shown in the figure below. The moment due to horizontal earthquake does not include E_{v-H} (vertical force due to horizontal input) which also produces overturning moment about A. The applicant is requested to provide justification for not including the vertical component of response due to horizontal seismic input in calculating the foundation overturning moment.



E – Horizontal seismic force

E_v – Vertical seismic force

E_s – Soil active force

E_p – Soil passive resistance

D – 0.9 of dead load

F_b – Buoyancy force

F_r – Frictional resistance