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

March 1, 2010
U7-C-STP-NRC-100048

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
<u>Response to Requests for Additional Information</u>

Attached are the responses to the NRC staff questions included in Request for Additional Information (RAI) letters numbered 317 and 318, related to Combined License Application (COLA) Part 2, Tier 2, Sections 2.3S, "Meteorology," 2.4S, "Hydrologic Description," and 2.5S, "Geology, Seismology, and Geotechnical Engineering."

Attachments 1 through 8 provide the responses to the RAI questions listed below:

02.03.04-11
02.03.05-12
02.04.12-37
02.05.01-22
02.05.01-23
02.05.02-29
02.05.02-30
02.05.02-31

There are two commitments in this letter. Attachment 9 provides a number, summary, and the milestones for each of these commitments.

Attachment 10 identifies a question from RAI letter number 317 that requires an extension, provides the reason why an extension is needed, and provides the date by which a response is expected to be submitted to the NRC staff.

If you have any questions, please contact Scott Head at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

D091
NRO

STI 32617192

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

Executed on 3/1/2010

M A McBurnett

Mark McBurnett
Vice President, Oversight & Regulatory Affairs
South Texas Project Units 3 & 4

rhb

Attachments:
1. RAI 02.03.04-11
2. RAI 02.03.05-12
3. RAI 02.04.12-37
4. RAI 02.05.01-22
5. RAI 02.05.01-23
6. RAI 02.05.02-29
7. RAI 02.05.02-30
8. RAI 02.05.02-31
9. Commitments
10. Response Date Extension for RAI Question

cc: w/o attachments and enclosure except*
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RAI 02.03.04-11:

QUESTION:

The response to RAI 02.03.04-9 dated October 29, 2009 states, in part, that Footnote 10 will be added to FSAR Table 2.0-2 stating that:

> $1.62\text{x}10^{-4}$ s/m^3 is the PAVAN generated Maximum 2-hour 5.0% value at the EAB;
> $2.74\text{x}10^{-4}$ s/m^3 is the PAVAN generated Maximum 2-hour 0.5% value at the EAB.

Please clarify in Footnote 10 that $1.62\text{x}10^{-4}$ s/m^3 is the PAVAN generated 2-hour 5.0% overall site value at the EAB and $2.74\text{x}10^{-4}$ s/m^3 is the PAVAN generated 2-hour 0.5% maximum sector value at the EAB.

The response to RAI 02.03.04-9 also states, in part, that Footnote 11 will be added to FSAR Table 2.0-2 stating that:

> $3.99\text{x}10^{-5}$ s/m^3 is the PAVAN generated Maximum 2-hour 5.0% value at the LPZ;
> $5.27\text{x}10^{-5}$ s/m^3 is the PAVAN generated Maximum 2-hour 0.5% value at the LPZ.

Likewise, please clarify in Footnote 11 that $3.99\text{x}10^{-5}$ s/m^3 is the PAVAN generated 2-hour 5.0% overall site value at the LPZ and $5.27\text{x}10^{-5}$ s/m^3 is the PAVAN generated 2-hour 0.5% maximum sector value at the LPZ.

RESPONSE:

FSAR Table 2.0-2, including Footnotes 10 and 11, will be revised as shown below to show both the 2-hour 0.5% maximum sector and 5% overall site meteorological dispersion χ/Q values as shown below. This revision supersedes the revision of this table in RAI Response 02.03.04-9, submitted to NRC by STPNOC Letter U7-C-STP-NRC-090185, dated October 29, 2009.

Table 2.0-2
Comparison of ABWR Standard Plant Site Design Parameters and STP 3 & 4 Site Characteristics

Subject	ABWR Standard Plant Site Design Parameters	STP 3 & 4 Site Characteristics	Bounded (Yes/No)
Exclusion Area Boundary (EAB)	An area whose boundary has a χ/Q less than or equal to 1.37 x 10^{-3} s/m^3	2.74 x 10^{-4} s/m^3	Yes
Meteorological Dispersion (χ/Q)	Maximum 2-hour 95% EAB: 1.37x10^{-3} s/m^3	1.62 x 10^{-4} s/m^3 [10] 2.74 x 10^{-4} s/m^3 [10]	Yes
	Maximum 2-hour 95% LPZ: 4.11x10^{-4} s/m^3	3.99 x 10^{-5} s/m^3 [11] 5.27 x 10^{-5} s/m^3 [11]	Yes
	Maximum annual average (8760 hour) LPZ: 1.17x10^{-6} s/m^3	7.09 x 10^{-7} s/m^3	Yes

[10] 1.62 x 10^{-4} s/m^3 is the PAVAN generated 2-hour 5.0% overall site value at the EAB; 2.74 x 10^{-4} s/m^3 is the PAVAN generated 2-hour 0.5% maximum sector value at the EAB.

[11] 3.99 x 10^{-5} s/m^3 is the PAVAN generated 2-hour 5.0% overall site value at the LPZ; 5.27 x 10^{-5} s/m^3 is the PAVAN generated 2-hour 0.5% maximum sector value at the LPZ.

RAI 02.03.05-12:

QUESTION:

The third bullet in Revision 3 to FSAR Section 2.3S.5.2 states that the maximum annual average no decay CHI/Q value for the EAB is 8.1E-06 sec/m^3 in the NW sector at a distance of 0.69 miles. This appears to conflict with the information presented in Revision 3 to FSAR Table 2.3S-27 which shows the maximum no decay CHI/Q value for the EAB is 1.5E-05 sec/m^3 in the NW sector at a distance of 0.52 miles. Please revise the FSAR to address this apparent conflict.

RESPONSE:

The third bullet in the second paragraph of FSAR Section 2.3S.5.2 will be revised as follows to be consistent with the COLA markup in RAI Response 02.03.04-5, Revision 1, submitted in STPNOC Letter U7-C-STP-NRC-090082, dated July 30, 2009 and FSAR Table 2.3S-27.

- 8.1E-06 sec/m^3 for the nearest ~~EAB~~ site boundary occurring in the NNW sector at a distance of 0.69 mi.

RAI 02.04.12-37:

QUESTION:

Provide a calculation package and a summary of the calculation package supporting conclusions regarding the transport and consequence analyses considering dispersion, advection, radioactive decay, and retardation under fastest flow conditions (e.g., the sensitivity analysis) including both retarded and non-retarded analytes, especially for tritium.

RESPONSE:

The calculation package, *Accidental Release of Liquid Effluent in Groundwater*, will be made available for NRC review in the Reading Room. The calculation provides a conservative analysis of a postulated, accidental liquid release of effluents to groundwater at the STP Units 3 & 4 site. The accident scenario and conceptual model are presented along with a description of potential pathways to water users. The analysis of radionuclide transport is described and the results are summarized. Transport results are compared against the Effluent Concentration Limits (ECLs) in 10 CFR Part 20, Appendix B, Table 2, Column 2. A summary of the calculation is provided below.

> The postulated accident scenario involves the rupture of a liquid radwaste tank with migration of the liquid effluent outside of the radwaste building resulting in a release directly to groundwater. The accident scenario assumes that 80 percent of the tank volume is discharged directly to the groundwater system. This accident scenario is conservative because the radwaste building contains multiple safeguards to prevent releases to the environment.
>
> An initial screening analysis was performed considering radioactive decay only. This analysis assumed that all radionuclides migrate at the same rate as groundwater and considered no adsorption or dispersion. This analysis accounts for the parent radionuclides expected to be present in the effluent plus progeny radionuclides that would be generated subsequently during transport. The analysis considered the progeny in the decay chain sequences that are important for dosimetric purposes.
>
> Radionuclides whose concentrations exceed one percent of the corresponding ECL for the groundwater pathway at the site boundary were further evaluated considering the processes of advection, dispersion, and adsorption. A sensitivity analysis was also performed using the range of average linear velocities/travel times estimated for the site. Corresponding site-specific distribution coefficient (K_d) values were selected to compliment the linear velocity evaluation. For example, the maximum average linear velocity (shortest travel time) incorporated the minimum K_d value, and the minimum average linear velocity (longest travel time) incorporated the maximum K_d value. The representative average linear velocity is based on averages and geometric means of measured physical properties

of the subsurface materials beneath the site and is considered to best represent the Shallow Aquifer at the STP site.

The results of the sensitivity analysis indicate no radionuclide is predicted to exceed its ECL whether using the maximum, representative, or minimum average linear velocities (i.e., minimum, average or maximum travel times) with the corresponding minimum, representative or maximum K_d values. The results of the analysis indicate that for each of the identified transport pathways, the ECLs are not exceeded at the exposure point based on the observed soil properties and depositional history of the subsurface materials.

No COLA revision is required as a result of this RAI response.

RAI 02.05.01-22:

QUESTION:

In response to RAI Question 2.5.1-19, you stated that growth fault GMP "is represented as a short north-northwest-trending projection within the STP 3 & 4 FSAR." You also stated that this "perceived" trend "does not represent the trend of the growth fault at depth." This information is in conflict with FSAR Figures 2.5S.1-42, 2.5S.1-43, and 2.5S.1-45 each of which shows fault GMP extending to the northwest through the cooling reservoir in the direction of proposed Units 3 and 4. If the surface projection of fault GMP (in the FSAR figures) does not represent the actual trend of the fault, then the figures are misrepresenting the data and are incorrect. In addition, FSAR Section 2.5S.1.2.4.3 states that fault GMP "trends north-northwest" beneath the cooling reservoir (as revised in the response to RAI 2.5.1-19) which is inconsistent with the RAI response which states that fault GMP actually trends to the west.

(a) Please resolve the inconsistencies between what is printed in FSAR Section 2.5S.1.2.4.3, what is shown in FSAR Figures 2.5S.1-42, 2.5S.1-43, and 2.5S.1-45, and the information provided in response to RAI 2.5.1-19.

(b) Please explain how the seismic reflection profiles used for the STP 1 & 2 UFSAR help "demonstrate that growth fault GMP does not present a hazard for the STP 3 & 4 site" if fault GMP was not even identified in the STP 1 & 2 UFSAR data.

RESPONSE:

Item (a):
The perceived inconsistency and misrepresentation of the trend of growth fault GMP noted in the response to RAI 02.05.01-19 is due to the level of detail within the FSAR describing the relationship between the subsurface trace of GMP as documented by the Geomap data (FSAR Reference 2.5S.1-124), and the surface projection of GMP presented within the FSAR (e.g., FSAR Figures 2.5S.1-42, 2.5S.1-43, and 2.5S.1-45). The response to RAI 02.05.01-19 explained that:

- The subsurface trace of GMP in the upper Geomap horizon, from east to west, initially trends to the northwest and then changes to a westward trend subparallel to fault GMO that extends to the west of the longitude of the STP 3 & 4 site;
- This subsurface trace of the fault in the upper horizon demonstrates that the fault does not trend beneath the STP 3 & 4 site;
- The subsurface trace of GMP in the lower Geomap horizon is significantly shorter and, is only identified along the portion of the fault that is trending to the northwest; and
- The northwest trend of the GMP surface projection is due to the fact that the shorter trace of GMP in the lower Geomap horizon controls the extent of projection. Because the trace in the lower horizon does not extend far enough to the west to include the

northwest-trending reach of the fault, there is insufficient data to estimate and display the change in trend in the surface projection shown in Figures 2.5S.1-42, 2.5S.1-43, and 2.5S.1-45.

Based on the information presented within the response to RAI 02.05.01-19 and summarized here, FSAR Figures 2.5S.1-42, 2.5S.1-43, and 2.5S.1-45 are correct in their depiction of the surface projection of GMP and do not misrepresent the Geomap data. However, this RAI question raises the issue that the depiction of the surface projection is potentially confusing because it does not illustrate the change in fault strike for GMP that is documented by the Geomap data. To clarify this issue, the second paragraph of FSAR Subsection 2.5S.1.2.4.3 will be modified to include a discussion of how the Geomap data demonstrates the change in the strike of GMP.

The second paragraph of FSAR Subsection 2.5S.1.2.4.3 will be deleted and replaced with the following two new paragraphs. This supersedes the proposed revision to this paragraph provided in the response to RAI 02.05.01-19:

~~Among the growth faults in the site area not recognized in the UFSAR for STP 1 & 2, fault GMP (Reference 2.5S.1-124), which trends north-northeast and is located beneath the southern part of the cooling reservoir, is the structure with the closest surface projection to STP 3 & 4 (approximately 1.4 mile) (Figure 2.5S.1-43 [References 2.5S.1-7, 2.5S.1-124, and 2.5S.1-151]). There was no observed surface expression of this growth fault to suggest that it has been active since the deposition of the late Pleistocene Beaumont formation.~~

Among the growth faults in the site area not recognized in the UFSAR for STP 1 & 2 but identified within the Geomap data, is fault GMP (Reference 2.5S.1-124), whose surface projection is shown as trending north-northwest at the southern part of the cooling reservoir and is the fault with the closest surface projection to STP 3 & 4 (approximately 1.4 miles) (Figure 2.5S.1-43 [References 2.5S.1-7, 2.5S.1-124, and 2.5S.1-151]). The surface projection of GMP shown in Figure 2.5S.1-43 suggests that the fault could extend north towards the STP 3 & 4 site. However, subsurface relations documented in the Geomap data demonstrate that the fault curves to the west and trends away from the STP 3 & 4 site. Within the Geomap structural contour maps, growth fault GMP is mapped as a short splay of the extensively mapped growth fault GMO that initiates at approximately the same longitude as the STP 3 & 4 site. Within the upper horizon of the Geomap data, GMP is mapped as a splay to the north of GMO that trends westward, subparallel to GMO, for a total distance of approximately 3 miles, ending west of the STP 3 & 4 site. Therefore, the mapping within the upper horizon clearly shows that the fault trends away from and does not approach the STP 3 & 4 site. Within the lower horizon of the Geomap data, however, GMP is only shown as an approximately 1 mile long splay, initiating at the same location and trending predominately northwest. The trace of the fault in the lower horizon does not extend far enough to the northwest to depict the change to a more westerly strike, as documented in the map of the upper horizon.

As described in Subsection 2.5S.1.2.4.2.2.1, the surface projection for any given fault is derived from the location of the fault within both Geomap horizons. Therefore, the extent of the GMP surface projection is limited to the mapped length of GMP as documented in the lower Geomap horizon. Because the mapped extent of GMP in the lower horizon is limited to the short reach trending to the northwest, and does not extend to where the trend bends westward subparallel to GMO, the surface projection of GMP shows only this northwest-trending reach. This short reach accurately reflects the surface projection of GMP over the reach, but it does not reflect the full behavior of GMP evident in the upper horizon data where the fault curves westward and follows the trend of GMO well beyond the longitude of the STP 3 & 4 site. The subsurface Geomap data support the conclusion that fault GMP trends west past the northwestern end of the surface projection shown in Figure 2.5S.1-43 and not towards the STP 3 & 4 site.

Item (b):
The quotation in Item (b) refers to the response to RAI 02.05.01-19 which includes the following statement:

> "These basic observations concerning GMP, combined with the conclusions of the STP 1 and 2 UFSAR that no growth faults project to the surface within the STP 3 & 4 site, demonstrate that growth fault GMP does not present a hazard for the STP 3 & 4 site."

This statement reiterates two observations that support the conclusion that growth fault GMP does not trend beneath the STP 3 & 4 site:

1. The subsurface trace of GMP in the upper Geomap horizon clearly indicates that the fault trends west past the end of the GMP surface projection, and beyond the longitude of the site; and
2. As part of the STP 1 & 2 UFSAR, seismic reflection surveys were analyzed explicitly to identify any shallow growth faults beneath the site, and no shallow faults (displacements at depths shallower than several thousand feet) (see discussion in FSAR Subsection 2.5S.1.2.4.2.1) were identified beneath the site indicating that there are no growth faults beneath the site with the potential to cause surface deformation. Specifically, the reflection data document continuous, unbroken reflectors beneath the site that provide positive evidence for the absence of faulting that offsets Pliocene to Miocene age deposits.

The second observation that supports this conclusion does not depend on the presence or absence of GMP in the Units 1 & 2 seismic reflection data. Instead, the statement highlights the fact that the Units 1 & 2 reflection data show positive evidence for the absence of *any* shallow growth faults beneath the site, and thus support the conclusion that there are no growth faults beneath the site with the potential to cause ground deformation. Also, from inspection of the reflection line geometries and the surface projection of GMP (FSAR Figure 2.5S.1-43), the absence of GMP in the STP Units 1 & 2 reflection data at the south end of the reservoir is likely due to the fact that the reflection lines do not actually cross fault GMP.

No COLA revision is required as a result of the RAI response to Item (b).

RAI 02.05.01-23:

QUESTION:

In order to fully evaluate the potential for deformation beneath the STP Units 3 and 4 site, please provide a commitment in the FSAR to (1) perform geologic mapping (based on the guidance provided in RG 1.208) of future excavations for safety-related structures, (2) evaluate any geologic features that are encountered, and (3) notify the NRC once any excavations for safety-related structures are open for inspection.

RESPONSE:

The STP 3 and 4 Environmental Report (COLA Part 3) currently describes plans for geologic mapping of excavations during construction. Specifically, Section 2.6.1.1, "Long-Term Geologic Impacts," states "The excavation for STP 3 & 4 will be geologically mapped to verify the absence of non-tectonic growth faults that might pose a hazard to the facility." Environmental Report Section 3.9S.3.11, "Power Block Earthwork (Excavation)," states "In accordance with Regulatory Guide 1.165 (Reference 3.9S-1), the open excavations will be geologically mapped and the NRC will be notified when the excavations are open for inspection." (Guidance relative to geologic mapping of excavations contained in Regulatory Guide 1.165 is the same as that contained in Regulatory Guide 1.208 referenced in this RAI.)

COLA Part 2, Tier 2, Section 2.5S.3, "Surface Faulting," will be revised in a future update as indicated below.

> 2.5S.3 Surface Faulting
>
> The following site-specific supplement addresses COL License Information Item 2.25. Subsection 2.5S.3 contains an evaluation of the potential for tectonic surface deformation and non-tectonic surface deformation at the STP 3 & 4 site. Information contained in Subsection 2.5S.3 was developed in accordance with both RG 1.165 and RG 1.208 and is intended to demonstrate compliance with 10 CFR 100.23, Geologic and Seismic Siting Criteria.
>
> This subsection contains information on:
>
> - Potential surface deformation associated with capable tectonic sources
> - Potential surface deformation associated with growth faults
> - Potential surface deformation associated with non-tectonic processes, such as collapse structures (karst collapse), subsurface salt migration (salt domes), volcanism, and man-induced deformation (e.g., mining collapse, subsidence due to fluid withdrawal)
>
> To summarize the conclusions of this subsection, there are no capable faults and negligible potential for non-tectonic fault rupture within the STP site vicinity. The STP site lies within a regional belt of potentially active growth faults along the Gulf coast. However, detailed studies of the site area show that there are no growth faults whose surface projections lie within the STP site, and thus there is negligible potential for

growth-fault-related surface deformation at the STP site, and no other potential for non-tectonic deformation in the site area. In accordance with RG 1.165 and RG 1.208, the exposed surfaces of open excavations for the safety-related structures of STP 3 & 4 will be geologically mapped in order to identify and evaluate any geologic features that might pose a hazard to the facility. The NRC will be notified when these excavations are open for inspection.

The following sections contain the data, observations, and references to support these conclusions.

RAI 02.05.02-29:

QUESTION:

In RAI 2.5.2-24, the staff asked the applicant about the low maximum magnitudes (Mmax) and probabilities of activity (Pa) for seismic sources located in the northwest corner of the site region. In response, FSAR Figure 2.S.2-8 was updated to show all of the EPRI seismic sources that fall within the 200-mile region surrounding the site and not just those that contributed to 99% of the total hazard. As such, the following were added to FSAR Figure 2.S.2-8 and to FSAR Tables 2.5S.2-7 through 2.5S.2-12: the Dames and Moore EST New Mexico source, the Roundout EST Background 50 source, and the Weston EST Combination Zone 109. The conclusion in the RAI response was that "the composite EST seismic sources, which cover the northwest portion of the site region, do adequately characterize the low contribution to seismic hazard from this area." The response to the RAI did not address the staff's specific concerns with regard to the low Mmax and Pa values for some of the sources in the northwest corner of the site region. Specifically, the Bechtel Group EST assigned a Pa of 0.1 and Mmax values ranging from mb 5.4 to 6.6 for its Texas Platform source and the Dames and Moore EST assigned a Pa of 0.35 and Mmax values of 5.5 [0.8] and 7.2 [0.2] for its Ouachitas Fold Belt. Further, the listed Pa of 0.1 for the Bechtel Group does not appear consistent with the value of 1.0 listed in the 1986 EPRI-SOG documentation.

Please justify the use of the assigned Mmax and Pa values of the source zones located in the northwest corner of the site region and whether the source models adequately characterize the hazard surrounding the site. This RAI describes the staff's concerns regarding SER Open Item 2.5.2-2.

RESPONSE:

The Pa and Mmax values in FSAR Tables 2.5S.2-7 through 2.5S.2-12, and in particular the values shown for the source zones within the northwest corner of the site region, were intended to be taken directly from the EPRI-SOG EQHAZARD Primer (Reference 1), as described in FSAR Subsections 2.5S.2.2.1 and 2.5S.2.4. However, as noted in the RAI question, the Pa value for Bechtel BZ2 was incorrectly transcribed to FSAR Table 2.5S.2-7 as 0.1 instead of the correct value of 1.0. This inconsistency is a typographical error in FSAR Table 2.5S.2-7, which will be corrected as shown in the markup provided with this response. The correct Pa value for BZ2 of 1.0 was used in the seismic hazard calculations for the STP 3 & 4 site.

The perception of a low Pa value for the Dames & Moore Ouachitas Fold Belt source (zone 25) expressed within the RAI question is likely due to the details of EPRI-SOG implementation of the Pa values and interdependencies of zones 25 and C08. In the EPRI-SOG model used for STP 3 & 4, these two zones are mutually exclusive (i.e., when zone 25 is "active" zone C08 is not, and vice versa). The Pa values for these zones reflect the weighting given by the Dames & Moore Earth Science Team (EST) of these respective scenarios. As presented in Table 2.5S.2-8, the Pa for zone 25 is 0.35. Table 2.5S.2-8 presents the Pa for zone C08 as "NA" because this is the value reported within the EQHAZARD Primer (Reference 1). However, the actual Pa value from the EPRI-SOG model for zone C08 is 0.65, and this value was used for the PSHA at the STP 3 & 4 site. Because the sum of the Pa values for zones 25 and C08 equals 1.0, the area covered by zones 25 and C08 within the site region always contributes to hazard at the STP 3 & 4 site. Therefore, the Pa values for the Dames & Moore source zones in the northwest corner of the site are not low.

The justification for using the Pa and Mmax values as reported within the EPRI-SOG EQHAZARD Primer (Reference 1) derives from the NRC regulatory guidance presented within Regulatory Guide (RG) 1.208 (Reference 2). This guidance states that:

> "...PSHA [should be] conducted with up-to-date interpretations of earthquake sources, earthquake recurrence, and strong ground motion estimation" (Reference 2, page 3).

The issued guidance also states that:

> "... seismic sources and data accepted by the NRC in past licensing decisions may be used as a starting point [for the PSHA]" (Reference 2, page 14).

Further, acceptable starting-point source zone characterizations identified within RG 1.208 (Reference 2, page A-1) include the EPRI-SOG study (References 1, 3 and 4). As part of the acceptance of these studies, RG 1.208 states that site-specific geological, geophysical, and seismological studies should be conducted to determine if these accepted source models adequately describe the seismic hazard for the site of interest given any new data developed since acceptance of the original models. The regulatory guidance explicitly states that:

> "The results of these investigations will also be used to assess whether new data and their interpretation are consistent with the information used in recent probabilistic seismic hazard studies accepted by NRC staff. If new data, such as new seismic sources and new ground motion attenuation relationships, are consistent with the existing earth science database, updating or modification of the information used in the site specific hazard analysis is not required. It will be necessary to update seismic sources and ground motion attenuation relationships for sites where there is significant new information provided by the site investigation" (Reference 2, page C-1).

For the case of new information requiring updated source characterizations, RG 1.208 recommends that the development of updated source characterizations conform to the guidance presented in NUREG/CR-6372 (Reference 5). NUREG/CR-6372, prepared by a Senior Seismic Hazard Analysis Committee (SSHAC), provides recommendations on the development of PSHA studies for nuclear facilities. A primary recommendation of the SSHAC is that for a given technical issue (i.e., source zone characterization):

> "The following should be sought ... (1) a representation of the legitimate range of technically supportable interpretations among the entire informed technical community..." (Reference 5, page xv).

The SSHAC outlines four levels of study for developing the range of interpretations with the choice of level depending on the complexity of the issue to be addressed. The four levels, Levels 1 through 4, are distinguished by the increasing levels of sophistication, resources, and participation by technical experts.

As discussed in FSAR Subsection 2.5S.2, the EPRI-SOG source characterizations are used as the base source models for determining the GMRS at the STP 3 & 4 site (Reference 3). The EPRI-SOG model is chosen because RG 1.208 explicitly identifies the EPRI-SOG source characterizations as an acceptable base model and because of the availability of detailed documentation describing the EPRI-SOG model (References 1, 3 and 4). However, another supporting reason for using the EPRI-SOG model is that the EPRI-SOG methodology and resultant source characterizations are largely consistent with a high level SSHAC study (Level 3 to 4), and the final aggregate source characterizations were developed to:

> "... reflect the range of current thinking on the causes of earthquakes in the eastern United States" (Reference 3, report summary page 1).

As required by RG 1.208, site and regional data collected for the STP 3 & 4 site were presented and discussed in FSAR Sections 2.5S.1, 2.5S.2.1 and 2.5S.4. This data was reviewed to:

> "...determine whether there are any new data or interpretations that are not adequately incorporated into the existing PSHA databases" (Reference 2, page 11).

As stated within the regulatory guidance, if significant new data or interpretations are found, they require updating of the EPRI-SOG source characterizations. Particular attention was paid to this review of new data collected for the STP 3 & 4 site because of the time elapsed since development of the EPRI-SOG source characterizations. From this review, it was determined that no new data exist that require alteration of the EPRI-SOG Pa or Mmax values for sources within the northwest corner of the site area, including the Dames & Moore Ouachitas Fold Belt zone and associated dependent zone (zones 25 and C08) and the Bechtel Texas Platform (zone BZ2).

References:

1. EPRI, 1989a, EQHAZARD Primer (NP-6452-D), EPRI, prepared by Risk Engineering for Seismicity Owners Group and EPRI.
2. Regulatory Guide 1.208: A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion, 2007, US NRC, p. 53.
3. EPRI, 1986-1989, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 1-3 & 5-10, EPRI.
4. EPRI, 1989b, Probabilistic seismic hazard evaluations at nuclear plant sites in the central and eastern United States: resolution of the Charleston earthquake issue (NP-6395-D), EPRI.
5. Budnitz, R.J., Apostolakis, G., Boore, D.M., Cluff, L.S., Coppersmith, K.J., Cornell, C.A., and Morris, P.A., 1997, Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts: Washington, D.C., US Nuclear Regulatory Commission, NUREG/CR-6372, p. 278.

Table 2.5S.2-7 will be revised as shown below:

Table 2.5S.2-7 Summary of Bechtel Group Seismic Source Zones

Source	Description	Distance [1]		Pa [2]	M_{max} (m_b) and Wts. [3]	Smoothing Options and Wts. [4]	Contributes to 99% of Hazard [5]	New Information to Suggest Change in Source		
		(~~f~~km)	(mi)					Geometry [6]	M_{max} [7]	RI [8]
BZ1	Gulf Coast	0	0	1.0	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	1 [0.33] 2 [0.34] 3 [0.33]	Yes	No	Yes	No
BZ2	Texas Platform	82	51	~~0.1~~ 1.0	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	1 [0.33] 2 [0.34] 4 [0.33]	Yes	No	No	No

[1] Shortest distance between STP 3 & 4 and source zone

[2] Probability of activity

[3] Maximum earthquake magnitude (M_{max}) in body-wave magnitude (m_b) and weighting (Wts.)

[4] Smoothing options
1 = constant a, constant b, no b prior
2 = low smoothing on a, high smoothing on b, no b prior
3 = low smoothing on a, low smoothing on b, no b prior
4 = low smoothing on a, low smoothing on b, weak b prior of 1.05
Weights on magnitude intervals are [1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0]

[5] Whether or not the source contributes to 99% of the hazard at STP 3 & 4

[6] No, unless new geometry proposed in literature

[7] No, unless M_{max} exceeded in literature

[8] RI = recurrence interval; assumed no change if no new paleoseismic data or rate of seismicity has not significantly changed

RAI 02.05.02-30:

QUESTION:

In RAI 2.5.2-25, the staff asked the applicant to clarify conflicting statements that describe the depth where the S-wave velocity reaches 2.8 km/s (9200 fps). The response to RAI 2.5.2-25 indicated that the FSAR correctly states that an S-wave velocity of 2.8 km/s (9200 fps) exists at a depth of more than 9144 m (30,000 ft) below the ground surface. The RAI response also stated that for the purpose of the site response calculations the soil column profile is truncated at a depth of 2469 m (8100 ft) and below this depth bedrock is assumed with an S-wave velocity of 2.8 km/s (9200 fps). This soil column truncation depth was selected in order to capture the seismic response for frequencies greater than or equal to 0.1 Hz. It was indicated that FSAR Figure 2.5S.4-57 will be replaced with a new figure showing the S-wave velocity profiles derived from deep sonic log data obtained from existing oil wells in the STP site vicinity. The new figure was provided in the RAI response as Figure 2.5S.4-57. The new figure shows that at 2500 ft (762 m) depth, the average S-wave velocity is approximately 3000 fps (0.9 km/s). In reviewing the relevant contents in FSAR Section 2.5S.4.7.2.2.1, FSAR Figure 2.5S.4-57, and the corresponding FSAR Table 2.5S.4-28, the staff found they still indicate an S-wave velocity of 2.8 km/s (9200 fps) at the depth of 2500 ft.

Due to the inconsistency between the descriptions of the depth to S-wave velocity of 2.8 km/s (9200 fps) in FSAR Section 2.5S.2 and FSAR Section 2.5.4, a key section in providing critical soil response calculation input data, the staff requests more clarification and consistency between these FSAR sections. This RAI describes the staff's concerns regarding SER Open Item 2.5.2-3.

RESPONSE:

To address the inconsistencies identified between the descriptions of the depth to S-wave velocity of 2.8 km/s (9200fps) in FSAR Sections 2.5S.2 and 2.5S.4, Subsection 2.5S.4.7.2.2.1 will be revised to be consistent with the deep soil profile descriptions contained in FSAR Subsection 2.5S.2 and the response to RAI 02.05.02-25 submitted in STPNOC Letter U7-C-STP-NRC-090146, dated September 21, 2009. As discussed in the response to RAI 02.05.02-25, shear wave velocities below 600 feet depth had previously been based on the more generic "Mississippi embayment lowland profile" down to 2500 ft depth, and below the 2500 ft depth, a hard rock shear wave velocity of 9285 feet/second had been assumed. However, this profile has been superseded by the shear wave velocity profile obtained from converting sonic logs from three existing oil wells, as described in FSAR Subsection 2.5S.4.7.2.2.2. Therefore, all references to the "Mississippi embayment lowland profile," in FSAR Subsection 2.5S.4 will be deleted. In addition, FSAR Table 2.5S.4-28, which tabulates shear wave velocity values from the "Mississippi embayment lowland profile," will be removed from the STP COLA.

The FSAR changes identified above will provide consistency between the COLA text and the revised FSAR Figure 2.5S.4-57 provided in the response to RAI 02.05.02-25, which plots the average of the three shear wave velocity profiles (and the average +/- 1 standard deviation) versus depth.

The last paragraph of Subsection 2.5S.4.7.2.2.1 and Subsection 2.5S.4.7.2.2.2 will be revised as follows:

~~Reference 2.5S.4-4 also contains deep shear wave velocity profiles developed for a later stage review of the STP site, among others. These profiles increase in shear wave velocity to a depth of approximately 2500 feet below ground surface and then maintain a common value of V_s between 2500 feet and 5000 feet depths. According to the Reference 2.5S.4-4, these profiles were based on site-specific cross-hole measurements in the uppermost approximately 250 feet and were then attached to the deeper and more generic "Mississippi embayment lowlands profile," which is described in more detail in the reference. The resulting composite V_s profiles are reproduced and shown on Figure 2.5S.4-57. Note that the details of this figure are truncated at El. -3250 feet, corresponding to a depth of approximately 3280 feet below ground surface, or 1 kilometer. Three shear wave velocity profile cases, M1P1, M1P2, and M1P3, are provided on the figure. The three profiles in Figure 2.5S.4-57 all show an increase in shear wave velocity to 9285 feet/second at a depth of approximately 2500 feet. Numerical values from the three shear wave velocity profiles versus depth, between 600 feet and 3280 feet below ground surface, or 1 kilometer, are summarized in Table 2.5S.4-28.~~ Soil unit weight information is limited ~~deeper~~ at depths greater than 600 feet, with available information from the STP 1 & 2 UFSAR (Reference 2.5S.4-3) ~~given~~provided in Table 2.5S.4-29. Note that for completeness, Table 2.5S.4-29 also provides the selected values of unit weight for the upper 600 feet of soils from the STP 3 & 4 subsurface investigation.

2.5S.4.7.2.2.2 Bedrock Shear Wave Velocity Profile

To assess the V_s profile at substantially greater depth, STP conducted a search ~~was made~~ of geophysical logging results (especially sonic ~~logging~~logs) ~~made for~~from existing oil wells in the STP site vicinity. Three such wells were selected (LL3341, LL4537, and LL4987) from the available information, having the deepest sonic logging results (to a maximum of approximately 19,900 feet below ground surface). ~~Conversion of the sonic logging data to shear wave velocities showed generally good agreement with the shear wave profiles presented on Figure 2.5S.4-57 down to depths of approximately 2,500 feet.~~

The average shear wave velocity obtained from converting the data in the three sonic logs was used for the deep layers as input to the site response analysis. These average shear wave velocities (and average +/- 1 standard deviation) are plotted versus depth in Figure 2.5S.4-57. Based on the conversion, in general, the shear wave velocity profile is as follows:

- At a depth of 2,500 feet the sonic logging data showed the shear wave velocity to be in the range of 2,900 to 3,200 feet/second~~, consistent with the results on Figure 2.5S.4-57~~. This range continues to a depth of 3,000 feet;
- Increases from 3,000 feet/second at a depth of 3,000 feet to 5,000 feet/second at 6,000 feet depth;
- Decreases to around 3,500 feet/second at an 8,000 feet depth;
- Increases linearly to 5,500 feet/second at an 18,000 feet depth; and

- Increases to about 6,500 feet/second just beyond 18,000 feet depth, then falls back to 5,000 feet/second at a 19,000 feet depth.

Table 2.5S.4-28 is no longer needed, and therefore will be removed in a future COLA revision.

Table 2.5S.4-28 Not Used~~Summary of Shear Wave Velocities Deeper than 600 Feet Below Ground Surface [1]~~

Profile	Top Depth (Feet)	Bottom Depth (Feet)	Top El. (Feet)	Bottom El. (Feet)	Mid-Point Depth [2] (Feet)	V_s (Ft/ sec)
M1P1	609	680	-575	-646	644.5	2,050
	680	780	-646	-746	730.0	2,150
	780	880	-746	-846	830.0	2,250
	880	1,300	-846	-1,266	1,090.0	2,350
	1,300	1,930	-1,266	-1,896	1,615.0	2,550
	1,930	2,500	-1,896	-2,466	2,215.0	2,850
	2,500	3,280	-2,466	-3,246	2,890.0	9,285
M1P2	609	1,000	-575	-966	804.5	1,585
	1,000	1,300	-966	-1,266	1,150.0	2,350
	1,300	1,930	-1,266	-1,896	1,615.0	2,550
	1,930	2,500	-1,896	-2,466	2,215.0	2,850
	2,500	3,280	-2,466	-3,246	2,890.0	9,285
M1P3	609	700	-575	-666	654.5	2,650
	700	780	-666	-746	740.0	2,825
	780	850	-746	-816	815.0	2,900
	850	1,000	-816	-966	925.0	3,000
	1,000	1,060	-966	-1,026	1,030.0	3,100
	1,060	1,160	-1,026	-1,126	1,110.0	3,200
	1,160	1,250	-1,126	-1,216	1,205.0	3,325
	1,250	1,700	-1,216	-1,666	1,475.0	3,575
	1,700	2,500	-1,666	-2,466	2,100.0	4,125
	2,500	3,280	-2,466	-3,246	2,890.0	9,285

[1] Shear wave velocities and depth ranges scaled from Figure B-12, "Shear Wave Velocity Profile for the South Texas Site," Reference 2.5S.4-4.

[2] Mid-point depth measured below El. 34 feet

RAI 02.05.02-31:

QUESTION:

The staff performed confirmatory site response calculations to determine the adequacy of the applicant's site response calculations. The staff used the static and dynamic soil properties provided in FSAR Section 2.5.S4 as input to its calculations. The staff used both low- and high-frequency 10^{-4} and 10^{-5} rock spectra provided in FSAR Tables 2.5S.2-18 and 2.5S.2-19 to represent the input motions and ran 30 of the 60 randomized soil columns. The staff also used the strong motion duration values provided in FSAR Table 2.5S.2-20, as well as applicant's selected effective strain ratio of 0.65. To be consistent with the applicant's methodology, the staff performed its site response calculations using RVT (Kottke, A.R. and Rathje, E.M., 2008). The staff's resulting amplification factors are compared with the applicant's corresponding results in SER Figure 2.5.2-12, which is also attached to this RAI. In the frequency range that is significant to a reactor's structures, systems, and components, there are significant differences between the staff's and the applicant's calculated amplification factors for the 10^{-4} (high-frequency) and 10^{-5} (both low- and high-frequency) hazard levels. For example, at 10 Hz, the staff's low-frequency 10^{-5} amplification is a factor of 1.5 higher than the applicant's. At 0.6 Hz, the staff's low-frequency 10^{-5} amplification is a factor of 1.25 higher than the applicant's. As described in FSAR Section 2.5S.2.6, the applicant used the amplification factors to calculate the 10^{-4} and 10^{-5} soil surface UHRS, which were then used to determine the STP Units 3 and 4 site GMRS.

Because these soil amplification factors have a significant impact on the calculation of the GMRS, the staff requests the applicant address the underestimation of the STP Units 3 and 4 site soil amplification factors. This RAI describes the staff's concerns regarding SER Open Item 2.5.2-4.

RESPONSE:

As described in RAI 02.05.02-31, the NRC staff confirmatory site response calculations using the Strata computer program (see Reference) identified differences with STP's calculated soil amplification factors. To determine the reasons for these differences, a copy of the Strata computer program was obtained and test runs were performed, using Revision 294 of the Strata software. The subsequent evaluation identified technical issues which were referred to the Strata program developers. After evaluation, the program developers acknowledged these issues and issued an updated version of Strata, Revision 312, to address these issues.

Based on the review of the updated Strata software, it is anticipated that further NRC confirmatory evaluations, using the updated software, should provide comparable results with STP's site response calculations.

Reference: Pacific Earthquake Engineering and Research Center, PEER 2008/10, Technical Manual for Strata, Kottke, A.R. and Rathje, E.M., University of Texas, Austin, dated February 2009.

Commitments

Commitment Number	Commitment Summary	Milestone or Date	Commitment Type
10-3861	Geologically map the exposed surfaces of open excavations for each safety-related structure of STP 3 & 4 in accordance with RG 1.165 and RG 1.208. Identify and evaluate any geologic features that might pose a hazard to the facility. (Reference FSAR Section 2.5S.3, Surface Faulting, and the response to RAI 02.05.01-23.)	14 days prior to the start of excavations for any STP 3 & 4 safety-related structure.	New
10-3862	Notify the NRC and provide a schedule for the excavation for each STP 3 & 4 safety-related structure at least two weeks prior to the start of excavations. (Reference FSAR Section 2.5S.3, Surface Faulting, and the response to RAI 02.05.01-23.)	14 days prior to the start of excavations for any STP 3 & 4 safety-related structure.	New

RAI Question	Reason for Extension	Extended Response Date
02.05.02-28	Additional time is needed to allow coordination and design review of RAI response and associated FSAR revision with STP contractors that prepared the analyses for the maximum magnitudes for the EPRI SOG seismic source parameters for the Gulf Coastal Source zones.	March 18, 2009