## PMSTPCOL PEmails

**From:** Ballinger, Amy [aballinger@STPEGS.COM]
**Sent:** Friday, September 05, 2008 10:49 AM
**To:** Adrian Muniz; Belkys Sosa; George Wunder; Loren Plisco; Raj Anand; Rocky Foster; Tekia Govan; Tom Tai
**Subject:** RAI Letters
**Attachments:** ABR-AE-08000070.pdf; ABR-AE-08000069 RAI extension.pdf

Attached, please find a courtesy electronic copy of the letters sent to the NRC today entitled:

- Response to Requests for Additional Information
- RAI Response Extensions Related to COLA Part 2 Tier 2.4S and 2 5S

The official paper copy was sent overnight according to the letter addressee list.

If you have any questions, please contact Coley Chappell at (361) 972-4745 or Bill Mookhoek at (361) 972-7274.

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**Hearing Identifier:** SouthTexas34Public_EX
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**From:** Ballinger, Amy

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September 4, 2008
ABR-AE-08000070

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Rockville MD 20852-2738

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

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter numbers 34, 49, 50, 51, 57, and 58 related to COLA Part 2 Tier 2 Sections 2.4S, 2.5S, and 13.3. This submittal includes responses to the following RAI questions:

| | | | | |
|---|---|---|---|---|
| 02.04.05-5 | 02.05.01-4 | 02.05.02-5 | 02.05.03-2 | 13.03-53 |
| 02.04.05-6 | 02.05.01-10 | 02.05.02-10 | 02.05.03-3 | 13.03-62 |
| | | 02.05.02-13 | | 13.03-70 |
| | | 02.05.02-14 | | |
| | | 02.05.02-15 | | |

When an RAI question response indicates a change to the STP 3&4 COLA, the change will be incorporated into the next routine revision of the COLA following NRC acceptance of the question response.

There are no commitments in this letter.

If you have any questions regarding the attached responses, please contact me at (361) 972-4626, or Bill Mookhoek at (361) 972-7274.

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

Executed on September 8, 2008

Greg Gibson
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

sab

Attachments:

1. Question 02.04.05-5
2. Question 02.04.05-6
3. Question 02.05.01-4
4. Question 02.05.01-10
5. Question 02.05.02-5
6. Question 02.05.02-10
7. Question 02.05.02-13
8. Question 02.05.02-14
9. Question 02.05.02-15
10. Question 02.05.03-2
11. Question 02.05.03-3
12. Question 13.03-53
13. Question 13.03-62
14. Question 13.03-70

cc: w/o attachment except*
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**RAI 02.04.05-5:**

**<u>QUESTION</u>**:

Explain why the PMH determined from NOAA NWS 23 was not used as input to run the SLOSH model to estimate water surface elevations for the PMSS.

**<u>RESPONSE</u>:**

The PMH determined from NOAA NWS 23 was not directly used as input to run the SLOSH model because the SLOSH code was not available publicly or commercially at the time of the preparation of Rev. 0 of the STP 3 & 4 COLA.

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

**RAI 02.04.05-6:**

**QUESTION**:

The NOAA NWS 23 report did not use hurricane data from approximately the last 30 years. Explain the efforts to adjust the estimated PMH parameters in light of more recent hurricanes that have occurred since the NOAA NWS 23 report was published.

**RESPONSE:**

Research on the effect of long-term climate variability on hurricane intensity indicates that, based on recent hurricane data, the Atlantic hurricane seasons have been significantly more active since 1995. However, Reference 1 states that "Earlier periods, such as from 1945 to 1970 (and perhaps earlier), were apparently as active as the most recent decade." Since NOAA Technical Report NWS 23 includes the last active hurricane period from 1945 to 1970 (and any such earlier periods from 1851) in the analysis, it is reasonable to assume that the PMH parameters thus derived from NWS 23 are sufficiently conservative even in the considerations of future climate variability.

In addition, recent PMH modeling by the Army Corps of Engineers (USACE) suggests recent storms may be less conservative than storms used for developing the PMH criteria described in NWS 23. For example, USACE used NWS 23 for developing PMH estimates for the entire Louisiana Coast (Reference 2).

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

**References**:

1. National Oceanic and Atmospheric Administration, *FAQ / State of the Science: Atlantic Hurricane & Climate*, U.S. Department of Commerce, (Nonproprietary), December 2006.

2. Louisiana Coastal Protection and Restoration Project, 2006, Enclosure F, U.S. Army Corps of Engineers, New Orleans, LA. Available at http://lacpr.usace.army.mil/default.aspx?p=report, accessed July 31, 2008.

**RAI 02.05.01-4:**

**QUESTION:**

Section 2.5S.1.1.4.4.5.1 describes that normal faults of the Mt. Enterprise-Elkhart Graben System (MEEG) displace gravel of late Quaternary age, but also says that seismic reflection data indicate that the faults are rooted in Jurassic salt and that movement of salt at depth probably drives slip on the faults. Please provide a more detailed summary of the data (including deposits, landform morphology, and updated ideas on age [see Collins et. al. 1980; Reference 2.5S.1-121]) for late Quaternary faulting on the MEEG. Provide a more detailed discussion of whether or not salt movement at depth could produce modern slip of 4mm/yr on overlying normal faults, and whether stratigraphic relations of the displaced gravel favor sudden surface displacement of tens of centimeters or gradual creep. Please cite examples of other places in the Gulf Coast region, or other similar regions, where salt movement has caused similar rates of surface deformation.

**RESPONSE:**

There are three issues identified within this RAI question, which can be summarized as:

1. Provide a more detailed summary of the data (including deposits, landform morphology, and updated ideas on age) for late Quaternary faulting on the MEEG.

2. Provide a more detailed discussion of whether stratigraphic relations of the displaced gravel favor sudden surface displacement of tens of centimeters or gradual creep.

3. Provide a more detailed discussion of whether or not salt movement at depth could produce modern slip of 4mm/yr on overlying normal faults. Please cite examples of other places in the Gulf Coast region, or other similar regions, where salt movement has caused similar rates of surface deformation.

Each of these issues will be addressed individually.

Issue 1

Collins et al. (Reference 1) has proposed Quaternary slip on faults within the MEEG. In particular, Collins et al (Reference 1) cites three observations (folded Quaternary gravel in outcrop, presumed folded Quaternary gravel in an auger profile, and leveling data) as the basis for their conclusion of Quaternary activity. Each of these observations is outlined below.

Collins et al. (Reference 1) noted the existence of a folded Quaternary gravel unit above faulted Eocene strata in a cut-bank deposit along the Trinity River. Collins et al. (Reference 1) provide an interpreted outcrop map that shows sand and shale units of the Eocene Claiborne group unconformably overlain by a thin (10-40 cm thick) Quaternary sand and gravel deposit, which in turn is overlain by a several-foot-thick sand unit. Collins et al. (Reference 1) identify three discrete normal faults (two consistent with down-to-the-south slip, and one with down-to-the-north slip) within the Eocene strata, and Collins et al. (Reference 1) measured a maximum offset of 118 cm along these faults. These distinct faults continue upsection but cannot be traced into the overlying Quaternary gravel. Instead, Collins et al. (Reference 1) notes that above the faults there is relatively broad (wavelengths on the order of several feet) folding of the thin Quaternary sand and gravel and that the faults in the Eocene units become “closely spaced, multiple shear surfaces” within this deposit. Collins et al. (Reference 1) describe these folds as having cumulative offsets of 22 cm, 53 cm and 66 cm. Collins et al. (Reference 1) estimate that the sand and gravel deposit is an approximately 37,000 year old terrace based on correlating the unit to terraces elsewhere within the Trinity River basin. Collins et al. (Reference 1) do not describe any faulting or folding within the overlying sand unit.

Collins et al. (Reference 1) also excavated a backhoe trench and measured an auger profile approximately 115 m to the east of the cut-bank exposure. No details are given as to the results of the trench excavation, but Collins et al. (Reference 1) report that 6 auger holes intersect the Quaternary sand and gravel identified in the outcrop. Collins et al. (Reference 1) cite a 46 to 60 cm apparent offset in the top of the gravel between two auger holes 9 feet apart as evidence that the Quaternary faulting in the outcrop extends further east.

The final observation that Collins et al. (Reference 1) use to support the conclusion of Quaternary faulting in the MEEG is an anomalous elevation change observed across the MEEG in a National Geodetic Survey leveling line originally surveyed in 1920 and then remeasured between 1947 and 1952. This leveling survey is approximately 40 miles to the northeast of the Trinity River outcrop described above. The releveling survey shows a down-to-the-south change in land surface elevation of 13.0 cm between two stations located approximately 5 miles apart. No information is given as to the accuracy of, or uncertainty in, the leveling survey, and the actual survey data were not published. Collins et al. (Reference 1) further report that no geologic or geomorphic field evidence of this change in elevation was observed along the leveling line.

No COLA revision is required as a result of Issue 1 of this RAI response.

<u>Issue 2</u>

Collins et al. (Reference 1) report cumulative offsets in the 10 to 40 cm thick Quaternary gravel of 22 cm, 53 cm, and 66 cm above the three faults in the cutbank exposure described above. Because the offsets of the base of the Quaternary sand and gravel unit are greater than the thickness of the unit, a prominent scarp would have formed in the upper surface of this unit if the offset occurred as seismogenic slip. Scarps in poorly consolidated materials such as the Quaternary sand and gravel predictably would have eroded relatively rapidly. Specifically, loose material on the upthrown side of the scarp would have been removed and deposited on the downthrown side of the scarp, thus forming a colluvial wedge. Collins et al. (Reference 1) do not describe a colluvial wedge, and there are no colluvial wedges documented within the log of the outcrop presented in Collins et al. (Reference 1). Therefore, it is unlikely that the interpreted offset in the Quaternary gravel formed rapidly in response to seismogenic slip.

No COLA revision is required as a result of Issue 2 of this RAI response.

Issue 3

Quaternary separation rates across the MEEG can be estimated from the offset observed in the Quaternary sand and gravel in the cut-bank exposure, the inferred offset observed in the auger profile, and the change in elevation observed in the leveling line. The highest separation rate comes from the releveling profile, which indicates a separation rate of ~4 mm/yr. As mentioned above, Collins et al. (Reference 1) does not discuss the uncertainty or accuracy of the leveling surveys. Therefore, it is difficult to judge the robustness of the 4 mm/yr separation rate estimate. However, both fault slip and surface displacement rates of 4 mm/yr are not uncommon in geologic settings where deformation is related to salt movement. For example, Angell et al. (Reference 2) studied extensional faults which form part of the Sigsbee Escarpment and disrupt the seafloor in the Gulf of Mexico. These faults formed above an allochthonous mass of the Louann salt and have slip rates between 2 and 10 mm/yr (Reference 2). In Louisiana, faulting rooted in low-strength salt has caused surface subsidence of 5 mm/yr (Reference 3). Also in Louisiana, surface subsidence rates of 5-9 mm/yr have been attributed to the reactivation of faults by salt movement at depth (Reference 4).

No COLA revision is required as a result of Issue 3 of this RAI response.

**References:**

1. Collins, E. W., Hobday, D.K., Kreitler, C. W., 1980, Quaternary faulting in east Texas: Bureau of Economic Geology Circular 80-1.

2. Angell, M. M., Hanson, K., Swan, F. H., Youngs, R., Abramson, H., 2003, Probabilistic fault displacement hazard assessment for flowlines and export pipelines, Mad Dog and Atlantis field developments, deepwater Gulf of Mexico: Offshore Technology Conference Paper #15402.

3. Dokka, R. K., Sella, G. F., Dixon, T. H., 2006, Tectonic control of subsidence and southeward displacement of southeast Louisiana with respect to stable North America: Geophysical Research Letters, v. 33, doi: 10.1029/2006GL027250.

4. Morton, R. A., Buster, N. A., Krohn, M. D., 2002, Subsurface controls on historical subsidence rates and associated wetland loss in southcentral Louisiana: Transactions Gulf Coast Association of Geological Societies, v. 52, p. 767-778.

**RAI 02.05.01-10:**

**QUESTION:**

Please discuss whether or not the methods used to measure possible cumulative displacement across the projection of fault I in Section 2.5S.1.2.4.2.2.2 are capable of measuring displacements of a few tens of centimeters over hundreds of years. In addition to broad monoclinal folding, assess the potential for growth fault I to splay upward near the surface into many normal faults of small displacement over a zone tens to hundreds of meters wide. Given the late Holocene surface processes at the site, please discuss whether it is possible to preserve scarps with heights of, for example, 0.5 m, at the surface as a distinct topographic break for hundreds to thousands of years. Please explain why you inferred that the surface projection of fault I/GMO bends to the southeast around the reservoir.

**RESPONSE:**

There are four issues identified within this RAI question, which can be summarized as:

1. Please discuss whether or not the methods used to measure possible cumulative displacement across the projection of fault I in Section 2.5S.1.2.4.2.2.2 are capable of measuring displacements of a few tens of centimeters over hundreds of years.
2. In addition to broad monoclinal folding, assess the potential for growth fault I to splay upward near the surface into many normal faults of small displacement over a zone tens to hundreds of meters wide.
3. Given the late Holocene surface processes at the site, please discuss whether it is possible to preserve scarps with heights of, for example, 0.5 m, at the surface as a distinct topographic break for hundreds to thousands of years.
4. Please explain why you inferred that the surface projection of fault I/GMO bends to the southeast around the reservoir.

Each of these issues will be addressed individually.

<u>Issue 1</u>

To address this issue, the following discussion will:

1) Characterize the nature of observed surface deformation associated with fault displacement at depth;
2) Summarize the standard precision and error of the surveying technique employed; and
3) Discuss conditions under which displacements of a few tens of centimeters on growth fault I may result in surface deformation that can be detected and measured using the employed surveying technique.

As discussed in Subsection 2.5S.1.2.4.2.2.2, surface deformation related to movement on growth fault I at depth is characterized by monoclinal folding. The monocline is defined by a discrete, local increase in the gradient of the surface of the Beaumont Formation, extending across a width of up to several hundreds of feet normal to the strike of the fault. In profile, the increase in surface gradient is a local down-to-the-south tilting of the land surface (see Figure 2.5S.1-46) that represents the limb of the monoclinal fold. The steepened fold limb is bounded on the north and south by the Beaumont Formation surface that retains its initial, undeformed lower gradient. In structural geology, the vertical separation of the undeformed Beaumont Formation surface north of the fold limb relative to its undeformed continuation south of the fold limb is formally referred to as "structural relief" rather than "displacement". If additional growth of the monocline due to slip on growth fault I at depth were to occur, it will predictably result in further steepening of the fold limb and an increase in the structural relief on the surface of the Beaumont Formation across the fold. In the specific example posed in the RAI question, displacement of several tens of centimeters on growth fault I at depth would result in a comparable increase in structural relief across the folded surface of the Beaumont Formation, accompanied by a very small increase in the dip of the fold limb.

The topographic profiles presented in Subsection 2.5S.1.2.4.2.2.2 were measured with standard field surveying techniques and equipment. Specifically, a Topcon GTS-303 electronic total station was used to measure the distance between the base station and mobile receptor prism mounted on a fixed height rod. Triangulation routines within the Topcon instrument converted each distance measurement into a profile distance and elevation value. Comparison of survey back-sights prior to and after each survey line suggests that the horizontal and vertical error of the topographic profiles is on the order of one inch and less than two inches.

Given the precision of the surveying technique, it is possible to measure an increase in structural relief of several tens of centimeters across the monocline of growth fault I. In a hypothetical example where the exact same topographic profile lines shown in Figure 2.5S.1-46 are measured before and after several tens of centimeters of additional displacement has occurred on growth fault I at depth, this increased structural relief would be apparent in an overlay of the "before" and "after" profiles because the surface of the Beaumont Formation south of the fold in the "after" profile will have subsided several tens of centimeters relative to its elevation in the "before" profile.

If the above scenario of monoclinal folding did occur over hundreds of years, the ability to identify the folding would also require that the features persist until the time of observation. As discussed in the response to Issue 3 below, there has been very little erosional or depositional modification of the land surface in the site area within the last 10,000 years. It is therefore unlikely that surface process would completely mask or degrade the increases in structural relief of the hypothetical monoclinal folding scenarios presented above.

No COLA revision is required as a result of Issue 1 of this RAI response.

<u>Issue 2</u>

Subsurface observations constraining deformation associated with fault I come from the seismic reflection data presented within a report prepared by Harding Lawson Associates (Reference 1) that is summarized within the STP Units 1 and 2 UFSAR (Reference 2). This report concludes that fault I is observed within seismic profile 2M up to a depth of approximately 900 feet and at this depth a seismic reflector is offset approximately 40 feet by the fault (see Subsection 2.5.1.2.5.3 of the UFSAR). Based on this observation, fault I is a distinct, singular slip plane below 900 feet, and if fault I splays into a zone of many normal faults, the splaying occurs above this depth.

The folding of overlying strata (e.g., the 900 feet of sediments overlying the tip of fault I) from slip on a non-emergent fault is generally referred to as “fault-propagation folding” (Reference 3). In some natural examples of fault-propagation folds, the folding is observed to occur within triangular zones, called “trishear zones," updip of the fault tip (Reference 4). The mechanism accommodating deformation within the triangular zone (e.g., folding, ductile flow, shearing on discrete fault planes) depends on the rheology of the strata and cannot be discerned solely from the surface expression of the deformation.

For fault I, it is possible that what appears as folding at the surface is caused by small amounts of slip occurring along many small discrete surfaces propagating off of the tip of fault I and into a triangular zone of deformation. The spacing of these potential small-scale slip surfaces could range over many length scales (e.g., centimeters to tens of meters). For the case of widely spaced slip surfaces, they could be individually described as faults. For the case of closely spaced surfaces it is likely more appropriate to describe the surfaces as part of a zone of distributed deformation (i.e., folding) and not faults. If smaller faults splay off of fault I, they do not intersect the surface with significant displacements because there are no discrete offsets observed at the surface related to growth faults (see Subsection 2.5S.1.2.4.2.2.2).

The width over which such faulting, folding, or distributed deformation occurs depends on the rheology of the overlying strata, the depth of the fault tip, and the dip of the fault ( Reference 4). Much of this information is not known for fault I, but the topographic profiles presented in Subsection 2.5S.1.2.4.2.2.2 provide direct constraints on the width of the deformation zone. Topographic profile STP L1 is the closest profile to seismic profile 2M (see Figure 2.5S.1-45 and 2.5S.1-46). Along this profile the zone of tilting or folding observed at the surface is approximately 500 feet wide, so this 500 feet is a reasonable constraint on the potential width of smaller growth faults splaying off of fault I.

No COLA revision is required as a result of Issue 2 of this RAI response.

<u>Issue 3</u>

As discussed in Subsection 2.5S.1.2.4.2, growth faults active within the Quaternary are characterized by broad monoclinal folding and flexure extending for several kilometers along the strike of the growth fault (Reference 5). Within the greater site area, this type of monoclinal folding warps the Beaumont Formation surface and has produced a gentle but distinct change in surface gradient where folding has steepened the Beaumont surface. This geomorphic expression should not be described as a scarp because there is no discrete break or offset in the land surface.

The morphology of a monoclinal fold in the Beaumont Formation surface is characterized by the total relief across the fold and the width of the fold limb. For the purpose of this question, it is assumed that the 0.5 m of relief occurs over a distance of several hundred feet similar to the monoclinal folds related to growth fault GMO and described in Subsection 2.5S.1.2.4.2.2.2. Monoclinal folds with this morphology are expected to be preserved for several thousand years or more because the surface processes active since the late Holocene are not capable of degrading or masking the folds along their entire extent in hundreds to thousands of years. Specifically, late Holocene surface processes within the greater site area occur at such low rates that neither erosion nor deposition would be sufficient to degrade or mask the folding. The few areas of accelerated erosion and deposition (i.e., active fluvial valleys) are constrained to relatively small regions compared to the lateral extent of the growth faults, so these regions of accelerated rates could not obliterate the full extent of surface deformation associated with a monoclinal fold. These conclusions are explained in detail below.

Monoclinal flexures or folds associated with growth faults could be removed by either: (1) deposition and erosion associated with active fluvial systems; or (2) paired erosion and deposition from small-scale, non-fluvial processes that remove sediments from the up-thrown side of the Beaumont surface and deposit them on the down-thrown side of the Beaumont surface, essentially diffusing the distinct change in surface gradient associated with the fold limb and reducing the surface gradient of the limb. For either of these processes to remove evidence of a growth fault, they need to occur over the entire along-strike extent of the monoclinal fold, commonly several miles or more (Reference 5).

Large-scale fluvial deposition and erosion within a valley could modify and obscure a growth-fault-related monoclinal fold and may be able to mask the entire lateral extent of the fold if the river system migrated extensively. However, the Colorado river to the east of the site is the only large-scale fluvial system with such potential within the greater site area, and mapping within this area shows that Holocene deposits of the Colorado river only occur within approximately 2 km of the current location of the river (Figure 2.5S.1-27) (Reference 6; Reference 7), and specifically within the incised river valley. Holocene fluvial erosion and deposition are constrained to this same region, and these activities only have the potential to obscure Holocene and older surface folding within the incised river valley. Therefore, it is unlikely that the full extent of these folds would be degraded because of the narrow extent of the region of fluvial modification relative to the typical extent of growth fault folds (Reference 5).

During the Holocene, small-scale, non-fluvial surface processes (e.g., sheet, rill, gulley, and wind erosion as well as associated deposition) have also occurred within the site area. These processes are generally thought to be a function of slope and curvature with rates increasing with both greater slope and curvature (Reference 8). The average slope of Pleistocene deposits (approximately 0.03°) (Reference 9) and the increased slope of the growth fault GMO fold (0.3° to 0.7°; see Subsection 2.5S.1.2.4.2.2.2) within the site area are very small (i.e., essentially zero) providing little to no topographic gradient or gravitational force to drive these geomorphic processes (Reference 8). The observed curvature is also very small (Figure 2.5.S1-46) again indicating that there is very little forcing to drive erosive processes. Therefore, these small-scale surface processes are not capable of masking the presence of a growth-fault induced monoclinal fold that formed during the Holocene.

The primary evidence supporting the conclusion that non-fluvial surface processes in the site area are not capable of removing monoclinal folds similar to that observed with growth fault GMO is the presence of well-developed and mature soils that have likely had 1000s to 10,000s of years to develop. As discussed below, the presence of these soils suggests that there has not been any significant erosion or deposition of the Beaumont Formation surface at least since development of the soils began.

The primary soils near growth fault GMO include the Bacliff, Edna, Dacosta, and Laewest series formed in the Pleistocene Beaumont Formation (Reference 7). The Bacliff, Edna, and Dacosta soils (vertisol, alfisol, and mollisol, respectively) are the more extensive soils, and the Laewest series (vertisol) is less extensive. Vertisols in the Texas Coastal Plain (e.g., the Bacliff and Laewest series) are generally Late Pleistocene in age and are estimated to be no older than 35,000 to 40,000 years old (Reference 10). The Bacliff series soil lacks Bt (clay accumulation) and Bk (carbonate accumulation) horizons, but the C horizon is strong brown to reddish yellow (7.5YR5/6, 7.5YR6/6, Munsell soil notation) suggesting a moderate amount of time to accumulate iron-based precipitates. The Laewest series also lacks a Bt horizon but has two Bkss horizons (Reference 7). Bk horizons, or calcic horizons, also require substantial time for accumulation of carbonate in the soil profile (Reference 11).

Within the Dacosta and Enda series, up to five Bt soil horizons are identified, and range in total thickness from 84 to 54 inches, respectively. Bt horizons indicate production and translocation (downward movement and accumulation) of clay, resulting in the well-developed and argillic (i.e., clay-rich) pedogenic horizons. Development of thick Bt horizons generally is a function of time. The presence of numerous Bt horizons, collectively over four-feet-thick, suggests a prolonged period of landscape stability and soil development for these series of greater than 1,000 years, and possibly greater than 10,000 years (Reference 11). In comparison with the Bacliff and Laewest series, the presence of the Bt horizons within the Dacosta and Edna soils suggests these soils may have developed over a longer time period than the Bacliff and Laewest soils. Significantly, the presence of these soils attests to an extended period of landscape stability with negligible erosion or burial of the surface of the Beaumont Formation. In aggregate, the different soils of the site area all support the conclusion that erosion and deposition within the site area has been minimal during the Holocene, thus demonstrating that monoclinal folds like those associated with growth fault GMO are expected to be preserved for several thousand years or more.

No COLA revision is required as a result of Issue 3 of this RAI response.

<u>Issue 4</u>

As described in Subsection 2.5S.1.2.4.2.2, surface projections were developed for faults identified within the two subsurface horizons by the Geomap Company (Reference 12). The bending of the surface projection of fault GMO to the southeast at the south end of the reservoir (e.g., Figure 2.5S.1-45) simply reflects the southeast bending of the fault as identified by Geomap in their subsurface data (Reference 12).

No COLA revision is required as a result of Issue 4 of this RAI response.

**References:**

1. HLA, 1985, Interpretation of Geophysical Data, South Texas Project, Houston Light and Power: Novato, CA, Harding Lawson Associates (HLA), HLA job number 3854,092.09, p. 27, 8 plates.

2. STPEGS, Rev 13, STPEGS Updated Final Safety Analysis Report, Units 1 and 2, Rev. 13.

3. Suppe, J., and Medwedeff, D.A., 1990, Geometry and kinematics of fault-propagation folding: Eclogae Geolicae Helvatiae v. 83, p. 409-454.

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**RAI 02.05.02-5:**

**QUESTION:**

Based on Section 2.5.S.2, EPRI Earth Science Teams (EST) either assigned very low maximum magnitudes or low probabilities of activity to the source area located in the northwest corner of the Site Region. This has resulted in this source area contributing little to the site total seismic hazard (less or equal to 1%, see Figure 2.5 S 2-8). Please explain whether or not the Johnston (1994) findings, the final versions of the Kanter (1994) assessments, and USGS's use of them as support for an Mmax of 7.0 constitute new information that requires an update of 1989 EPRI source model.

**RESPONSE:**

The Kanter (Reference 7) and Johnston (Reference 5) studies represent two out of six chapters in the first volume of the Johnston et al. (Reference 6) report. As such, these studies need to be considered within the context and conclusions of the entire report. In preparing the STP 3 & 4 COLA, the Johnston et al. (Reference 6) report, including the findings of Johnston (Reference 5) and the final versions of the Kanter (Reference 7) assessments, as well as the source characterizations used by the United States Geological Survey (USGS) in their national seismic hazard maps (References 3, 4, 8) were evaluated to determine whether this body of research constituted new information that should motivate revisions to EPRI-SOG seismic source characterizations (Reference 2). As stated in Subsection 2.5S.2, it was concluded that none of these studies constituted new information requiring updates to the EPRI-SOG (Reference 2) source characterizations. The technical basis for this conclusion is outlined below.

Johnston et al. (Reference 6) Study

The Johnston et al. (Reference 6) study was conducted from the mid-1980s to the early 1990s under the direction of EPRI with the goal of developing an earthquake database for Stable Continental Regions (SCRs) worldwide and exploring the possibility of using this database to help constrain characterizations of the potential for large earthquakes within SCRs. To accomplish this goal, the Johnston et al. (Reference 6) study:

(1) Defined SCRs worldwide, subdivided these regions into tectonic domains, and defined descriptor variables for these domains (e.g., crust type, age, stress regime) (see Chapter 2 of Johnston et al. (Reference 6)).

(2) Compiled a global catalog of earthquakes within SCRs (see Chapter 3 of Johnston et al. (Reference 6)).

(3) Tested for significant statistical correlations between the SCRs subdivided at different levels and the maximum observed earthquake magnitude with these subdivisions to determine if a robust estimator of $M_{max}$ values could be developed (see Chapter 5 of Johnston et al. (Reference 6)).

Two of the fundamental assumptions of the Johnston et al. (Reference 6) study are: (1) that for similar tectonic domains within SCRs worldwide (e.g., extended Mesozoic crust), space can be traded for time to allow development of a composite earthquake catalog for that particular style of tectonic domain that is larger than the catalog of earthquakes within just a single occurrence of that domain (e.g., extended Mesozoic crust in North America); and (2) these grouped, similar tectonic domains (e.g., all extended Mesozoic crust worldwide) have the same fundamental seismicity characteristics (i.e., maximum magnitudes ($M_{max}$)).

EPRI's primary motivation for initiating the Johnston et al. (Reference 6) study was twofold: (1) to provide the EPRI-SOG earth science teams (ESTs) (Reference 2) with guidance on estimating $M_{max}$ values for source zones within the central and eastern US (CEUS); and (2) to determine if there is a robust method of estimating $M_{max}$ based on historical seismicity. The Johnston et al. (Reference 6) study was conducted in two phases to meet these goals. As part of the first phase, Johnston et al. (Reference 6) developed an initial division of SCRs based on tectonic features and a global catalog of earthquakes within SCRs. These materials were then used to develop first-order conclusions to aid the ESTs in their development of source characterizations for the CEUS. The main conclusion presented to the ESTs was that there is an association between rifts and passive margins of Mesozoic and younger age and the largest observed earthquakes in SCR regions (see chapter 1, page 1-2 of Johnston et al. (Reference 6)).

The second phase of the Johnston et al. (Reference 6) study attempted to expand upon this conclusion and determine if there was a robust method for estimating $M_{max}$ based on historical earthquakes by following the three steps outlined below: 1) defining tectonic domains; 2) developing a SCR seismicity catalog; and 3) testing for statistical correlation between the tectonic domains and seismicity. As part of this effort Johnston et al. (Reference 6) refined their subdivision of tectonic domains and their defining characteristics (see Chapter 2 of Johnston et al. (Reference 6)). The broadest subdivision used by Johnston et al. (Reference 6) to classify SCRs was that between extended and non-extended crust. Extended crust includes regions of rifting, distributed continental extension, and passive margins; non-extended crust includes the remainder of SCR crust (Reference 6). In addition to this subdivision, Johnston et al. (Reference 6) further defined 24 different categories of non-extended crust and 720 categories of extended crust based on what they refer to as descriptor variables characterizing the crust (e.g., stress regime, crustal type, crustal age) (see Chapter 2 and 5 of Johnston et al. (Reference 6)).

These subdivisions, representing different sets of descriptor variables, were examined to determine if there was a statistically significant correlation between the subdivisions and the maximum observed earthquakes in the subdivisions. The conclusion reached by Johnston et al. (Reference 6) from analyzing all of the different subdivisions and descriptor variables was that there is only a slight statistical difference between the mean maximum observed earthquake magnitude in extended crust and the mean maximum observed magnitude in non-extended crust. No other descriptor variable was found to have a statistically significant correlation. Johnston et al. (Reference 6) qualify the impact of these conclusions by stating, "we find that there is no strong evidence that any typical extended crust domain has a larger maximum magnitude than a typical non-extended crust domain," (page 5-17) (Reference 6). Johnston et al. (Reference 6) essentially concluded that a robust estimator of $M_{max}$ cannot be found using the assumption of space-time equivalence for seismicity and the tectonic descriptions of SCRs defined by Johnston et al. (Reference 6).

Despite the lack of a robust estimator for $M_{max}$, the main conclusion from the first phase of the Johnston et al. (Reference 6) study persisted through the end of the second phase and was refined to say that the maximum observed earthquake in extended SCRs worldwide is greater than the maximum observed earthquake in non-extended SCRs (see Chapter 4 and 5 of Johnston et al. (Reference 6)). As summarized above and outlined in Chapter 1 of Johnston et al. (Reference 6), this main conclusion of the study was presented to the EPRI-SOG ESTs during their evaluations of seismic sources. The information contained within this conclusion was evaluated by the EPRI-SOG ESTs, and thus the information is not new information that requires updating of the EPRI-SOG source characterizations.

Another result of the Johnston et al. (Reference 6) study that is potentially relevant to the EPRI-SOG source characterizations is the subdivision of the CEUS presented by Kanter in chapter 2 of Johnston et al. (Reference 6). However, the subdivisions within the STP 3 & 4 site region are primarily based on information that was also available to the EPRI-SOG ESTs in developing their source characterizations (see Subsection 2.5S.2.2). Therefore, these assessments also do not constitute new information that requires updating of the EPRI-SOG source characterizations.

<u>USGS National Seismic Hazard Maps</u>

The most complete description of the USGS's justification for the CEUS $M_{max}$ values used in their national seismic hazard maps is included in the documentation for the 2008 maps (Reference 8). This documentation was not available during preparation of the STP 3 & 4 COLA, but the justification contained within it is consistent with that presented in earlier versions of the hazard maps (References 3, 4). Therefore the following discussion refers to the documentation for the 2008 maps (Reference 8).

The USGS source model has five zones of unique $M_{max}$ distributions for the CEUS (Reference 8). Two of these zones (the craton and extended margin $M_{max}$ zones) are within the STP 3 & 4 site region and are thus relevant to the site. The extended margin zone encompasses all of the CEUS seaward of the limit of Precambrian crustal rifting associated with opening of the Iapetan ocean and contains the STP 3 & 4 site. The remainder of the CEUS east of longitude 102º W is the craton zone. The extended margin zone has a mean $M_{max}$ of Mw 7.5 ($m_b$ 7.2), and the craton zone has a mean $M_{max}$ of Mw 7.0 ($m_b$ 6.8) (Reference 8). These $M_{max}$ values are generally higher than those defined by the EPRI-SOG ESTs for similar areas within the site region (see Subsection 2.5S.2.2).

As reported in the documentation for the 2008 maps (Reference 8), the $M_{max}$ values used for these two zones are based on: (1) a qualitative analysis by Wheeler (Reference 10) that concluded the two zones should have different $M_{max}$ values; and (2) comparisons of the extended margin and craton zone in the CEUS to analogous SCRs worldwide (References 11, 12). The second basis depends on: (a) adopting the fundamental assumption of Johnston et al. (Reference 6) that seismicity from other cratonic and extended margin regions can be used to estimate $M_{max}$

for the CEUS; and (b) the observation of Johnston et al. (Reference 6) that the largest magnitude earthquakes occurring globally in SCRs occur in extended crust. As discussed below, the only actual information or data contained within any of these points is the observation that the largest earthquakes occurring within SCRs worldwide occur within regions of extended crust. As previously noted, this observation was made prior to the development of the EPRI-SOG source characterizations and was explicitly presented to the participant ESTs. Therefore, there is no new information within the USGS $M_{max}$ characterizations (Reference 8) that requires updating the EPRI-SOG source models used for STP 3 & 4.

The first basis for the $M_{max}$ values used by the USGS is the work of Wheeler (Reference 10) that suggests there are differences in seismic behavior (i.e., $M_{max}$ values) of the CEUS that are associated with the limit of Iapetan faulting. Essentially, Wheeler (Reference 10) defines two large domains within the CEUS: the craton landward of the limit of Iapetan faulting and the extended margin seaward of the same limit of faulting. Wheeler (Reference 10) posits that normal faults associated with Iapetan rifting in the extended crust are capable of larger earthquakes in the cratonic crust. The EPRI-SOG ESTs followed the same methodology of using tectonic features and characteristics to define source zone geometry (Reference 2). The observations used by Wheeler (Reference 10) to derive his division of the CEUS are not significantly different from those available to the ESTs during their evaluations, so there is no new information contained in Wheeler's (Reference 10) subdivisions that were not considered by the ESTs. Therefore, there is no need to update the EPRI-SOG source zones to explicitly reflect the work of Wheeler (Reference 10).

The second basis for the $M_{max}$ values used by the USGS for the CEUS depends on: (a) adopting the assumption of Johnston et al. (Reference 6) that seismicity from other cratonic and extended margin regions can be used to estimate the $M_{max}$ for the CEUS; and (b) the observation of Johnston et al. (Reference 6) that the largest magnitude earthquakes occurring globally in SCRs occur in extended crust. The assumption of Johnston et al. (Reference 6), and thus the USGS (Reference 8), that seismicity from other SCRs can be used to estimate $M_{max}$ for the CEUS is stated in Johnston et al. (Reference 6) as an underlying philosophy, and there is no explicit effort within the study to justify this philosophy or assumption. As such, there are no new data supporting this assumption that motivates updates to the EPRI-SOG ESTs source characterizations (Reference 2). It is also important to reiterate that the EPRI-SOG ESTs were presented with the Johnston et al. (Reference 6) philosophy, and they evaluated its appropriateness for use in their source characterizations.

The final part of the second basis for the $M_{max}$ values used by the USGS for the CEUS depends on the observation of Johnston et al. (Reference 6) that the largest magnitude earthquakes occurring globally in SCRs occur in extended crust. As previously discussed, this basic conclusion of Johnston et al. (Reference 6) was reached during the first phase of the study, remained essentially unchanged at the end of the second phase, and was presented to the EPRI-SOG ESTs for use in their evaluation of source zone characteristics for the CEUS. As such, this basis for the USGS $M_{max}$ values depends on information that was available to and evaluated by the EPRI-SOG ESTs during their source characterization efforts, and this basis also does not present any new information that motivates updates to the EPRI-SOG ESTs source characterizations.

Summary

Given the review presented above, the $M_{max}$ values used by the USGS (Reference 8) and partially motivated by the Johnston et al. (Reference 6) study do not represent new information that requires modification of the EPRI-SOG source characterizations. There are no new data contained within Johnston et al. (Reference 6) that was not evaluated by the EPRI-SOG ESTs. The different $M_{max}$ values adopted by the USGS and the EPRI-SOG ESTs is due to different interpretations of the same data, not the development of new data. This evaluation and conclusion is consistent with early site permits that have been issued by the NRC (e.g., Dominion Nuclear, Grand Gulf) (References 1, 9) for which applicants have also concluded there is no need to update $M_{max}$ values based on the USGS source models (References 3, 4) or the Johnston et al. (Reference 6) study.

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

**References:**

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2. EPRI, 1986, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 5-10, Electric Power Research Institute (EPRI).

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4. Frankel, A.D., Petersen, M.D., Muller, C.S., Haller, K.M., Wheeler, R.L., Leyendecker, E.V., Wesson, R.L., Harmsen, S.C., Cramer, C.H., Perkins, D.M., and Rukstales, K.S., 2002, Documentation for the 2002 Update of the National Seismic Hazard Maps, U.S. Geological Survey, Open-file Report 02-420, 33 p.

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9. SER, 2005, System Energy Resources Inc. (SER) Application for the ESP at the Grand Gulf Site, Rev. 2, NRC ADAMS Accession Number ML052780463.

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12. Wheeler, R.L., and Frankel, A.D., 2000, Geology in the 1996 USGS Seismic-hazard Maps, Central and Eastern United States: Seismological Res. Lett., v. 71, p. 273-282.

**RAI 02.05.02-10:**

**QUESTION:**

Section 2.5S.2.2.8 discusses the USGS seismicity source models. Contrary to the “small number of sources” described by the applicant, the USGS models use hundreds of gridded seismicity sources in the site region, organized by completeness criteria into several spatially detailed source models that reflect local historical rates of seismic activity. Please reconcile the published descriptions of the USGS seismicity source models with the descriptions given in Section 2.5S.2.2.8.

**RESPONSE:**

The apparent discrepancy noted in this RAI question is resolved by replacing the third paragraph of Subsection 2.5S.2.2.8 with the following, more precisely worded text.

> ~~Unlike the 1986 EPRI model (Reference 2.5S.2-13) that incorporates many background zones and local sources for a detailed description of the tectonics and seismicity, the USGS source model in the CEUS includes only a small number of sources. The hazard is largely based on historical seismicity and the variation of that seismicity within large background or “maximum magnitude” zones. Within the STP 3 & 4 site region the USGS model defines a single seismic source (the Extended Margin Background zone) that covers nearly the entire eastern and southeastern United States. The USGS assigned a $M_{max}$ value of **M** 7.5 ($m_b$ 7.2) to this zone. The rationale for the relatively large $M_{max}$ value used by the USGS for the Extended Margin Background Zone was based on developing a simple source model capable of explaining the 1886 **M** 7.3 ($m_b$ 7.1) Charleston earthquake (Reference 2.5S.2-11) and recognizing that $M_{max}$ over this broad area did not make a significant difference for hazard estimates at the periods of interest for the USGS study.~~
>
> Similar to the 1986 EPRI model, the USGS model for the CEUS uses historical seismicity to determine the rates and relative magnitudes of earthquakes. Both models used a weighted distribution of different methods to calculate the rates and relative magnitudes. The 1986 EPRI model incorporates many background zones and local sources each with individual $M_{max}$ distributions. In contrast, the USGS source model in the CEUS defines only five $M_{max}$ zones between which $M_{max}$ values are allowed to vary. The vast majority of the STP 3 & 4 site region, including the site, is within the USGS Extended Margin $M_{max}$ zone that includes all of the CEUS seaward of the limit of Precambrian crustal rifting associated with opening of the Iapetan ocean (Reference 2.5S.2-11 and 2.5S.2-28). The USGS assigned a $M_{max}$ value of **M** 7.5 ($m_b$ 7.2) to the Extended Margin $M_{max}$ zones. The rationale for the relatively large $M_{max}$ value used by the USGS for the Extended Margin $M_{max}$ zone was based on an interpretation of the origin of the 1886 **M** 7.3 ($m_b$ 7.1) Charleston earthquake, and the recognition that $M_{max}$ over this broad area did not make a significant difference to hazard estimates at the periods of interest for the USGS study (Reference 1).

**References:**

1. Frankel, A., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M., 1996, National Seismic-Hazard Maps: Documentation, June 1996: Denver, CA, U.S. Geological Survey Open-File Report 96-532, 41 p.

**RAI 02.05.02-13:**

**QUESTION:**

In Section 2.5 S.2.4.3, you described the update of EPRI seismic source maximum magnitudes (Mmax). Please describe the procedure you used to revise the EPRI SOG source parameters. Please specifically address whether the revision is a SSHAC process and if so what level it is (the EPRI SOG source characterization process was equivalent to a SSHAC level 3-4 study)? If a SSHAC process was not used, please justify and fully describe the alternate process.

**RESPONSE:**

The updates to the $M_{max}$ distributions for the Gulf Coastal Source Zones of the EPRI-SOG teams described in Subsection 2.5S.2.4.3 followed a SSHAC level 2 process (Reference 1). The various levels of SSHAC studies are described in detail in NUREG/CR-6372 (Reference 1). The essential components of a level 2 study with respect to the $M_{max}$ update described in Subsection 2.5S.2.4.3 are:

- Technical integrators (TIs) responsible for developing the updated $M_{max}$ distributions through discussions with experts and review of published information and data;
- Resource and proponent experts who are interviewed in an effort to gain expert insight that aids in forming the basis for the updated $M_{max}$ distributions; and
- A participatory peer review panel that provides unbiased feedback, critical review, and guidance throughout the development of the updated $M_{max}$ distributions.

The TIs for this study were Dr. Christopher Fuller and Dr. Jeff Unruh from William Lettis & Associates, Inc. Experts queried for this update included academics and commercial geoscientists with expertise in tectonics and seismicity within the Gulf of Mexico (e.g., Dr. Jim Dewey of the USGS, Dr. Frank Peel of BHP Billiton Petroleum, Dr. Meredith Nettles of Lamont-Doherty Earth Observatory, Dr. Joe Dellinger of BP, Dr. Goran Ekstrom of Lamont-Doherty Earth Observatory, Dr. Martin Chapman of Virginia Tech) and members of the original EPRI-SOG ESTs (e.g., Dr. Joe Litehiser of the Bechtel team, George Klimkiewicz of the Weston team, and Jim McWhorter of the Dames & Moore team). The peer review panel consisted of seismic Technical Advisory Group (TAG) members Dr. Carl Stepp, Dr. Robert Kennedy, Dr. Cliff Frohlich, and Mr. Donald Moore.

The update to the $M_{max}$ distributions arose from an extensive review by the TIs of information and data published since the EPRI-SOG study, as recommended in Regulatory Guide 1.208 (see Subsection 2.5S.2.4). Based on this review, the TI's concluded that there is no new information or data that motivates updating the fundamental characteristics (e.g., geometry, $M_{max}$, activity rate) of the EPRI-SOG source model within the site region besides the revisions to the $M_{max}$ distributions described in Subsection 2.5S.2.4.3. These revisions were based on the occurrence of earthquakes since publication of the EPRI-SOG model (Reference 2) that: (1) are within or very close to EPRI-SOG Gulf Coastal Source Zones, and (2) have magnitudes that are greater than the lower-bound $M_{max}$ value for the respective zones.

As reflected in the RAI question, the EPRI-SOG study is widely viewed as equivalent to a high-level Senior Seismic Hazard Analysis Committee (SSHAC) study (Reference 1). The EPRI-SOG source models were developed using an expert elicitation process that involved six independent earth science teams comprised of scientists recognized as experts in the fields of seismology, geology, and geophysics. One goal of the study was to capture and represent the range of uncertainty about the occurrence of future earthquakes and seismic sources within the central and eastern US (CEUS). The resulting seismic source model for the CEUS is commonly viewed as representing the state of knowledge of the informed expert community at the time of the study with respect to the seismogenic potential of the CEUS crust, including the crust throughout the STP 3 & 4 site region.

The updates to the EPRI-SOG model for STP 3 & 4 were designed to preserve the robustness and heritage of the high-level, SSHAC-equivalent EPRI-SOG source model while updating the model to reflect the current state of knowledge. This goal was accomplished by: (1) limiting revisions to those elements of the EPRI-SOG model that required updating (i.e., the $M_{max}$ distributions), and (2) using the original methodologies of the EPRI-SOG teams to update their respective source models. By accomplishing this goal, the updated EPRI-SOG model used for STP 3 & 4 can then be viewed as representing the state of knowledge of the informed technical community, as represented by the EPRI-SOG teams, with respect to the seismogenic potential of the CEUS crust given modern data and information.

The explicit process used for developing the updated $M_{max}$ distributions followed the processes outlined in NUREG/CR-6372 (Reference 1). Peer reviewers were defined at the onset of the project as members of the TAG for the STP 3 & 4 COLA effort. The TIs' initial efforts consisted of compiling available data from published literature and by interviewing experts, with a focus on identifying information developed since publication of the EPRI-SOG study bearing on the seismic potential of the Gulf of Mexico region, including the STP 3 & 4 site region. The goal of this task was to develop an up-to-date understanding of the seismic and structural characteristics of the Gulf of Mexico region and, in particular, the areas surrounding the earthquakes that motivated the $M_{max}$ update. Based on their review of the compiled structural and seismic characteristics of the region, the TIs developed a preliminary methodology for updating the $M_{max}$ distributions. These characteristics of the region and the preliminary update methodology were presented to the TAG peer review panel. The comments from the panel reflected their position that modifications to the EPRI-SOG model, if required to incorporate new information (e.g., the occurrence of the earthquakes motivating the $M_{max}$ updates), should endeavor to preserve the heritage of the high-level, SSHAC-equivalent process originally used to develop the model, as reflected in the characterization of seismic sources therein. Consistent with this view, the TIs decided to follow the specific methodologies used by the original EPRI-SOG ESTs to update $M_{max}$ distributions for the large areal source zones in the Gulf of Mexico.

Based on the peer review comments, the update methodology was refined and further expert interviews were conducted. These efforts focused on: (1) evaluating whether or not the occurrence of these earthquakes identified previously unobserved seismogenic structures within the Gulf of Mexico, and (2) interviewing experts involved in the EPRI-SOG study to evaluate their opinions of how these earthquakes impact their original $M_{max}$ distributions. All of this information was integrated by the TIs into a final methodology and updated $M_{max}$ distributions, which were then presented to the peer review panel for further comment. The panel endorsed the updated $M_{max}$ distributions and methodology. The final methodology and $M_{max}$ distributions are those presented in Subsection 2.5S.2.4.2.3, and the background information developed from the literature review, interviews with experts, and endorsed by the seismic TAG is incorporated within Subsections 2.5S.1 and 2.5S.2.

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

**References:**

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2. EPRI, 1986, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 5-10, Electric Power Research Institute (EPRI).

**RAI 02.05.02-14:**

**QUESTION:**

In Section 2.5S.2.4.4.1, you stated that "Subsurface structure, imaged by seismic reflection data, indicates that the MEEG is rooted in the Jurassic Louann Salt at maximum depths of 4.5 to 6 km. This suggests that late Quaternary displacement and contemporary creep across the MEEG may be driven by the movement of salt at depth, indicating that the fault is not accommodating tectonic deformation and thus is not an independent source of moderate to large earthquakes." a) Please explain why the nature of the loading mechanism (salt movement rather than tectonic forces) alone disqualifies the MEEG as a seismic source. Specifically, describe the potential for the ability of the structure (also growth faults?) to accumulate stress, rather than the nature of the loading? b) Please explain why the much-lower, long-term separation rate based on offset Quaternary gravels is used in the sensitivity modeling for the MEEG (Section 2.5S.2.4.4.1), rather than the higher rate that "likely reflects movement of salt at depth and is not indicative of the rate of tectonic strain accumulation."

**RESPONSE:**

There are three issues identified within this RAI question, which can be summarized as:

1. Please explain why the nature of the loading mechanism (salt movement rather than tectonic forces) alone disqualifies the Mt. Enterprise-Elkhart Graben (MEEG) as a seismic source.

2. Describe the potential for the ability of the structure (also growth faults?) to accumulate stress, rather than the nature of the loading.

3. Please explain why the much-lower, long-term separation rate based on offset Quaternary gravels is used in the sensitivity modeling for the MEEG (Section 2.5S.2.4.4.1), rather than the higher rate that "likely reflects movement of salt at depth and is not indicative of the rate of tectonic strain accumulation."

Issue 1

In the probabilistic seismic hazard assessment for STP 3 & 4, the MEEG is not disqualified from being a seismic source based upon its loading mechanism or any other factor. As described in Subsection 2.5S.2.4, the MEEG was included in a screening analysis for the STP 3 & 4 site, and from this analysis it was determined that the MEEG did not contribute to the seismic hazard. Consequently, the MEEG was not included as a source in the calculation of the site ground motions. The main significance of the salt associated with the MEEG at depths of 4.5 to 6 km (References 1, 2, 3) is that the rupture area of any potential earthquake is limited to the 4.5 to 6 km of crust above the salt. This constraint is used in the derivation of magnitudes used for the MEEG source characterization (see Subsection 2.5S.2.4.4.1). The statement that "the MEEG is rooted in the Jurassic Louann salt" implies that the fault does not extend into the crystalline bedrock below the salt. Thus, any movement on the fault is confined to the overlying sedimentary section and does not reflect tectonic strain accumulation and release in the crust.

No COLA revision is required as a result of Issue 1 of this RAI response.

Issue 2

MEEG faults share many characteristics with growth faults within the Gulf of Mexico region. In particular, the MEEG is comprised of shallow crustal, listric normal faults that root into the Jurassic Louann salt and do not penetrate into the underlying crystalline basement (References 1, 3). Faults of this style, and in particular the MEEG, are generally characterized as, and observed to be, aseismic (References 1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14). The basis for this evaluation is the observation that: (1) there have been no earthquakes positively associated with growth faults (References 15, 16, 17), and (2) the shallow faults do not penetrate competent basement rocks but occur in poorly consolidated, relatively weak, sedimentary basin deposits that have little capacity to accumulate elastic strain energy or stress. Instead of seismogenic rupture, these faults are observed to slip aseismically in response to processes that occur within the sedimentary section at depth (e.g., salt movement, fluid withdrawal, large-scale slumping of the Gulf of Mexico sediments) (References 18, 19, 20, 21). This same style of aseismic slip appears to be occurring at the MEEG as evident in the 13 cm of elevation change that accumulated aseismically across the MEEG between 1920 and 1952 (References 15, 16, 17, 22). Therefore, it is not likely that the MEEG is able to accumulate the stresses and elastic strain energy required for seismogenic rupture.

No COLA revision is required as a result of Issue 2 of this RAI response.

Issue 3

The separation rate of 4 mm/yr calculated from leveling data between 1920 and 1952 is not used as the basis for earthquake recurrence rates for the MEEG because this rate does not represent the long-term, average slip rate across the MEEG and, as discussed above, does not represent seismogenic slip across the MEEG. In contrast, the relatively high slip rate observed between 1920 and 1952, if accurately measured and documented by the leveling data summarized in Collins et al. (1980) (Reference 22) is likely an aseismic slip transient. Such aseismic transient slip is commonly observed with growth faults (References 20, 23, 24). Supporting evidence that this high rate represents a transient comes from the observation that there is no escarpment associated with the elevation change in the leveling profile. For example, if this slip rate was constant for 1000 years (i.e., was not a transient), there should be an escarpment with an offset of approximately 4 meters, and no such escarpment has been observed (Reference 22). It is generally accepted that short observations of transient slip events are not appropriate to characterize the long-term seismogenic behavior of faults because they do not accurately characterize fault behavior over return periods of interest (10,000 to 100,000 years for nuclear power plants) (Reference 8).

No COLA revision is required as a result of Issue 3 of this RAI response.

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1. Jackson, M.P.A., 1982, Fault tectonics of the east Texas basin: Austin, TX, University of Texas at Austin, Bureau of Economic Geology, Geological Circular, No. 82-4, 31 p.

2. Ewing, T.E., 1991, Structural framework, in Salvador, A., ed., The Geology of North America: the Gulf of Mexico Basin, Volume J: Boulder, CO, Geological Society of America, p. 31-52.

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10. Wheeler, R.L., 1999, Fault number 924, Gulf-margin normal faults, Texas, in Quaternary fault and fold database of the United States, USGS. Available at: http://earthqakes.usgs.gov/regional/qfaults, accessed on 1/11/07.

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**RAI 02.05.02-15:**

**QUESTION:**

Paleoliquefaction features in southeastern Arkansas and northeastern Louisiana indicate that previously unrecognized seismogenic sources may exist in those areas (e.g., Al-Shukri et al, 2005; Cox et. al., 2004; Tuttle et. al., 2006). Please explain or justify whether these sources could potentially impact the seismic hazard determined for the STP site. References "Spatial and temporal characteristics of paleoseismic features in the southern terminus of the New Madrid Seismic Zone in eastern Arkansas," Seismological Research Letters, Volume 76, Pages 502-511, Al-Shukri, H. J., Lemmer, R. E., Mahdi, H. H., Connelly, J. B., 2005. "Preliminary assessment of sand blows in the southern Mississippi Embayment," Bulletin of the Seismological Society of America, Volume 94, Pages1125-1142, Cox, R. T., Larsen, D., Forman, S. L., Woods, J., Morat, J., and Galluzzi, J., 2004. "Very large earthquakes centered southwest of the New Madrid seismic zone 5,000-7,000 years ago," Seismological Research Letters, Volume 77, Pages 755-770, Tuttle, M. P., Al-Shukri, H., Mahdi, H., 2006.

**RESPONSE:**

Paleoliquefaction features identified within Arkansas and northeastern Louisiana (References 1 - 3) do not require an update to the seismic source model used in the STP 3 & 4 probabilistic seismic hazard analysis, and therefore do not have an impact on the seismic hazard determined for the site. Proposed seismic sources include the New Madrid Seismic Zone (NMSZ) and local, generally unidentified and unnamed, sources (References 1 - 3). These different professional opinions indicate the absence of consensus within the scientific community with respect to the tectonic source of ground shaking that caused these paleoliquefaction features. The impact of the seismic hazard posed by the NMSZ is already included in the probabilistic seismic hazard assessment (PSHA) for STP 3 & 4 (see Subsection 2.5.S.2.4.4.2). Regarding the hypothesized sources proximal to the liquefaction features, the magnitudes are too small (approximately **M** 6) and the distances are too far from STP 3 & 4 (over 600 km) to have a significant impact on the site hazard.

Cox et al. (Reference 2) studied sand blows located in Ashley and Desha counties in southeastern Arkansas, more than 175 km from the NMSZ and more than 675 km from the STP site. In this region of sparse modern seismicity, four trenches at three sites were examined to reveal multiple sand blow events. Cox et al. (Reference 2) were able to constrain four events around 6400-4600 B.P., 2200 B.P., 1200-900 B.P., and 700 B.P., and identified several other events for which they were unable to determine accurate ages. While some of the recognized events correlate with published NMSZ event compilations (e.g., the ~1100 event of Tuttle et al. (Reference 3)), not all do. Moreover, not all of the events are temporally consistent between the sites, and Holocene liquefiable deposits with few or no sand blows separate the identified liquefaction sites. Based on these observations, Cox et al. (Reference 2) suggest that some of the events may originate from a local, unidentified source of **M** 5.5-6.5 earthquakes. However, partially based on an eye-witness account of sand-venting in the area during the NMSZ 1812 event, Cox et al. (Reference 2) also acknowledge that some of the liquefaction features are likely related to the NMSZ. Cox et al. (Reference 2) conclude that their paleoseismic record is incomplete and that the liquefaction features may have been generated during large NMSZ events or hypothesized local events on the Arkansas River fault zone and/or the Saline River fault zone.

Al-Shukri et al. (Reference 1) trenched 3 sites located near Marianna, Arkansas, approximately 90 km from the present-day seismicity of the NMSZ and approximately 1000 km from the STP site. The trenching revealed the presence of a sand blow unit varying in thickness from 22 to 130 cm. Three radiocarbon dates on underlying clay units range between 4800 and 5660 B.P. and were interpreted to represent a liquefaction event at ~5500 B.P. Al-Shukri et al. (Reference 1) suggest that this event could be the result of: (1) a New Madrid seismic event, (2) a local source that might not be related to NMSZ seismicity, or (3) aftershocks near the study area from a local source triggered by mainshocks within the NMSZ. Al-Shukri et al. (Reference 1) do not identify a preferred hypothesis.

Tuttle et al. (Reference 3) also investigated sand blows near Marianna, Arkansas. Multiple trenches, a cut-bank exposure, and ground-penetrating radar surveys were used to identify several large sand-blow deposits. Radiocarbon and optically-stimulated luminescence dates indicate ages between 5000 and 7000 B.P. for these deposits. Currently, no sand blows of these ages have been identified in the NMSZ chronology. On the basis of this observation, and the size of the sand blows near Marianna, Tuttle et al. (Reference 3) conclude that the events identified are from a local source. They suggest several nearby potential seismic sources, in particular the eastern Reelfoot Rift margin, but indicate that more information is required to directly identify a source.

All of the liquefaction features discussed above are within 175 km of the zone of New Madrid seismicity, and liquefaction has been documented as far as 250 km away from epicenters of the 1812 and other NMSZ large historical earthquakes (e.g., Reference 4). Moreover, all of the above studies and external evaluations of them (e.g., Reference 5) indicate that the NMSZ is a likely source for these features. No data presented in the studies above provide alternative geometries, recurrence intervals or maximum magnitudes for the NMSZ that require revision of the NMSZ model used for the STP 3 & 4 PSHA.

Alternatively, researchers have proposed that the paleoliquefaction features may be related to a previously unrecognized seismogenic source proximal to the features. Currently, none of the paleoliquefaction studies and related research has positively identified such a source or the seismic characterization of that source (Reference 5). However, all of the hypothesized sources are over 600 km from the STP 3 & 4 site, and the hypothesized magnitudes are between **M** 5.5 and 6.5 (Reference 2; Reference 5). Given these large distances and moderate magnitudes, any source proximal to the features will not have a significant impact on the hazard at STP 3 & 4.

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

**References:**

1. Al-Shukri, H. J., Lemmer, R. E., Mahdi, H. H., Connelly, J. B., 2005, Spatial and temporal characteristics of paleoseismic features in the southern terminus of the New Madrid Seismic zone in eastern Arkansas: Seismological Research Letters, v. 76, p. 502-511.

2. Cox, R. T., Larsen, D., Forman, S. L., Woods, J., Morat, J., Galluzzi, J., 2004, Preliminary assessment of sand blows in the Southern Mississippi Embayment: Bulletin of the Seismological Society of America, v. 94, p. 1125-1142.

3. Tuttle, M. P., Al-Shukri, H., Mahdi, H., 2006, Very large earthquakes centered southwest of the New Madrid Seismic Zone 5000-7000 years ago: Seismological Research Letters, v. 77, 755-770.

4. Johnston, A.C., and Schweig, 1996, The enigma of the New Madrid earthquakes of 1811-1812: Ann. Rev. Earth Planet. Sci., v. 24, p. 339-384.

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**RAI 02.05.03-2:**

**<u>QUESTION:</u>**

In the last 15 years, there is wider recognition that seismicity migrates within crustal zones over periods of thousands to tens of thousands of years (e.g., Nelson et. al., 1999; Schweig and Ellis, 1994; Coppersmith, 1988; Tuttle et. al., 2006). Please explain how this might apply to the site region. "Quaternary grabens in southernmost Illinois — Deformation near an active intraplate seismic zone," Tectonophysics, Volume 305, Pages 381-397, Nelson, W.J., Denny, F.B., Follmer, L.R., and Masters, J.M., 1999. "Temporal and Spatial Clustering of Earthquake Activity in the Central and Eastern United States," Seismological Research Letters, Volume 59, Pages 299-304, Coppersmith, K.J., 1989. "Reconciling Short Recurrence Intervals with Minor Deformation in the New Madrid Seismic Zone," Science, Volume 264, Pages 1308-1311, Schweig, E.S., and Ellis, M.A.,1994. "Very Large Earthquakes Centered Southwest of the New Madrid Seismic Zone 5,000-7,000 Years Ago," Seismological Research Letters, Volume 77, Pages 755-770, Tuttle, M. P., Al-Shukri, H., Mahdi, H., 2006.

**<u>RESPONSE</u>:**

The papers referenced in the above RAI question focus on two general ideas:

1. Recurrence rates for some seismogenic structures appear to have been not uniform over long periods of time (e.g., hundreds of thousands of years) (e.g., Reference 1, 2); and
2. Within the Reelfoot Rift aulacogen, large earthquakes appear to have occurred at several different locations throughout the Quaternary over different time periods.

The combined impact of these two observations is stated in the most recent of the papers (Reference 3), where it is hypothesized that seismicity within the Reelfoot Rift has varied in space and time (i.e., has been non-stationary) (e.g., Reference 1) during the Quaternary. An implication of this hypothesis is that both geological and seismological observations should be used as the basis for characterizing potential seismic sources in an effort to identify and characterize non-stationary behavior.

With respect to the Reelfoot Rift, the focus of the referenced papers, the concept of non-stationary seismicity related to tectonic structures does not have an impact on the STP 3 & 4 site because: (1) the New Madrid seismic zone (NMSZ) source model used for the site is based on the most recent geologic and seismologic observations of the Reelfoot Rift region (see discussion in Subsection 2.5S.2.4.4.2); and (2) hypothetical sources south and north of the NMSZ proper, but within the Reelfoot Rift (Reference 3, 4), are too small and at too great of a distance from the site to significantly impact site ground motions (see response to RAI question 02.05.02-15).

With respect to potential seismogenic sources closer to and within the site region, the concept of non-stationary seismicity in the Reelfoot rift also does not have an impact on the STP 3 & 4 site. The basis for this conclusion is that: (1) the tectonic setting of the study region is that of a passive continental margin, not an aulacogen; (2) there are no known capable tectonic structures within the site region, and therefore there are no tectonic structures along which large earthquakes may occur in a non-stationary manner similar to that proposed for the Reelfoot Rift (Reference 3, 4); and (3) the EPRI-SOG seismic source characterizations (Reference 5) used as the basis for the seismic hazard calculations at the site have been evaluated and updated with respect to the latest geological and seismological observations.  Therefore, the ideas presented in the above referenced papers do not have any implications for the STP 3 & 4 site that are not already incorporated into the seismic hazard model for the site.

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

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1. Coppersmith, K.J., 1988, Temporal and Spatial Clustering of Earthquake Acitivity in the Central and Eastern United States Seismological Res. Lett., v. 59, p. 299-304.

2. Schweig, E.S. and Ellis, M.A., 1994, Reconciling Short Recurrence Intervals with Minor Deformation in the New Madrid Seismic Zone: Science, v. 264, p. 1308-1311.

3. Tuttle, M.P., Al-Shukri, H. and Mahdi, H., 2006, Very Large Earthquakes Centered Southwest of the New Madrid Seismic Zone 5,000–7,000 Years Ago: Seismological Res. Lett., v. 77, p. 755-770.

4. Nelson, W.J., Denny, F.B., Follmer, L.R. and Masters, J.M., 1999, Quaternary grabens in southernmost Illinois: deformation near an active intraplate seismic zone Tectonophysics, v. 305, p. 381-397.

5. EPRI, 1986, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 5-10, Electric Power Research Institute (EPRI).

**RAI 02.05.03-3:**

**QUESTION:**

A significant portion of the Site Region for the STP COLA site is covered by the Gulf of Mexico. Please discuss seismic potential in this specific area due to concealed capable faults under the water.

**RESPONSE:**

As shown in Figure 2.5S.1-1, approximately half of the STP 3 & 4 site region encompasses the Gulf of Mexico including the Texas-Louisiana shelf and slope. These regions are comprised of 11 to 15 km of Mesozoic sediments underlain by either thin transitional or oceanic crust (see Figure 2.5S.1-16, Figure 2.5S.1-18 and discussion in Subsections 2.5S.1.1.4.1.3 and 2.5S.1.1.4.4.3). As discussed in Subsections 2.5S.1.1.4.4, 2.5S.2.2, and 2.5S.3, no capable faults have been identified within the offshore STP 3 & 4 site region including within the thin and oceanic crust or the Mesozoic sediments. Growth faults have been identified within the Mesozoic sediments of this region (e.g., see Figures 2.5S.1-5 and 2.5S.1-42), but these faults are aseismic and are not capable faults (see discussion in Subsections 2.5S.1.1.4.1.3 and 2.5S.1.1.4.4.5.4) (Reference 1).

As outlined in Subsection 2.5S.2, the Electric Power Research Institute Seismicity Owners Group (EPRI-SOG) source model (Reference 2) comprises the base characterization of seismic potential within the site region. A comprehensive review of all available information and data developed since the EPRI-SOG study was conducted as part of the STP 3 & 4 COLA effort. One focus of this review was the identification of any information or data that would alter the evaluations of the EPRI-SOG teams with respect to the strong earthquake potential of the site region, including the offshore region. The new information developed since the EPRI-SOG study includes new gravity and magnetic data, refined kinematic models for the opening of the Gulf of Mexico, earthquakes that occurred since the EPRI-SOG study, and revised models of the state of stress within the site region. All of this information is discussed and presented within Subsections 2.5S.1 and 2.5S.2; and, as stated in those sections, none of this information requires or motivates a revision to the EPRI-SOG characterization of seismic potential for the site region with the exception of modifications to the maximum magnitude ($M_{max}$) distribution for some Gulf Coastal Source Zones. These modifications were motivated by the occurrence of two earthquakes that occurred within the Gulf of Mexico with magnitudes greater than the lower-bound $M_{max}$ value for some of the EPRI-SOG source zones that contain them (see Subsection 2.5S.2.4.3). These earthquakes have not been associated with any tectonic structures and are fully accounted for with the $M_{max}$ modifications to the EPRI-SOG model (see Subsection 2.5S.2.4.3).

Given the lack of specific information regarding discrete faults that may be potential seismic sources, the contribution to ground shaking hazard at STP 3 & 4 from the Gulf of Mexico region is modeled by areal source zones, as defined and characterized in the EPRI-SOG study (Reference 2). Therefore, the documentation of the EPRI-SOG source characterizations

(Reference 2) is the most comprehensive evaluation for the Gulf of Mexico region. These characterizations are summarized in subsection 2.5S.2.2 and described in detail in the EPRI-SOG documentation (Reference 2). This position is further supported below.

As outlined in the introduction to Subsection 2.5S.2, the potential for strong ground motion at the STP 3 & 4 site, including the Gulf of Mexico region, is characterized by the seismic source model used in the probabilistic seismic hazard analysis (PSHA) described in Subsection 2.5S.2. The basis for this source model and PSHA is guidance provided by the NRC as outlined in Regulatory Guide (RG) 1.208. This guidance states that the PSHA should be:

> "…conducted with up-to-date interpretations of earthquake sources, earthquake recurrence, and strong ground motion estimation" (page 3).

RG 1.208 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)" (page 14).

According to RG 1.208, the EPRI-SOG study (Reference 3, 4, 5) is an acceptable starting-point source characterization. Therefore, the EPRI-SOG model was adopted as the starting model for STP 3 & 4.

The EPRI-SOG study provides a comprehensive assessment of seismic hazards for the central and eastern US (CEUS) that was developed using an expert elicitation process involving six independent earth science teams (ESTs) comprised of scientists recognized as experts in the fields of seismology, geology, and geophysics. Through the expert elicitation process, this study incorporated the range of uncertainty about the occurrence of future earthquakes and seismic sources within the CEUS. Therefore, the resulting seismic source model for the CEUS can be viewed as representing the state of knowledge of the informed expert community at the time of the study with respect to the seismic potential of the CEUS crust, including the crust throughout the STP 3 & 4 site region.

However, RG 1.208 also states that site-specific geological, geophysical, and seismological studies should be conducted to determine if the EPRI-SOG source model adequately describes the seismic hazard for the site of interest given new data developed since acceptance of the original model. 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" (page C-1).

As outlined in Subsections 2.5S.1 and 2.5S.2, a comprehensive review was conducted to determine whether or not any new data or information exists that would require updating the EPRI-SOG source model for the STP 3 & 4 site. All of the updates made to the EPRI-SOG model are described in Subsection 2.5S.2; the changes included:

- Updating the $M_{max}$ distributions for source zones within the Gulf coastal region to account for recent earthquakes within these zones that have magnitudes higher than the lower-bound $M_{max}$ value for the respective zone (see Subsection 2.5S.2.4.3);
- Updating the New Madrid Seismic Zone source model to account for new information developed since the EPRI-SOG study on the recurrence and magnitude of large earthquakes within that region (see Subsection 2.5S.2.4.4.2);
- Revising the smoothing parameters of the Dames & Moore South Coastal Margin source zone to more conservatively represent the hazard at the STP 3 & 4 site (see Subsection 2.5S.2.4.5.1); and
- Updating the southern extent of the EPRI-SOG source model to ensure that seismicity parameters were defined for the entire site region (see Subsection 2.S.2.4.5.2).

With these modifications to the original EPRI-SOG source characterizations (Reference 2), the source model used for the STP 3 & 4 PSHA can be viewed as representing the potential for strong earthquake ground motions from sources within the site region, including the Gulf of Mexico, and none of these modifications drastically alter the characterization provided by the EPRI-SOG teams. Therefore, with the exception of the updates made to the EPRI-SOG source model described above, the EPRI-SOG source zones summarized within Subsection 2.5S.2.2 and fully presented within the EPRI-SOG documentation (Reference 2), characterize the seismic potential for the Gulf of Mexico region, given the current state of knowledge.

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

**References:**

1. NRC, 2007, Reg. Guide 1.208: A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion, US NRC, p. 53.

2. EPRI, 1986, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 5-10, Electric Power Research Institute (EPRI).

3. EPRI, 1989, Probabilistic seismic hazard evaluations at nuclear plant sites in the central and eastern United States: resolution of the Charleston earthquake issue (NP-6395-D), Electric Power Research Institute (EPRI).

4. EPRI, 1986-1989, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 1-3 & 5-10, Electric Power Research Institute (EPRI).

5. EPRI, 1989, EQHAZARD Primer (NP-6452-D), Electric Power Research Institute (EPRI), prepared by Risk Engineering for Seismicity Owners Group and EPRI.

**RAI 13.03-53**

**<u>QUESTION:</u>**

**<u>SITE-37</u>:** Subject: Addressing geophysical phenomenon "hydrologic"
[Basis: 10 CFR 50.47(b)(8); NUREG-0654, FEMA-REP-1, Rev. 1, November 1980: Criterion H.5.a, H.6.a; NUREG-0800, Chapter 13.3, SRP ACCEPTANCE CRITERIA: Requirements A and B; Acceptance Criteria 1, 2]

Provide reference to Plan Section(s) that addresses the geophysical phenomenon "hydrologic".

**<u>RESPONSE:</u>**

The Emergency Plan identifies assessment instrumentation in Table H-1. Specific reference to 'hydrologic' instrumentation is not identified in this table. However, precipitation monitoring equipment on the meteorological tower is identified. Precipitation is one of the identified states of hydrology and is measured by a specific instrument described in Section H, on page 7.

The Emergency Plan in Section H.1.6 'Meteorological System' last paragraph describes that weather forecasts are available from the National Weather Service (NWS). Products available through the NWS include precipitation, flood warnings, and storm surge. Each of these products is part of the 'hydrology' states that may cause STP to initiate emergency measures under natural or destructive phenomena guidelines described in the Emergency Classification procedure.

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

**RAI 13.03-62**

**QUESTION:**

**SITE-46:** Subject: Program verification
[Basis: 10 CFR 50.47(b)(8); NUREG-0654, FEMA-REP-1, Rev. 1, November 1980: Criterion K.6.c; NUREG-0800, Chapter 13.3, SRP ACCEPTANCE CRITERIA: Requirements A and B; Acceptance Criteria 1, 2]

Plan Section J.3 refers to "Station Radiation Protection Program". Provide response verifying that this program is consistent with Draft ANSI 13.12.

**RESPONSE:**

Criterion K.6.c; references Draft ANSI 13.12. However, this Standard has been revised and approved since NUREG-0654, FEMA-REP-1, Rev. 1, November 1980 was published. The current approved ANSI/HPS N13.12 -1999 scope identifies the applicability to the clearance of materials and equipment from controlled areas during operations. This scope is applicable to the Criterion K.6.c described in NUREG-0654.

The STP "Station Radiation Protection Program" maintains a comprehensive program including procedures and policies for control of radioactive materials and release of materials from controlled areas during operations. Additionally, the Emergency Plan Section A.2 identifies:

> "In addition to the Emergency Plan implementing and administrative Procedures, additional Station procedures will be utilized and implemented during response to a declared emergency. These procedures are:
>
> - Chemistry, Radiochemistry and Station Radiation Protection Procedures - These procedures provide instructions for instrument operation, performing surveys, analyzing samples and providing guidance for the monitoring and decontamination of personnel. These procedures also define administrative controls and procedures for the use of radiological monitoring devices, protective clothing and equipment, and prescribed radiological control limits and procedures;"

The above description verifies STP's "Station Radiation Protection Program" is consistent with the scope identified in ANSI/HPS 13.12 -1999.

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

**RAI 13.03-70**

**<u>QUESTION:</u>**

**ONSITE EMERGENCY PLAN: <u>SITE-4</u>:** Subject: Verification of addressing security/safeguards items
[Basis: NUREG-0800, Chapter 13.3, Section II, ACCEPTANCE CRITERIA, Requirement G, and Item 30 under "SRP Acceptance Criteria"]

NUREG-0800: Section 13.3, II. ACCEPTANCE CRITERIA, Requirements states that Acceptance criteria are based on meeting the relevant requirements of the following Commission and FEMA regulations:

G. Interim Compensatory Measures (ICMs) B.5.c, B.5.d, and B.5.e of Commission Orders of February 25, 2002, to all operating commercial nuclear power plants, relating to security-based emergency plans and preparedness. [Footnote: See also, SECY-06-0098, "Licensee Response to Demand for Information Regarding Mitigation Strategies Required Under Section B.5.b of the Orders Dated February 25, 2002, and Staff Recommendations for Follow-up Action," issued May 2, 2005 (Safeguards document).]

Although this order is addressed to operating reactors, it is expected that any new reactor license application would ensure that the applicable emergency plans would comply with the intent of this order. Please provide information concerning the applicant's intent on incorporating the applicable elements of ICMs B.5.b, B.5.c, B.5.d, and B.5.e in the submitted emergency plan, or indicate where in the application or emergency plan these are addressed, or justify an alternative approach.

**<u>RESPONSE:</u>**

NUREG-0800, Chapter 13.3, Section I, AREAS OF REVIEW states "In general, if an application is for an additional reactor at an operating reactor site, and the application proposes to incorporate and extend elements of the existing emergency planning program to the new reactor (including by reference), those existing elements should be considered acceptable and adequate."

Reg. Guide 1.206 provides criteria that an applicant should do if using an existing Emergency Plan as part of their COL application. This criterion addresses to the extent to which the existing plan is credited for the new unit(s), including various elements of existing plans with required modifications to this plan for staffing, EALs and the like.

STP's submittal of COLA Part 5 uses existing features of the current approved Emergency Plan for Units 1 and 2. Contained within these features are the criteria which the operating reactors were required to comply with in regards to:

- Interim Compensatory Measures (ICMs) B.5.c, B.5.d, and B.5.e of Commission Orders of February 25, 2002, to all operating commercial nuclear power plants, relating to security-based emergency plans and preparedness.

- SECY-06-0098, "Licensee Response to Demand for Information Regarding Mitigation Strategies Required Under Section B.5.b of the Orders Dated February 25, 2002, and Staff Recommendations for Follow-up Action," issued May 2, 2005 (Safeguards document).

STP completed an NRC Inspection (TI 2515/164) related to the B.5.b implementation criteria. NRC Inspection Reports [Safeguards Information documents] 05000498/2005009 and 05000499/2005009 dated January 27, 2006 found that STP "Fully meets the minimum acceptance criteria" related to B.5.b.

Elements of compliance with the above referenced documents can found within the Emergency Plan in Section D (EAL schemes) and Section G (Evacuation Routes).

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

Nuclear Operating Company
South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

September 4, 2008
ABR-AE-08000069

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 No. 52-012 and 52-013
<u>RAI Response Extensions Related to COLA Part 2 Tier 2 Sections 2.4S and 2.5S</u>

The purpose of this letter is to provide a revised schedule for submitting responses to NRC staff Request for Additional Information (RAI) questions. Responses to the affected RAI questions for COLA Part 2 Tier 2 Sections 2.4S and 2.5S, among those cited in References 1, 2, 3 and 4, will be submitted in accordance with the following.

The response to RAI question 02.04.14-1 for Section 2.4S will be provided by December 4, 2008, due to additional time required to incorporate the latest flooding analysis.

Responses to the following RAI questions for Section 2.5S will be provided by October 16, 2008, due to additional time required for incorporation of comments received during the August 2008 NRC staff site visit on the subjects of hydrology, geology and seismology:

| | | |
|---|---|---|
| 02.05.01-7 | 02.05.02-18 | 02.05.04-1 |
| 02.05.01-9 | | 02.05.04-2 |
| | | 02.05.04-3 |
| | | 02.05.04-4 |
| | | 02.05.04-12 |

There are no commitments in this letter.

If there are any questions regarding the due date extensions, please contact me at 361-972-4626, or Bill Mookhoek at 361-972-7274.

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

Executed on September 9, 2008

Gregory T. Gibson
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

ccc

References:

1. Letter, R. Anand to G. Gibson, "Request for Additional Information Letter No. 41 Related to the SRP Section 02.04.14 for the South Texas Combined License Application," dated May 12, 2008 (ML081350035)

2. Letter, G. Wunder to G. Gibson, "Request for Additional Information Letter No. 49 Related to the SRP Section 02.05.01 for the South Texas Combined License Application," dated May 19, 2008 (ML081410483)

3. Letter, G. Wunder to G. Gibson, "Request for Additional Information Letter No. 50 Related to the SRP Section 02.05.02 for the South Texas Combined License Application," dated May 19, 2008 (ML081420041)

4. Letter, G. Wunder to G. Gibson, "Request for Additional Information Letter No. 52 Related to the SRP Section 02.05.04 for the South Texas Combined License Application," dated May 19, 2008 (ML081420331)

cc:

(paper copy)

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