Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

March 15, 2010
U7-C-STP-NRC-100057

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Responses to Request for Additional Information

Attached is the response to a NRC staff question included in Request for Additional Information (RAI) letter number 317, related to Combined License Application (COLA) Part 2, Tier 2, Section 2.5S, "Geology, Seismology, and Geotechnical Engineering." Responses to the other questions in RAI letter number 317 were provided in letter U7-C-STP-NRC-100048, dated March 1, 2010. This letter completes the response to RAI letter number 317. Additionally, in response to an NRC staff request during a teleconference on March 3, 2010, attached is a supplement to the response to an RAI question previously submitted in letter U7-C-STP-NRC-100012, dated January 21, 2010.

Attachments to this letter provide the following RAI responses:

02.05.02-28 02.05.04-33, Supplement 1

Where there are COLA markups, they will be made at the first routine COLA update following NRC acceptance of the RAI response.

There are no commitments in this letter.

If you have any questions regarding these responses, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

DD91
NRO

STI 32628659

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 3/15/10

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

rhb

Attachments:
1. 02.05.02-28
2. 02.05.04-33, Supplement 1

cc: w/o attachments and enclosure except*
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RAI 02.05.02-28

QUESTION:

In RAI 2.5.2-13, the staff asked what process the applicant used to revise the EPRI-SOG seismic source parameters for the Gulf Coastal Source zones (GCSZs). The response indicated that a SSHAC Level 2 process was used, however, only a general description of the process was provided. The staff asked RAI 2.5.2-21 to solicit more details. Specifically, the staff asked how the experts' opinions were integrated into the model development; how conflicting opinions between the experts were dealt with; and how the final source model represents the informed consensus of the community.

The response to RAI 2.5.2-21 provided details of the SSHAC Level 2 process that resulted in the updates to maximum magnitudes (Mmax) for the EPRI-SOG GCSZs. The response states that the SSHAC TI team's original recommendation was for a Mmax distribution that ranged from magnitude (m_b) 6.1 to 7.2 (6.1 [0.1], 6.6 [0.4], 6.9 [0.4], 7.2 [0.1]). The weighted average of this Mmax distribution is m_b 6.73. However, the SSHAC peer review panel did not approve of this Mmax distribution on the bases that "the Mmax value used by the USGS was not developed through a formal SSHAC process, was not intended to capture the 'legitimate range of technically supportable interpretations among the entire informed technical community' (NUREG/CR-6372, page 6), and was primarily developed to reflect hazard associated with the short return periods of building codes." Instead the SSHAC peer review panel recommended that the individual Mmax distributions for five of the six ESTs' Gulf source zones be updated. The weighted average of the updated Mmax values for the five ESTs is m_b 6.14.

Concerning the adopted Mmax distributions for the Gulf of Mexico source zones, the staff requests the following:

1. Please incorporate a description of the SSHAC process used to update the GCSZs into the FSAR.

2. Provide justification for rejecting the USGS Mmax value (m_b 7.2) as representing a legitimate end member of the informed technical community.

3. Provide justification for not adopting the original TI team's Mmax distribution. The TI team's original recommendation was for a Mmax distribution that ranged from magnitude (m_b) 6.1 to 7.2, not solely a single value m_b 7.2, on which the USGS 2002 National Hazard Map places a weight of 1.0. There is a significant difference between the two weights (0.1 for TI team versus 1.0 for USGS) for the Mmax value of m_b 7.2.

4. The weighted average of the adopted Mmax distributions for the five ESTs that had updated values is m_b 6.14. This is about the same magnitude (m_b 6.1) of the December 12, 2006, Gulf earthquake. Considering this result, provide justification for the modest updates to the Mmax values for five of the six ESTs Gulf Coast models.

5. In view of the two 2006 Gulf Coast earthquakes, describe how the limited Woodward Clyde Consultant's source model adequately characterizes the hazard for the Gulf.

This RAI describes the staff's concerns regarding SER Open Item 2.5.2-1.

RESPONSE:

As described in Section 2.5S.2 of the STP 3 & 4 FSAR, the response to RAI 02.05.02-13 (STPNOC Letter U7-C-STP-NRC-080070, dated December 15, 2008), and the response to RAI 02.05.02-21 (STPNOC Letter U7-C-STP-NRC-090146, dated September 21, 2009), two earthquakes within the Gulf of Mexico in 2006 (10 February and 10 September) suggested that there was a need to update the characterizations of the EPRI-SOG Gulf Coastal Source Zones (GCSZs). The updates that were used in the STP 3 & 4 FSAR were developed following the guidance of RG 1.208. In particular, a Senior Seismic Hazard Analysis Committee (SSHAC) Level 2 process was used to develop the updates (NUREG/CR-6372). This SSHAC Level 2 process resulted in the development of updated Mmax distributions for five of the six EPRI-SOG GCSZs (and maintenance of the Mmax distribution for the sixth EPRI-SOG EST) that did not erode the high-level, SSHAC Level 4-like character of the original EPRI-SOG study and that, when combined with the existing EPRI-SOG GCSZ geometries and earthquake recurrence rates, present a reasonable representation of the "legitimate range of technically supportable interpretations among the entire informed technical community" (NUREG/CR-6372, page 6) with respect to seismic source characterizations for the Gulf coastal plain.

The responses provided below to the items in this RAI further clarify the development of these updated characterizations and provide support for the assertion that the updated model is an adequate and reasonable representation of the legitimate range of technically supportable interpretations among the entire informed technical community. Updated characterizations of the EPRI-SOG GCSZs and the resulting updated model are appropriate, having been developed in accordance with existing regulatory guidance, in particular, RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion" and NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts."

Item 1:

The description of the Senior Seismic Hazard Analysis Committee (SSHAC) process used to develop the updated maximum magnitude (Mmax) distributions for the Gulf Coastal Source Zones (GCSZs) will be added to the FSAR. This text is abstracted from the response to RAI 02.05.02-21.

FSAR Subsection 2.5S.2.4.3, including the title, will be replaced as follows.

2.5S.2.4.3 ~~New Maximum Magnitude Information~~Updated Characterization of Gulf Coastal Source Zones

Geological and seismological data published since the 1986 EPRI seismic source model are summarized and discussed in Subsections 2.5S.1 and 2.5S.2.1 through 2.5S.2.3, respectively. Following the guidance of RG 1.208, these data were reviewed to determine whether the existing EPRI-SOG source characterizations for the STP 3 & 4 site (see Subsection 2.5S.2.2.1) adequately capture the new data. As part of this review, it was noted that two earthquakes within the Gulf of Mexico (10 February 2006 Emb 5.52 and 10 September 2006 Emb 6.11) had occurred since the EPRI-SOG study with magnitudes greater than the lower-bound Mmax values for some of the source zones that contain them. In general, these source zones encompass the Gulf Coastal region, extend into the Gulf of Mexico, and contain the STP 3 & 4 site (Figure 2.5S.2-8). For convenience, these zones are referred to here as Gulf Coastal Source Zones (GCSZs).

Based on the identification of new data potentially suggesting the need for revisions to the EPRI-SOG source characterizations of the GCSZs, the guidance of RG 1.208 was followed in developing updated source characterizations for the GCSZs. In particular, a Senior Seismic Hazard Analysis Committee (SSHAC) Level 2 process (Reference 2.5S.2-XX) was used to develop the updates. The Technical Integrators (TIs) for this study were Dr. Christopher Fuller and Dr. Jeff Unruh from William Lettis & Associates, Inc. Experts queried for this update included the following academic and commercial geoscientists with expertise in tectonics and seismicity within the Gulf of Mexico (Dr. James Dewey, USGS; Dr. Frank Peel, BHP Billiton Petroleum; Dr. Meredith Nettles, Lamont-Doherty Earth Observatory; Dr. Joe Dellinger, British Petroleum; Dr. Goran Ekstrom, Lamont-Doherty Earth Observatory; Dr. Martin Chapman, Virginia Tech; Dr. James Pindell, Rice University) and members of the original EPRI-SOG ESTs (Dr. Joe Litehiser, Bechtel team; Mr. George Klimkiewicz, Weston team; and Mr. Jim McWhorter, Dames & Moore team). The peer review panel (PRP) consisted of the seismic Technical Advisory Group (TAG) members for the STP 3 & 4 project: Dr. Carl Stepp, independent Consultant; Dr. Robert Kennedy, RPK Consulting; Dr. Cliff Frohlich, University of Texas; Dr. Allin Cornell, Stanford University (deceased); and Mr. Donald Moore, Southern Company.

GCSZ Update Methodology Background

As discussed in the introduction to Section 2.5S.2, development of the PSHA used for STP 3 & 4 followed the guidelines of RG 1.208. The EPRI-SOG PSHA model (Reference 2.5S.2-XY), considered an acceptable base model per RG 1.208, was used as the starting base model. Following the guidance of RG 1.208, this base model was evaluated in light of new data developed since the EPRI-SOG study to determine whether modifications needed to be made to the model to ensure that it adequately represents the most recent information. The key criteria specified by RG 1.208 for evaluation of the EPRI-SOG model is whether the model "adequately" describes, or is "consistent" with, the new data.

The decision to modify the GCSZs of the EPRI-SOG model resulted from an extensive review by the TIs of information and data published since the EPRI-SOG study, as recommended in RG 1.208 (see FSAR Sections 2.5S.1 and 2.5S.2.1 through 2.5S.2.3). The specific new data that triggered the update was the occurrence of the 10 February 2006 and 10 September 2006 earthquakes, hereafter referred to as the February and September earthquakes, which have magnitudes greater than the lower-bound maximum magnitude of some of the GCSZs that contain the earthquakes. Earthquakes with magnitudes greater than their host source zone's lower-bound maximum magnitude represent new data that require a revision to the EPRI-SOG model because the maximum magnitude for a source zone cannot be less than the largest observed historical earthquake within the zone.

SSHAC Process

As described in NUREG/CR-6372 (Reference 2.5S.2-XX), SSHAC guidelines can be applied to any aspect or issue of a PSHA. The issues explicitly addressed in this investigation were:

1. Does Gulf of Mexico seismicity, and in particular the February and September earthquakes, provide evidence that EPRI-SOG GCSZ characterizations need to be updated?
2. What components of the characterizations (i.e., geometry, recurrence, Mmax) need to be updated?
3. What methodology should be used to update those components, if required?

To address these issues, relevant available datasets were compiled and analyzed. This data compilation and analysis were conducted following the guidance of RG 1.208, as documented in FSAR Sections 2.5S.1 and 2.5S.2.1 through 2.5S.2.3.

Also as part of the data collection step, numerous experts were interviewed to help define the "legitimate range of technically supportable interpretations among the entire informed technical community" (Reference 2.5S.2-XX, page 6) with respect to the geologic and seismotectonic setting of the two earthquakes. The interviews focused on determining: (1) whether the experts were familiar with the two earthquakes; and (2) if the experts knew of any distinguishable geologic features or structures that may have been sources for the earthquakes. The interviews demonstrated that there is no current consensus among the informed technical community as to whether a distinguishable geologic feature or structure is associated with either earthquake.

The TIs analyzed the interview results and data and determined that:

- The Mmax values of the GCSZs needed to be updated because the magnitudes of the February and September earthquakes were larger than the lower-bound Mmax for some of the zones;
- The earthquake recurrence model did not need to be updated because there has not been a significant change in seismicity rate (see Subsections 2.5S.2.1 and 2.5S.2.4); and,
- The geometry of the GCSZs needed to be considered for updating because the earthquakes occur in some of the zones and not others (Figure 2.5S.2-8).

The TIs evaluated whether the earthquakes implied that the GCSZ geometries needed to be updated separately for each of the earthquakes. For the September earthquake, the TIs concluded that the existing EPRI-SOG GCSZ geometries adequately characterize the community distribution of potential seismic sources that may have caused the earthquake. This conclusion was based on the expert opinions expressed in interviews that demonstrated there is significant uncertainty with respect to whether or not the earthquake is related to an identifiable feature (e.g., geologic structure), and the fact that the existing GCSZ geometries can be interpreted as representing both possibilities. For example, three of the ESTs source zones included the earthquake epicenter, and thus these source zones represent the interpretation that an earthquake similar to the September event can occur anywhere within a very broad region in the Gulf of Mexico (Bechtel, Weston, Rondout). The remaining three EPRI-SOG GCSZs do not include the earthquake epicenter, and thus represent the interpretation that the earthquake is related to a source outside of the existing source zones.

For the February earthquake, the TIs also concluded that the existing GCSZ geometries adequately encompass the community distribution of potential geologic features or structures that may have caused the earthquake. All of the new data, information, and interviews indicated that there is considerable uncertainty with respect to what geologic feature or structure may have been responsible for the earthquake. For example, some of the experts interviewed suggested that a large-scale landslide on the Sigsbee escarpment in the Gulf of Mexico may have caused the earthquake (Reference 2.5S.2-23). This hypothesis implies that similar earthquakes may occur along other segments of the Sigsbee escarpment, thus suggesting the presence of a potential localized seismic source along the escarpment. The TIs evaluated these opinions and concluded that:

- The hypothesis that the February earthquake was caused by a large-scale landslide is not uniformly accepted within the technical community and represents only a single model of the possible cause of the earthquake;
- The existing EPRI-SOG GCSZ geometries capture this hypothesized source as well as other potential sources (e.g., the hypothesis that the earthquake occurred in the basement beneath the sedimentary section) (Reference 2.5S.2-XZ); and
- The existing EPRI-SOG GCSZs adequately characterize the "legitimate range of technically supportable interpretations among the entire informed technical community" (Reference 2.5S.2-XX, page 6) with respect to the source of the February earthquake.

Thus, following a SSHAC Level 2 process, the TIs concluded that the existing EPRI-SOG GCSZs are an adequate representation of the "legitimate range of technically supportable interpretations among the entire informed technical community" (Reference 2.5S.2-XX, page 6) with respect to source geometry. Therefore, the TIs determined that only the Mmax values for the GCSZs did not adequately describe, or were not consistent with, the new data (i.e., the February and September earthquakes), and thus needed to be updated.

Through the process of interacting with the PRP, the final result of the SSHAC Level 2 study was the decision to update the Mmax values using the original EST methodology because this methodology would: (1) preserve one of the original goals of the EPRI-SOG study, and the goal of a SSHAC process, to represent the range of uncertainty in the informed technical community because interpretations from six different expert ESTs are used; and (2) result in revised Mmax distributions that are consistent with the latest data. The revised updates to the GCSZs Mmax values developed using this methodology are presented in the following paragraphs. The PRP endorsed both the TIs' approach of applying the EPRI-SOG EST's Mmax methodologies and the resultant updated Mmax distributions.

Updated Mmax Values

As described in the paragraphs above, the Mmax values for some of the EPRI-SOG GCSZs were updated to reflect the February and September earthquakes. A review of the original Mmax distributions for each EPRI EST is provided in Table 2.5S.2-7 through Table 2.5S.2-12 and a summary of original and modified Mmax distributions for GCSZs is provided in Table 2.5S.2-13. The GCSZs and the two earthquakes are shown in Figure 2.5S.2-8. For this update the Mmax distribution for a particular GCSZ was revised only if two conditions were met: (1) one or both of the 2006 moderate-magnitude earthquakes cannot be determined to have occurred outside the source zone with reasonable certainty; and (2) the observed Emb magnitude for the largest earthquake in the zone is greater than the minimum m_b magnitude of the original EPRI-SOG 1986 Mmax distribution for the zone. Details on the revisions for each of the EST GCSZs, where required, are described in Subsections 2.5S.2.4.3.1 through 2.5S.2.4.3.6.

Add the following new references to FSAR Section 2.5S.2.7:

2.5S.2-XX	NUREG/CR-6372, Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts. Washington, D.C., U. S. Nuclear Regulatory Commission, Budnitz, R.J., Apostolakis, G., Boore, D.M., Cluff, L.S., Coppersmith, K.J., Cornell, C.A., and Morris, P.A., 1997.
2.5S.2-XY	EPRI, 1986-1989, Seismic Hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 1-3 & 5-10, EPRI.
2.5S.2-XZ	Dewey, J.W., and Dellinger, J.A., 2008, Location of the Green Canyon (Offshore Southern Louisiana) Seismic Event of February 10, 2006, U.S. Geological Survey, Open File Report 2008-1184, p. 30.

Item 2:

As described in the response to RAI question 02.05.02-21, submitted in STPNOC Letter U7-C-STP-NRC-090146, dated September 21, 2009, the Mmax value from the USGS National Seismic Hazard Maps for the Gulf of Mexico coastal region of m_b 7.2 was used in developing a preliminary version of the Mmax update that was presented to the participatory peer review panel (PRP) as part of the SSHAC Level 2 process. Also as described in the response to RAI question 02.05.02-21, after reviewing the initial updated values, the PRP recommended that the upper bound of the updated Mmax distribution should not be based on, or justified primarily by, the USGS Mmax value because:

1. The value was not developed through a formal SSHAC process;
2. The value was not intended to capture the legitimate range of technically supportable interpretations among the entire informed technical community (evident in the fact that no uncertainty was placed on the Mmax value in the 2002 model) (FSAR Reference 2.5S.2-28);
3. The value was primarily developed to reflect hazard associated with the short return periods of building codes; and

4. The adoption of the same Mmax distribution for all six EPRI-SOG EST characterizations of the GCSZ erodes the high-level, SSHAC-like character of the EPRI-SOG study because the same Mmax distribution would be used for each EST.

Therefore, although included in the original and updated EPRI-SOG composite Mmax distribution over all earth science teams (EST), the USGS Mmax value of m_b 7.2 was not explicitly imposed on each EST in this Mmax update.

However, the updated Mmax distributions for the GCSZs do encompass the m_b 7.2 Mmax value of the 2002 USGS source model (Reference 2.5S.2-28). As is shown in FSAR Table 2.5S.2-13, the updated Mmax distributions for two of the GCSZs have upper bound Mmax values of m_b 7.2: Dames & Moore South Coastal Margin (zone 20) and Weston Gulf Coast (zone 107). The TIs noted in their consideration of this issue that the EPRI-SOG methodology for developing Mmax in the GCSZs does give weight to the interpretation that GCSZs are capable of producing m_b 7.2 earthquakes.

No COLA revision is required as a result of the response to Item 2.

Item 3:
Item 3 of this RAI asks for justification for not retaining the TI team's preliminary updated Mmax distribution initially presented to the PRP. As described in the response to RAI 02.05.02-21, submitted in STPNOC Letter U7-C-STP-NRC-090146, dated September 21, 2009, this preliminary distribution was uniformly applied to all ESTs and was: m_b 6.1 [0.1], 6.6 [0.4], 6.9 [0.4], 7.2 [0.1]. The lower bound of the distribution was set at m_b 6.1, corresponding to the magnitude of the September earthquake, and the upper bound was set to m_b 7.2, corresponding to the Mmax used in the 2002 USGS National Seismic Hazard Map for the extended margin (FSAR Reference 2.5S.2-28). The m_b 6.1 magnitude of the September event was chosen by the TIs as the lower-bound Mmax for the source zones, even those that did not contain the event, as a conservative Mmax estimate. The USGS Mmax value was used as an upper bound because the USGS Mmax represents an interpretation of the technical community. Weights assigned to the Mmax values reflected the TIs' preliminary interpretation.

In their review of the TI's work, the PRP followed the SSHAC guidance, which in part outlines their role "...to ensure that the process followed [for developing PSHAs] was adequate and to ensure that the results provide a reasonable representation of the diversity of views of the technical community" (FSAR Reference 2.5S.2-XX, p. 27). As such the PRP reviewed both the process and the results of the TI's work, and the PRP's suggestion not to adopt the preliminary Mmax values was based on their review of the update process used by the TIs. Therefore, the PRP's recommendation not to use the USGS Mmax value was a valid critique of the preliminary Mmax distribution from a process perspective.

Although there is no guidance within NUREG/CR-6372 that states the PRP's recommendations must be followed, NUREG/CR-6372 does clearly indicate that the PRP comments and recommendations should be considered and addressed. The SSHAC demonstrates the advantage of addressing PRP comments to the satisfaction of the PRP by indicating that the PRP's support of the process to integrate community opinion adds credibility to the results of the study (FSAR Reference 2.5S.2-XX, p. 29). However, NUREG/CR-6372 also implies that to gain this credibility, "...the peer reviewers must be 'peers' in the true sense: recognized experts on the subject matter under review" (FSAR Reference 2.5S.2-XX, p. 48). Recognizing that the PRP panel for the STP 3 & 4 project consisted of recognized experts in geology, seismology, PSHAs, and nuclear siting and safety with respect to seismic issues, it was the TI's judgement that the recommendations of the PRP should be addressed.

Therefore, when the PRP indicated that they did not agree with the process used to develop the preliminary Mmax distribution, the TIs adopted a revised process that they believed would address the critical comments of the PRP and result in an Mmax distribution that better reflected a reasonable representation of the "legitimate range of technically supportable interpretations among the entire informed technical community" (FSAR Reference 2.5S.2-XX, page 6). Because the PRP agreed with the revised process and with the revised Mmax distributions, the TIs believed that they had developed a more robust and credible representation of Mmax for the GCSZs.

In summary, the preliminary Mmax revisions were not adopted because the PRP preferred not to erode the high-level, SSHAC Level 4-like character of the original EPRI-SOG study and the TIs responded to the PRP according to the guidance of RG 1.208 and NUREG/CR-6372.

No COLA revision is required as a result of the response to Item 3.

Item 4:
The justification for the updated Mmax values developed for the GCSZs is presented in detail in the response to RAI question 02.05.02-21 and is further clarified in the responses to other items raised in this RAI. In brief, the justification is that:

- New data were discovered during the site-specific investigations for STP 3 & 4 that suggested the Mmax values for some GCSZs needed to be updated; and
- The updated Mmax distributions were developed following a SSHAC Level 2 process, as recommended by RG 1.208.

Item 4 of this RAI requests justification for the updates to Mmax values for five of the six EST's Gulf Coast models since the weighted mean of the five updated Mmax distributions (m_b 6.15) is about the same magnitude as the magnitude of a "December 12, 2006" earthquake. It is assumed that the reference to a December 12, 2006 earthquake is a typographical error and should instead refer to the September 10, 2006 Emb 6.11 earthquake because: (1) the updated catalog for STP 3 & 4 does not extend to December 2006, and (2) there is no reference to a December 12, 2006 earthquake within the Gulf of Mexico in the USGS Advanced National Seismic System (ANSS) seismicity catalog (http://www.ncedc.org/anss/catalog-search.html), the NEIC catalog (http://neic.usgs.gov/neis/epic/epic_rect.html), or the ISC catalog http://www.isc.ac.uk/search/bulletin/rectang.html).

Therefore, this response addresses the September 10, 2006 Emb 6.1 earthquake, referred to here as the September earthquake.

As described in FSAR Subsection 2.5S.2.4.3 and in the response to RAI question 02.05.02-21, the Mmax distribution for each EST GCSZ was updated only if: (1) one or both of the 2006 moderate-magnitude earthquakes (the September earthquake or the 10 February 2006 Emb 5.5 earthquake) cannot be determined to have occurred outside the source zone with reasonable certainty; and (2) the observed Emb magnitude for the largest of the two earthquakes in the zone is greater than the minimum m_b magnitude of the EPRI-SOG characterization for the zone. The basis for only updating the Mmax distribution for zones if the earthquake occurred within the zone follows the basic practice of seismic source characterization that only earthquakes occurring within a given source zone are relevant to that source zone.

The EPRI-SOG ESTs defined source zones based on their interpretation of the geologic and seismotectonic setting of different regions of the crust, and, presumably, those ESTs that did not extend their GCSZs to include the region of the September earthquake considered the crust in the region of the earthquake to be distinct from the crust in their GCSZs. Therefore, it would not be appropriate to modify the Mmax distribution of any GCSZ based on the September earthquake if that source zone likely does not contain the earthquake given uncertainty in the location of the earthquake. The September earthquake is reasonably well located and is well outside of the three GCSZs that were not updated to account for the September earthquake (see FSAR Table 2.5S.2-15). Therefore, the comparison made in this RAI (i.e., Item 4) between the magnitude of the September earthquake and the weighted mean magnitude of the updated source zones should only be made with the source zones that were updated based on the September earthquake. The weighted mean magnitude of those source zones (Bechtel BZ1, Rondout 51, Weston 107) is m_b 6.47. This value is approximately 0.4 magnitude units above the observed September earthquake. Also note that, for each of these three GCSZs, the minimum Mmax was 6.1 or greater.

During the process of developing the updated Mmax distributions the TIs recognized the possibility that the September earthquake might reflect new data suggesting that the geometry of the EPRI-SOG GCSZs needed to be updated. As described in the response to RAI question 02.05.02-21, this possibility was explored during the SSHAC Level 2 study that updated the Mmax distributions, and the TIs concluded that the existing variation in GCSZ geometry is a reasonable representation of the "legitimate range of technically supportable interpretations among the entire informed technical community" (FSAR Reference 2.5S.2-XX, page 6) with respect to appropriate source zone geometries for the Gulf of Mexico region.

No COLA revision is required as a result of the response to Item 4.

Item 5:
Item 5 of this RAI requests justification that Woodward Clyde zone B43 adequately characterizes the hazard for the Gulf of Mexico. Based on an understanding of the EPRI-SOG and Woodward Clyde methodology, this zone was not specifically developed to characterize the hazard for the Gulf of Mexico. Instead the zone was developed to characterize the contribution to

hazard at the STP 1 & 2 site from a general background source proximal to the site, and this is the way in which the zone was used for the STP 3 & 4 COLA. Zone B43 is one of six equally weighted interpretations from the EPRI-SOG model describing the potential seismic hazard within the Gulf Coastal region of the STP 3 & 4 site region. Therefore, having followed the guidance of RG 1.208, it is only necessary to justify that: (1) the EPRI-SOG model, composed of the six EST interpretations, is an adequate characterization of hazard for the STP 3 & 4 site based on the review of new data; and (2) the Woodward Clyde zone B43 represents a component of the range of uncertainty for the potential seismic hazard within the STP 3 & 4 site region, given data that have been developed since the EPRI-SOG model.

The basis for these justifications is presented in general in FSAR Section 2.5S.2.1 through 2.5S.2.3 and, more specifically, in the response to RAI question 02.05.02-21 and in response to other Items raised in this RAI. These pertinent justifications are summarized below.

The general justification for not revising the Woodward Clyde source model is that it is a component of the EPRI-SOG model that is presented by RG 1.208 as a starting point source model for COLAs. As described in the response to RAI 02.05.02-21, and in response to other items raised in this RAI, RG 1.208 requires that this base model be checked against new data to ensure that the model adequately represents any new data. This step was taken as part of the STP 3 & 4 COLA, and it was determined that the EPRI-SOG characterizations needed to be modified. Following the guidance of RG 1.208, the SSHAC guidelines (FSAR Reference 2.5S.2-XX) were followed; and the resulting updates did not revise the Woodward Clyde GCSZ.

Specifically, the Woodward Clyde GCSZ (zone B43) was not updated in light of the February and September earthquakes in the Gulf of Mexico because it was determined that the variations in the GCSZs of the six ESTs, when Mmax values were updated for five of the ESTs, are a reasonable representation of the "legitimate range of technically supportable interpretations among the entire informed technical community" (FSAR Reference 2.5S.2-XX, page 6) of potential seismic source zones representing the Gulf Coastal region within 200 miles of the STP 3 & 4 site. As described in the response to RAI 02.05.02-21, and Item 1 above, the basis for this conclusion is that:

- There is considerable uncertainty in whether either the February or September earthquake can be related to a known, and thus localized, geologic structure.
- If the earthquakes were caused by identified structures proximal to the epicenters, seismic sources localizing the locations of potential future earthquakes along those structures would be appropriate. Sources proximal to the epicenters would be significantly greater than 200 miles from the STP 3 & 4 site, so there is no need to add source zones for this interpretation.
- If the earthquakes were not caused by identified structures proximal to the epicenters, an alternate interpretation of the earthquakes is that they could occur anywhere within broad seismic source zones encompassing regions of similar seismotectonic settings. The existing EPRI-SOG source zones that encompass the February and September earthquakes represent broad source zones that can explain this second interpretation if the magnitudes for these zones are modified.

- Because both interpretations of the two earthquakes are represented within the existing EPRI-SOG model geometries, there was no need to modify the geometry of the source zones.
- Based on the conclusion that there was no need to update the zone geometries, Mmax values only needed to be updated for zones that contain, or could reasonably contain, the February and September earthquakes. The Woodward Clyde interpretation of the seismic potential within the site region (zone B43) does not extend to the regions of the February and September earthquakes, so the Woodward Clyde model does not require modification to incorporate these earthquakes.

Expanding on this conclusion, the Woodward Clyde EST was one of six ESTs in the original EPRI-SOG study that developed interpretations of the seismic potential of the region surrounding the STP 3 & 4 site. By defining the STP 3 & 4 background zone as an approximately 200 mile square region surrounding the site, the Woodward Clyde zone represents the interpretation that: (1) only the seismicity within this extent defines the potential for future "background" earthquakes for the STP 3 & 4 site (e.g., seismicity at great distances from the site does not impact the background seismicity at the site); and (2) the extent and geometry of background zones for specific sites do not depend on regional geologic or seismotectonic features. Given the new data that has been developed since the EPRI-SOG model and the results of interviews conducted during the SSHAC Level 2 study to develop the updated Mmax values, this interpretation of the Woodward Clyde EST has not been disproved and is still valid. Therefore, when considered within the context of the six ESTs of the EPRI-SOG model where the Woodward Clyde interpretation receives 1/6th weight, the Woodward Clyde EST's interpretation of the Gulf Coastal region within the site area represents a distinct methodology within the informed technical community and is a reasonable and adequate representation of the seismic hazard for the STP 3 & 4 site.

No COLA revision is required as a result of the response to Item 5.

RAI 02.05.04-33, Supplement 1

QUESTION:

In response to RAI 2.5.4-31 you indicate that you will determine static and dynamic engineering properties for the backfill materials, but you do not specify types or quantity of tests to be performed. As some of your Category 1 structures will be founded on structural backfill, the critical soil parameters (strength, compressibility, shear modulus degradation and damping ratio) need to be defined for the range of backfill types that will be encountered in the placement of 2.2 million cubic yards of backfill. Please provide additional information for the FSAR that specifies types of tests, frequency of testing and how your quality control program will ensure that assumed soil parameters used in design are bounded by as-built backfill soil parameters.

RESPONSE, Supplement 1:

STPNOC letter U7-C-STP-NRC-100012, dated January 21, 2010 (ML100250137) provided a response to RAI 02.05.04-33 that included a proposed revision to COLA Part 2 (Tier 2) Section 2.5S.4.5.3. The proposed revision to the STP Units 3 and 4 COLA Part 2, Section 2.5S.4.5.3, included a commitment that stated, "Prior to placing the imported materials as backfill, an engineering report will be prepared to confirm that the materials, construction equipment and methods used to construct the test pad are capable of producing acceptable and consistent results." The intent of this commitment was to respond to the request made in this RAI for the applicant to "provide additional information for the FSAR that specifies types of tests, frequency of testing and how your quality control program will ensure that assumed soil parameters used in design are bounded by as-built backfill soil parameters." Since a source of backfill material has not yet been identified for STP Units 3 and 4, the specific engineering properties of this material are not available. The response proposed that, after the backfill source is identified, a test pad will be constructed, laboratory and field testing conducted, and an engineering report will be developed confirming that the proposed backfill materials have engineering properties that bound the values used in the design calculations for Seismic Category I structures.

During a telephone call on January 28, 2010, the staff indicated that this commitment did not provide sufficient certainty that the engineering properties of the backfill material will bound the engineering parameters used in the engineering analysis and design calculations of Seismic Category I structures. In order to resolve this concern, this supplemental response proposes incorporating the previously provided commitment in the COLA in the form of an additional ITAAC. Specifically, STPNOC proposes to add a new ITAAC (Item 3) in COLA Part 9, Table 3.0-11, as shown below. Note that STPNOC previously proposed revisions to Table 3.0-11 in response to NRC RAI 14.03.02-6 (STPNOC letter U7-C-STP-NRC-090150 dated September 21, 2009, ML092660093). For clarity, the COLA markup provided below includes changes to Table 3.0-11 as previously submitted in response to NRC RAI 14.03.02-6.

While preparing this supplemental response, additional changes related to structural backfill quality control requirements were identified as being warranted for consistency with STP Units 3 and 4 quality assurance program requirements. Specifically, the "STP 3 & 4 Quality Assurance

Program Description," Revision 1, as referenced in COLA Part 2 (Tier 2), Section 17, includes a commitment to comply with the requirements of Subpart 2.5 of NQA-1 (1994) for inspection requirements for construction. Based upon a review of the quality control requirements for backfill placement contained in Table 5.6 of NQA-1 (1994) Subpart 2.5, STPNOC found the proposed quality control sampling and testing program specified in COLA Part 2 (Tier 2), Section 2.5S.4.5.3, Compaction Specifications, require revision for consistency with NQA-1 requirements. Accordingly, revisions will be incorporated into the STP Units 3 and 4 COLA Part 2 (Tier 2), Section 2.5S.4.5.3, Table 2.5S.4.5.3-1, Quality Control Recommendations for Structural Fill, as indicated in the markup provided below.

Based on the above supplemental response, the STP Units 3 and 4 COLA will be revised as indicated in the following markups:

COLA Part 9, Section 3.0, Table 3.0-11, will be revised as follows with changes indicated by gray shading:

Table 3.0-11 Backfill uUnder Category ~~1~~I Structures

Design Requirement	Inspections, Tests, and Analyses	Acceptance Criteria
1. Backfill material under Seismic Category I structures is installed to meet a minimum of 95 percent of the Modified Proctor density.	1. Testing will be performed during placement of the backfill materials.	1. A report exists that concludes the installed backfill material under Seismic Category I structures meets a minimum of 95 percent of the Modified Proctor density.
2. The shear wave velocity of backfill under Seismic Category I structures meets the value used in the site-specific design analyses.	2. Field measurements and analyses of shear wave velocity in backfill will be performed.	2. An engineering report exists that concludes that the shear wave velocity of backfill under Seismic Category I structures meets the value used in the site-specific design analyses.
3. The engineering properties of backfill under Seismic Category I structures bound the values used in the site-specific design analyses.	3. Laboratory tests, field measurements and analyses of engineering properties of the backfill will be performed.	3. An engineering report exists that concludes that the engineering properties of backfill under Seismic Category I structures (unit weight, phi angle, shear strength, compressibility, shear modulus degradation and damping ratio) meet the values used in the site-specific design analyses.

COLA Part 2 (Tier 2), Table 2.5S.4.5.3-1, will be revised as follows:

Table 2.5S.4.5.3-1 Quality Control Recommendations for Structural Fill

Material	**Test**	**Minimum Sampling and Testing Frequency[1]**
Structural Fill	Field Density	For backfill placed in trenches and surrounding structures: Minimum 1 sample per 200 cubic yards placed, sample taken at suspect areas, and at least one per every lift. Elsewhere: Minimum 1 sample per 500 cubic yards placed, sample taken at suspect areas, and at least one per every lift.
	Moisture	One test for each Field Density test
	Moisture-Density Relationship (Modified Proctor)	One test for every borrow area and material type and any time material type changes. Additional test for every ~~40~~ 10 Field Density test (ASTM D1557)
	Gradation	One test for each Moisture-Density test. (ASTM D 6913)
	Atterberg Limits	One test for each Moisture-Density test~~.~~ (ASTM D 4318) for backfill types appropriate for this test.)
	Material Type	Soil must come from an approved borrow source. Other soil sources must be tested and approved.

Note 1: Consistent with the requirements of NQA-1 (1994) Subpart 2.5, the need for each specific test shall be established in site-specific construction specifications. In-process tests shall be performed more frequently if the test results are erratic, or if the trend of results or an apparent change in material characteristics indicates that the frequency should be increased. These test frequencies shall be considered minimum unless documentary test data are available to establish adequate confidence in conformance with specification requirements.