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Sent: Thursday, July 17, 2008 11:42 AM
To: Adrian Muniz; Belkys Sosa; George Wunder; Loren Plisco; Raj Anand; Rocky Foster; Tekia Govan; Tom Tai
Subject: Response to Request of Additional Information
Attachments: ABR-AE-08000054.pdf

Good Morning,

Attached, please find a courtesy electronic copy of the RAI response letter with attachments which answers the NRC's Request for Additional Information related to Combined License Application (COLA) Part 2, Tier 2 Sections 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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July 16, 2008
ABR-AE-08000054

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

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter numbers 39 (May 12, 2008) and 49 (May 19, 2008) related to Combined License Application (COLA) Part 2, Tier 2 Sections 2.4S and 2.5S. This submittal includes responses to the following Question numbers:

02.04.12-11	02.05.01-6
02.04.12-14	02.05.01-8
02.04.12-22	02.05.01-15
02.04.12-25	

When a change to the COLA is indicated by a question response, the change will be incorporated into the next routine revision of the COLA following NRC acceptance of the question response.

STPNOC is extending the schedule for responding to two RAIs, 02.04.08-1 and 02.04.08-2, as transmitted under RAI letter number 44 (May 12, 2008). These responses were assigned to STPNOC's prime environmental/safety contractor, Bechtel Incorporated, who was unable to deliver them within the response period they agreed to meet. STPNOC is currently working with Bechtel to produce a quality response to these RAIs and will submit them by August 28, 2008.

There are no new commitments made 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 July 16, 2008

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

sab

Attachments:
1. Question 02.04.12-11
2. Question 02.04.12-14
3. Question 02.04.12-22
4. Question 02.04.12-25
5. Question 02.05.01-6
6. Question 02.05.01-8
7. Question 02.05.01-15

cc: w/o attachment except*
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RAI 02.04.12-11:

QUESTION:

In FSAR Section 2.4S.12.2.4, Page 2.4S.12-11, is the information in the second paragraph summarized in Table 2.4S.12-14? It does not appear to be present in the table, but should be. Please indicate whether or not these properties represent the vadose zone and the confining sequence above the Upper Shallow, or some portion of the Shallow Aquifer.

RESPONSE:

The information in FSAR Section 2.4S.12.2.4 includes generalizations of geotechnical data that is presented in FSAR Section 2.5S.4. However, only data that provide insight to hydrogeologic properties of the subsurface at Units 3 & 4 are presented in FSAR Table 2.4S.12-14. The discussion included in the second paragraph of FSAR Section 2.4S.12.2.4 is provided to present a summary of some of the geotechnical findings (i.e., moisture content and wet density). However, these data are not included in FSAR Table 2.4S.12-14 because they are not germane to that table. The geotechnical data are summarized in FSAR Tables 2.5S.4-8, -10, and -12.

Although discussed in FSAR Section 2.4S.12.2.4, the information presented in the second paragraph does not pertain to the Shallow Aquifer, but to the confining sequence/vadose zone above the Upper Shallow Aquifer. FSAR Tables 2.5S.4-8, -10, and -12, which summarize this geotechnical information, indicate the confining sequence as stratum A.

The second paragraph of FSAR Section 2.4S.12.2.4 will be revised as shown below:

> The vadose zone is considered to be relatively thin and limited at the site. The first saturated sand zone is encountered at a general depth of approximately 20 ft below ground surface, and it is classified as part of the Upper Shallow Aquifer. The aquifer zone exhibits semi-confined to confined conditions. The potentiometric head is under pressure, rising to within 5 ft to 10 ft of ground surface as measured in the onsite observation wells. The soils overlying the sand are generally described as clay (CL to CH, USCS Groups). From the geotechnical data listed in Subsection 2.5S.4 and summarized in Tables 2.5S.4-8, -10, and -12, measured natural moisture contents from samples collected to a depth of 20 ft ranged from approximately 5 percent to 29 percent. The majority of the values ranged between 15 percent and 25 percent. Dry unit weights for the materials sampled ranged from approximately 92 pounds per cubic foot (pcf) to 115 pcf. Wet densities, when measured, ranged from approximately 97 pcf to 133 pcf.

RAI 02.04.12-14:

<u>QUESTION</u>:

In FSAR Section 2.4S.12.2.4.1, Page 2.4S.12-13, (refer to Figure 2.4S.12-19) a statement is made that “flow pathway …(is)… from the MCR toward STP 3 and 4.” The head drop in the figure implies flow in the opposite direction, i.e., toward the MCR from STP 3 and 4. Please clarify.

<u>RESPONSE</u>:

Figure 2.4S.12-19 includes potentiometric surface contour maps of the Upper Shallow Aquifer for February 22 and April 27, 2007. The February 22 and April 27, 2007 contour maps indicate the measured head at observation wells OW-932U (24.79 ft and 25.06 ft, respectively) and OW-933U (24.67 ft and 25.05 ft, respectively) located between the MCR and STP 3 & 4 are consistently at slightly higher elevations than those measured in the observation wells OW-420U (24.47 ft and 24.71 ft, respectively), OW-348U (24.57 ft and 24.94 ft, respectively), and OW-349U (24.32 ft. and 24.73 ft, respectively) located at the south end of Units 3 & 4.

These data indicate that a head drop from south to north or from the MCR to STP 3 & 4 exists in the Upper Shallow Aquifer. However, because the difference in head is on the order of tenths of feet, a contour line representing an equal elevation (a whole number) is not drawn to illustrate this. However, these data do suggest that some flow in the Upper Shallow Aquifer emanates from the south of STP 3 & 4 where the MCR is located.

Data collected from the observation wells located at the northern power block area and north of STP 3 & 4 indicate the prevalent flow originates from the northwest. This indicates groundwater flow in the Upper Shallow Aquifer converges at STP 3 & 4. FSAR Section 2.4S.12.2.2 states influence from the MCR and the duck pond/marsh to the Upper Shallow Aquifer is evident based on data used to prepare the maps provided in Figure 2.4S.12-19. A brief statement is provided in FSAR Section 2.4S.12.2.4.1 concerning an observed high hydraulic conductivity zone that may correspond with the high groundwater elevations measured in the area in the Lower Shallow Aquifer. This statement will be deleted in a revision of FSAR Section 2.4S.12.2.4.1 per the response to FSAR RAI Question 02.04.12-15.

The COLA revision required as a result of this RAI response is included in the response to FSAR RAI Question 02.04.12-15.

RAI 02.04.12-22:

QUESTION:

In FSAR Section 2.4S.12.3.1, Page 2.4S.12-17, provide the basis for the statement that there is "no credible offsite release pathway for Deep Aquifer." To what extent does the conclusion reached rely on the continued operation of deep production wells? What about timing? What if a release occurred near the end of plant design life? Are there more germane reasons that this is not a plausible pathway?

RESPONSE:

The excavation for the foundations of the deep structures associated with the construction of Units 3 & 4 is planned to depths of about 100 feet below existing site grade, within the Shallow Aquifer. The Shallow Aquifer extends to depths ranging from about 120 feet to 150 feet. The Shallow Aquifer is in direct contact with the excavation backfill material surrounding the building structures, including the radwaste building - the postulated release point of contaminants to groundwater.

Therefore, any postulated release of liquids from the radwaste building to the backfill would immediately impact the Shallow Aquifer. A downward hydraulic head and hydraulic connectivity between the upper and lower zones of the Shallow Aquifer would result in vertical migration downward through the backfill to the Lower Shallow Aquifer, which has an east to southeast flow direction.

The possibility of an accidental release from the Lower Shallow Aquifer to the Deep Aquifer was ruled out as a likely pathway for an offsite release for the following reasons:

- A release of contaminants would be in an aqueous form from the radwaste building to the excavation backfill. The aqueous contaminants would follow the path of least resistance, which is the permeable sand layers within the Shallow Aquifer that are in communication with the backfill.
- The Deep Aquifer is separated from the Shallow Aquifer by a regional aquitard that consists of a 100- to 150-foot thick sequence of clay and silt layers. Laboratory tests of similar, shallower clay materials at the site have hydraulic conductivity values between 10^{-6} to 10^{-8} cm/sec (Table 2.4S.12-13).
- An aquifer pumping test conducted on January 27, 1975 at STP Deep Aquifer production well No. 5 had a reported pumping rate of 600 gpm for three days of testing and showed no hydraulic response at a Shallow Aquifer observation well located approximately 75 feet from the pumping well; however, significant responses were recorded in Deep Aquifer piezometers located at distances of 75 to 462 feet from the test well (Reference 1). Based on the results of this pumping test, it is concluded that there was no observed groundwater movement from the Shallow to the Deep Aquifer, and consequently it is extremely unlikely that contamination would infiltrate into the Deep Aquifer from surface activities at STP.

The above reasons indicate that the downward migration of contaminants from the Shallow Aquifer to the Deep Aquifer is not a credible scenario. In addition, the large thickness of the low-permeability confining layer separating the Deep and Shallow Aquifers would provide substantial protection for the deep unit due to prolonged travel time and abundant opportunity for dispersion and adsorption of contaminants before they could reach the Deep Aquifer.

Based on the above, it is considered irrelevant if the production well pumps are in operation or not with regard to contamination of the Deep Aquifer. These lines of evidence suggest that the Deep Aquifer is not a plausible pathway for off-site release of groundwater contaminants originating on the STP site.

Reference:

1) Woodward-Clyde Consultants, July 9, 1975, Deep Aquifer Ground-Water Evaluation and Pump Test Results – South Texas Project, for Brown & Root, Inc., Houston, Texas; Woodward-Clyde Consultants, Consulting Engineers and Geologists, Oakland, California.

The last paragraph of Section 2.4S.12.3.1 will be revised as follows:

> The Deep Aquifer is the least likely hydrogeologic unit to be impacted by an accidental liquid effluent release. The Deep Aquifer is separated from the Shallow Aquifer by a 100 ft to 150 ft thick clay and silt layer. Recent potentiometric surface maps for the Deep Aquifer (Subsection 2.4S.12.2.2) indicate that groundwater flow in the plant area is moving toward the production wells at the site, thus precluding the potential for offsite migration should the effluent pass through the clay layer. The additional groundwater needs for operation of STP 3 & 4 will further depress the potentiometric surface in the Deep Aquifer. The combined effects of horizontal flushing by flow in the Shallow Aquifer~~,~~ and radionuclide sorption as the effluent passes through the 100+ ft thick clay layer~~,~~ suggest that a completed pathway in the Deep Aquifer to off-site receptors is extremely unlikely. Under these conditions, ~~and groundwater capture by the site production wells suggest that~~ there is no credible offsite release pathway for the Deep Aquifer.

RAI 02.04.12-25:

QUESTION:

In Section 2.4S.12.4, Page 2.4S.12-20, the applicant states that an unlikely event would “trigger” operational accident monitoring. Explain what would detection of groundwater contamination by operational accident monitoring “trigger”?

RESPONSE:

Potential groundwater contamination due to unintentional releases of plant-related radionuclides to the environment could include those that are acute and the result of recognized operational incidents such as a tank overfill, those that are chronic and due to unrecognized on-going situations such as slow leakage from an unlined sump or buried pipeline, or even those due to routine permitted plant emissions.

The Electric Power Research Institute (EPRI) guideline forms the basis for monitoring groundwater quality at the STP units. The monitoring plan specifies techniques for sampling groundwater from monitoring wells, frequency of sampling, radionuclides to be analyzed for, methods and minimum detectable concentrations for sample analysis, methods of quality assurance for collection and analysis of samples, indicators for elevated constituents of concern and remedial action levels (triggers) for each radionuclide of concern.

Trigger mechanisms include: (1) observation and associated required notification of acute releases as determined by plant procedures and processes implemented during plant operations, and (2) detection of elevated levels of potential contaminants or indicator parameters from routine plant environmental monitoring activities, including groundwater monitoring. Triggering could result in one or more of the following: increased sampling frequency and analysis, expansion of the monitoring network, implementation of a site- or source-specific subsurface investigation, and/or implementation of remedial actions.

The second to the last paragraph of FSAR Section 2.4S.12.4 will be revised as shown below based on this response.

> Operational accident monitoring would be triggered in the unlikely event of a release of liquid effluent from the plant. Trigger mechanisms may include, but not be limited to, observations and notification of acute releases through plant procedures and processes implemented during plant operations, and detection of elevated levels of potential contaminants or indicator parameters from routine plant environmental monitoring activities, including groundwater monitoring. Quarterly groundwater samples would be collected from site production wells and downgradient Shallow Aquifer observation wells. Selection of downgradient observation wells would be based on flow directions determined from the most recent groundwater level measurements. Additional monitoring, subsurface investigations or remedial action may be required based on the triggers and situation encountered.

RAI 02.05.01-6:

QUESTION:

Section 2.5S.1.1.4.4.5.2 indicates that Collins et. al. 1990 (Reference 2.5S.1-134) concluded that there is a need for a paleoseismic study to determine if the Balcones fault zone is active. Please explain why you have not conducted such a study.

RESPONSE:

Regulatory Guide 1.208 (NRC, 2007) outlines the process of developing seismic source models for COL applications. This guidance states that seismic sources defined within the Electric Power Research Institute Seismicity Owners Group (EPRI-SOG) study (EPRI, 1986-1989) are acceptable starting-point source characterizations under the condition that new information developed since the EPRI-SOG study (i.e., approximately 1986) is evaluated to determine if the EPRI-SOG source characterizations need to be updated. Implied in this guidance is that the EPRI-SOG source models adequately represented the seismic hazard given the state of knowledge at the time of the study and that updates need to be made to the source models to reflect updates to this state of knowledge.

The study of Collins et al. (1990) post-dates the development of source models within the EPRI-SOG study (EPRI, 1986), so it was evaluated in conjunction with all other available information published since the EPRI-SOG study to determine whether or not a revision to the EPRI-SOG source model was required. A paleoseismic study of the Balcones fault zone was not conducted as part of the STP 3 & 4 COL application because it was determined from this review of materials that there is no new evidence to support the conclusion that the Balcones fault zone is a capable tectonic feature, and thus no reason to conduct a paleoseismic study to update the EPRI-SOG model. The basis for this evaluation is outlined below.

The Balcones fault zone was a known tectonic feature at the time of the EPRI-SOG study (EPRI, 1986) as evidenced by published studies of the fault that pre-date EPRI-SOG (e.g., Murray, 1961), and the inclusion and discussion of the Balcones fault zone in the STP Units 1 & 2 FSAR (STPEGS, Rev 13). Several of the EPRI-SOG Earth Science Teams explicitly discuss the Balcones fault zone as a tectonic feature (e.g., Bechtel and Law Engineering) in their seismic source characterizations of the central and eastern US (EPRI, 1986), and thus the seismogenic potential of the Balcones fault zone as understood at the time of the EPRI-SOG study is reflected in the EPRI-SOG source model for the central and eastern US (EPRI, 1986).

Given the NRC's acceptance of the EPRI-SOG model (EPRI, 1986) as a valid base or starting model for conducting a probabilistic seismic hazard analysis for COL applications as outlined in Regulatory Guide 1.208 (NRC, 2007), the evaluation of the Balcones fault zone with respect to its seismogenic potential and whether or not a detailed paleoseismic study was needed focused on: (1) determining whether any new information or data developed since the EPRI-SOG study demonstrates that the EPRI-SOG characterization of the Balcones fault zone is outdated or nonconservative, and (2) determining whether there is strong evidence that the fault zone is a capable tectonic feature.

Numerous seismic hazard assessments and seismic source characterizations of tectonic and other geologic features have been conducted in regions that include the Balcones fault zone since the EPRI-SOG study (e.g., Crone and Wheeler, 2000; Frankel et al., 1996; Frankel et al., 2002; Savy et al., 1998; Wheeler, 2005, 2006, 2008; Wheeler and Crone, 2001), the most recent of which is the 2008 update of the United States Geological Survey (USGS) National Seismic Hazard Maps (Petersen et al., 2008). None of these studies, including those explicitly tasked with identifying capable and potentially capable geologic features (e.g., Crone and Wheeler, 2000; USGS and Texas BEG, 2006; Wheeler, 2005, 2006, 2008; Wheeler and Crone, 2001) have identified the Balcones fault zone as a capable or potentially capable seismic source. This large quantity of research represents the current state of knowledge of the seismic potential of the Balcones fault zone.

As noted in the current RAI, Subsection 2.5S.1.1.4.4.5.2 cites a field trip guidebook from a 1990 Austin Geological Society field trip along the Balcones fault zone (Collins et al., 1990) as stating that detailed paleoseismic studies are needed to conclusively demonstrate Quaternary activity or non-activity of the fault zone. This report is the only post-EPRI-SOG (EPRI, 1986) study to suggest that the Balcones fault zone may have had Quaternary activity. The relevant data presented by Collins et al. (1990) used to reach these conclusions is reviewed below.

Collins et al. (1990) noted "wedge shaped" fractures at one location along the Balcones fault zone that were filled with reddish clay, silt, and sand that Collins et al. (1990) suggest "may be terra rossa" deposits, an old soil interpreted to be between 0.73 and 2.0 million years old. Collins et al. (1990) speculate that these wedge-shaped fractures "likely opened during rupture or slip of the fault, and it is possible that the sediments filled the fractures during or soon after fault movement." Based on the assumption that the fracture-filling sediments are Quaternary terra rossa deposits, Collins et al. (1990) concludes that "this fault may have moved during the early Pleistocene" and that "it may be premature to conclude that this fault zone is extinct." However, Collins et al. (1990) also note that "poorly dated Pleistocene (?) high terrace deposits are apparently not offset by the fault" providing positive and direct evidence that the Balcones fault zone has not had Pleistocene activity.

For the STP 3 & 4 COLA, the above information was evaluated. As stated in Subsection 2.5S.1.1.4.4.5.2, it was concluded that the fracture filling deposits cited as potential evidence for Quaternary activity by Collins et al. (1990) is contradictory and does not provide positive evidence that the fault zone is a capable tectonic feature. The observation of unfaulted Pleistocene deposits overlying the fault is positive evidence for non-activity. The presence of colluvial deposits within fractures can be explained by non-tectonic processes, and thus is ambiguous evidence for tectonic activity. Also, the Collins et al. (1990) study, when considered in the context of other more recent peer-reviewed studies (e.g., Crone and Wheeler, 2000; Frankel et al., 1996; Frankel et al., 2002; Savy et al., 1998; Wheeler, 2005, 2006, 2008; Wheeler and Crone, 2001), does not reflect a change in the state of knowledge of the seismic potential of the Balcones fault zone that is robust enough to justify either modifying the seismic source characterizations of the EPRI-SOG model, or conducting a detailed paleoseismic study. This conclusion was based on the following observations:

- The field trip guidebook within which Collins et al. (1990) make their observations has not been peer reviewed, and thus there is no implicit acceptance of its scientific validity by the broader technically informed community;
- There is uncertainty in whether or not the reddish deposits in the fractures, which are the basis for the conclusion that the fault may have had Quaternary activity, are terra rossa;
- If the deposits are terra rossa, there is considerable uncertainty in the age of the terra rossa, and at its oldest the terra rossa may be Late Pliocene (i.e., pre-Quaternary implying the fault zone is not capable);
- It is unknown whether the fractures opened during a seismogenic event, and if so when this event occurred (i.e., the reddish brown deposits may not have filled the fractures till well after the fractures formed). Thus the fractures provide only indirect and ambiguous evidence of fault activity;
- Deposits mapped as Pleistocene (Garner and Young, 1976)deposits are not offset by the fault, which is direct and unambiguous evidence for nonactivity;
- Expert compilations of the known evidence for potentially and positively Quaternary active features do not include the Balcones fault zone (e.g., Crone and Wheeler, 2000; Wheeler, 2005, 2006, 2008; Wheeler and Crone, 2001).

Eddie Collins, lead author of the Collins et al. (1990) report, was interviewed in preparation of this response. When asked about his opinion of the evidence for activity of the Balcones fault zone he replied that, "I don't know of any field evidence that would verify Pleistocene or Holocene slip on any of the fault strands that compose the Balcones Fault Zone" (Collins, 2008). Collin's current opinion of the Balcones fault zone agrees with the interpretation of the Collins et al. (1990) work in Subsection 2.5S.1.1.4.4.5.2 that there is no evidence to support the interpretation of the Balcones fault zone as a capable feature.

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

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RAI 02.05.01-8:

QUESTION:

Seismic reflection, well log, and imagery data sources described in Section 2.5S.1.2.4.2.2.1 and Section 2.5S.1.2.4.2.2.1 were not capable of resolving the surface locations of growth faults. Please explain why the investigations for the STP COLA site did not include a LiDAR survey of the site area to reassess evidence for possible subtle surface folding or faulting along growth faults in the site area, particularly along the possible surface trace of fault I.

RESPONSE:

Subsections 2.5S.1.2.4.2.2.1 and 2.5S.1.2.4.2.2.2 describe in detail the investigations completed to identify potential surface features related to growth fault activity (e.g., broad monoclinal folding and flexure of the land surface). These investigations included a detailed review of all publicly available data concerning the position of growth faults, analysis of proprietary subsurface mapping of growth faults, review of the growth fault investigation undertaken in the UFSAR for STP Units 1 and 2 (STPEGS UFSAR, Rev 13), analysis of aerial photos, aerial reconnaissance, and detailed ground reconnaissance. Within this effort the identification of growth faults with a geomorphic expression primarily came from aerial photo analysis and ground reconnaissance.

Figures 2.5S.1-44 and 2.5S.1-45 will be replaced with enhanced figures that show the location of anomalous geomorphic features (e.g., closed and linear depressions, slope breaks, vegetation lineaments) identified in the aerial photo analysis. During the analysis, particular attention was applied to identifying geomorphic features that were spatially correlated with the growth fault projections developed in the COLA and in the UFSAR for STP Units 1 and 2 (STPEGS UFSAR, Rev 13). As stated in Subsection 2.5S.1.2.4.2.2.2, the only strong spatial correlation between distinct lineaments and projected growth faults was with growth fault I/GMO (Figure 2.5S.1-45) suggesting that fault I/GMO is the only fault within the site area with a geomorphic expression of potential Quaternary activity.

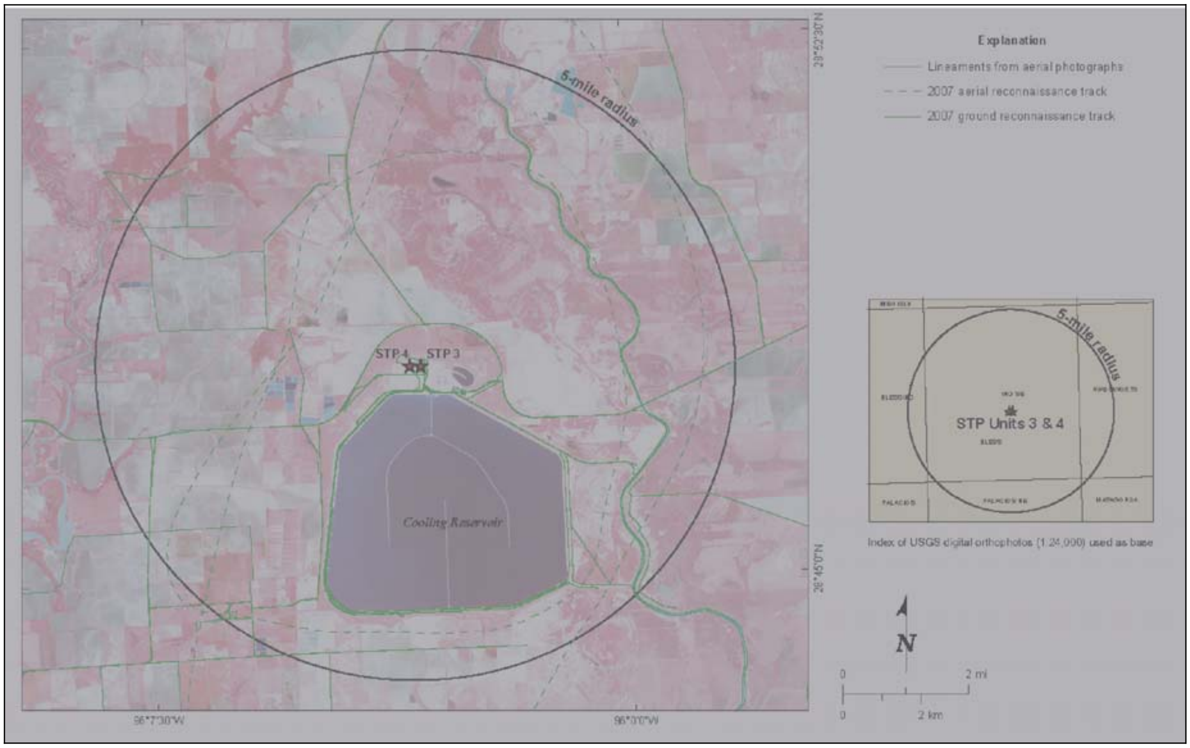
As discussed in Subsection 2.5S.1.2.4.2.2.2, lineaments and growth fault projections within the site area to which access could be obtained were investigated during ground reconnaissance efforts. The only growth fault projection or lineament that was observed to have a surface expression consistent with growth fault activity (e.g., laterally persistent monoclinal folding and flexure) was the projection of and lineaments correlated with fault I/GMO. These observations confirmed the results of the aerial photo analysis.

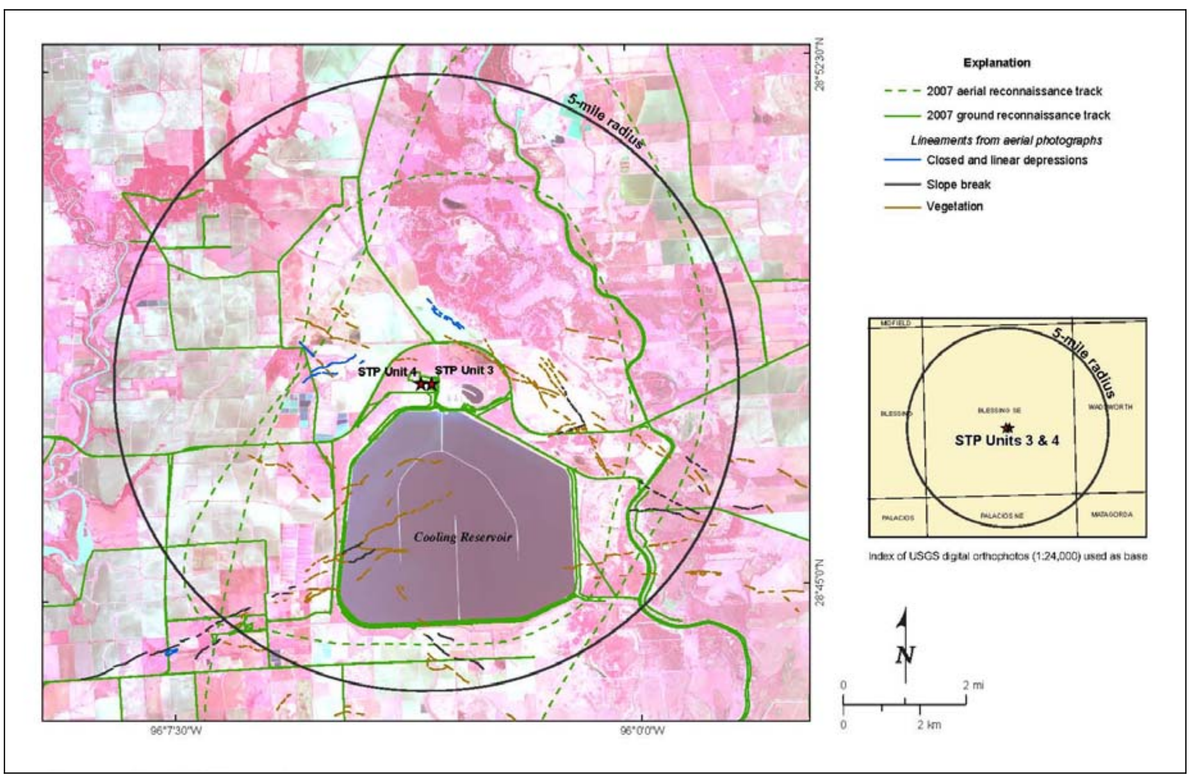
As presented in Subsection 2.5S.1.2.4.2.2.2 and apparent in Figure 2.5S.1-45, the monoclinal folding, lineations, and surface projections associated with fault I/GMO are strongly correlated, suggesting that the diversity of methods used to identify growth faults with surface expression (e.g., ground reconnaissance, fault projections, aerial photo analysis) were robust and capable of identifying the surface expression of growth faults if present. The robust nature of these methods then provides confidence that the methods are capable of identifying surface deformation from growth faulting throughout the site area if it exists. Therefore, it was deemed unnecessary to conduct a separate LiDAR survey to identify surface deformation associated with growth faulting.

References:

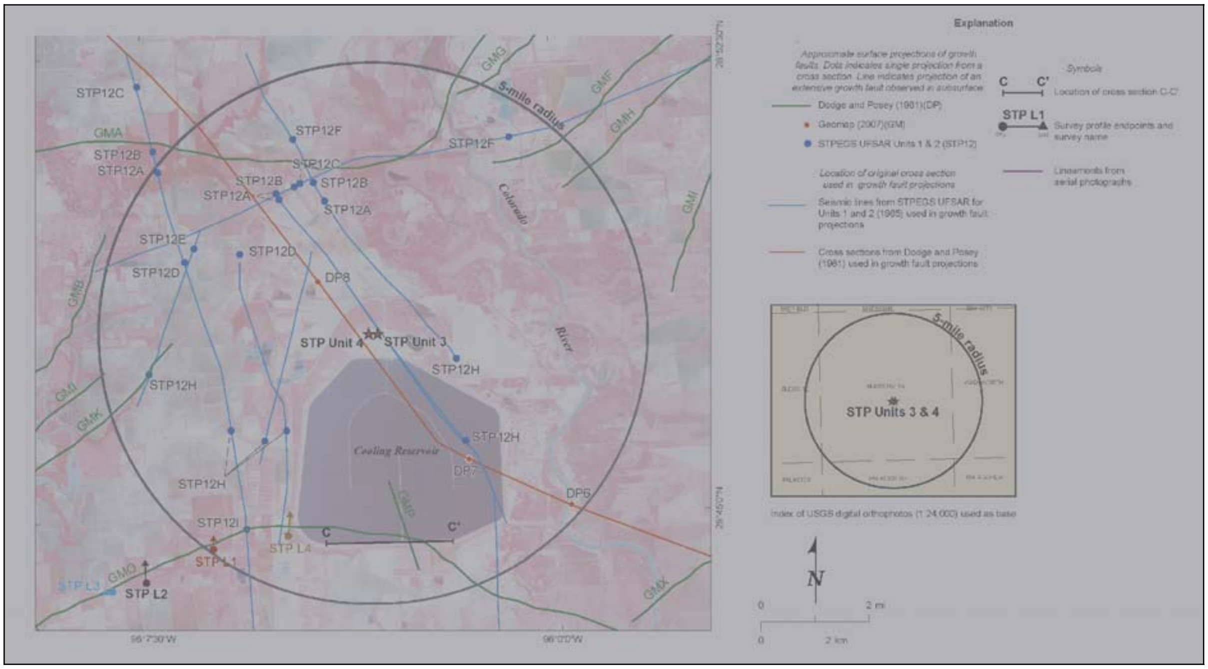
STPEGS UFSAR, Rev 13, STPEGS Updated Final Safety Analysis Report, Units 1 and 2, Revision 13.

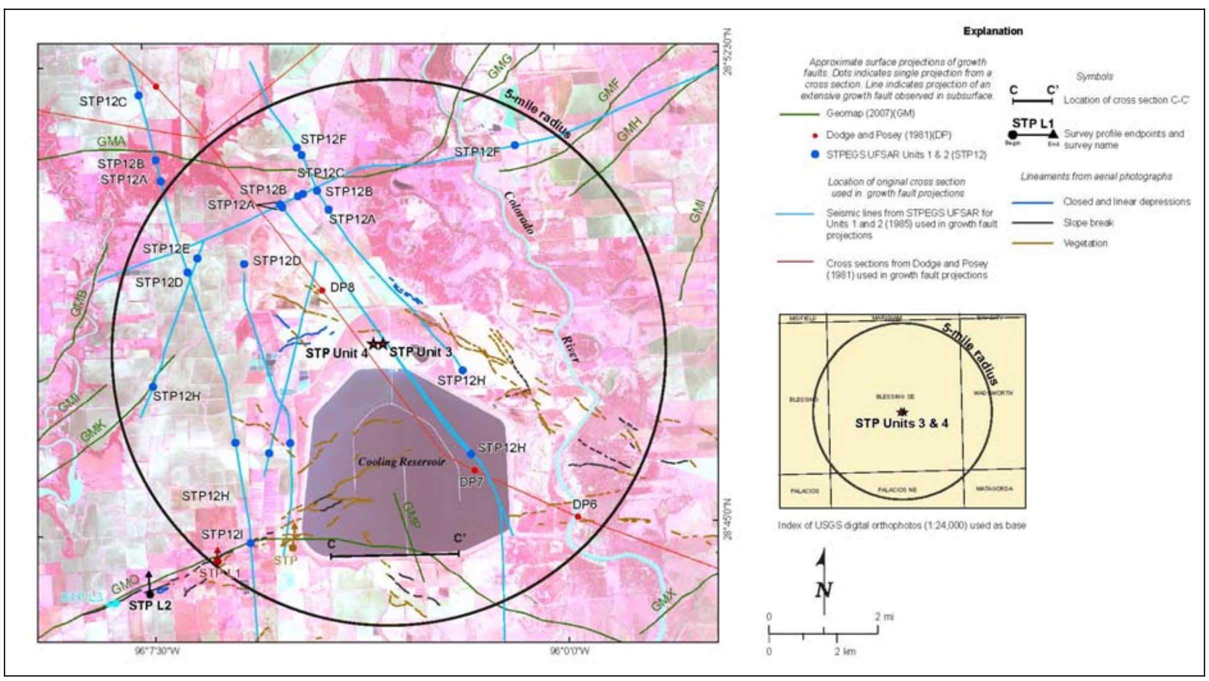
Replace Figure 2.5S.1-44 with a revised version that includes lines for lineaments.





Replace Figure 2.5S.1-45 with a revised version that includes lines for lineaments.





RAI 02.05.01-15:

QUESTION:

As illustrated in Figure 2.5S. 1-8, 1-15, 1-16, and Plate 6 of Reference 2.5S.1-23, faults that were active during Mesozoic rifting and are now buried by 3-15 kilometers of Mesozoic and Cenozoic deposits are likely to occur below the site region. Direct study of these buried faults in outcrop or in excavations is not possible. Elsewhere in the Central and Eastern U. S. (CEUS) where similar geologic conditions exist, researchers used liquefaction features induced by large earthquakes to estimate timing, source areas, magnitudes, and recurrence intervals of large prehistoric earthquakes. Holocene and Late Pleistocene deposits (e.g., fluvial, deltaic, beach and back beach deposits) that are likely to be susceptible to liquefaction during large earthquakes occur in the STP site region. Please explain why you did not search for liquefaction features potentially produced during large earthquakes in the site region.

RESPONSE:

As described in Sections 2.5S.1 and 2.5S.2, an extensive review of published scientific literature, government agency reports, and other materials was conducted as part of the STP 3 & 4 COLA. One focus of this review was on the identification of any reported liquefaction features within the site region. The review of available literature at the time (e.g., Crone and Wheeler, 2000; Wheeler, 2005, 2006; Wheeler and Crone, 2001) and more recent studies (Wheeler, 2008) discovered no reported liquefaction features within the site region. The lack of any previously reported liquefaction features and the absence of any moderate to large earthquakes within the site region within the historical record (see discussion in Section 2.5S.2) (e.g., Davis et al., 1985; Davis et al., 1989; Frohlich and Davis, 2002) suggest that the probability of existence of liquefaction features within the site vicinity is small.

Despite the small likelihood of any liquefaction features existing within the site vicinity, original investigations were carried out for the STP 3 & 4 COLA partially with the goal of identifying paleoseismic features within the greater site area. These investigations included the analysis of stereo-paired aerial photography and field reconnaissance. Analysis of the aerial photography is described in Subsection 2.5S.1.2.4.2.2.2 in the context of the growth fault investigation, but analysts also looked for evidence of liquefaction (e.g., tonal variations from sand ejected during liquefaction, filling of contemporary fissures, and stream bank failure). As noted in Subsection 2.5S.1.2.4.2.2.2, all "potentially anomalous geomorphic features" in the aerial photos were identified. None of these features provided evidence of liquefaction.

During geologic field reconnaissance within the greater site area, exposures of Quaternary sediments also were investigated for the presence of liquefaction features. The best exposures of sediments within the site vicinity were of the Pleistocene Beaumont Formation along the banks of the Colorado River. Over 15 miles of riverbank along the Colorado River were investigated within the greater site vicinity for the presence of liquefaction features (see Figure 2.5S.1-44 for the extent of the investigation within the site area), and no evidence of liquefaction was found.

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

References:

Crone, A.J., and Wheeler, R.L., 2000, Data for Quaternary faults, liquefaction features, and possible tectonic features in the Central and Eastern United States, east of the Rocky Mountain front, U.S. Geological Survey Open-File Report 00-260, p. 342.

Davis, D.M., Pennington, W., and Carlson, S., 1985, Historical seismicity of the state of Texas: a summary: Gulf Coast Association of Geological Societies Transactions, v. 35, p. 39-44.

Davis, S.D., Pennington, W.D., and Carlson, S.M., 1989, A compendium of earthquake activity in Texas, University of Texas at Austin, Bureau of Economic Geology, Geological Circular 89-3.

Frohlich, C., and Davis, S.D., 2002, Texas Earthquakes: Austin, University of Texas Press, 275 p.

Wheeler, R.L., 2005, Known or Suggested Quaternary Tectonic Faulting, Central and Eastern United States—New and Updated Assessments for 2005, U.S. Geological Survey Open-File Report 2005-1336, p. 40.

—, 2006, Quaternary tectonic faulting in the eastern United States: Engineering Geology, v. 82, p. 165-186.

—, 2008, Paleoseismic Targets, Seismic Hazard, and Urban Areas in the Central and Eastern United States: Bull. Seis. Soc. Am., v. 98, p. 1572-1580.

Wheeler, R.L., and Crone, A.J., 2001, Known and suggested Quaternary faulting in the midcontinent United States: Engineering Geology, v. 62, p. 51-78.