PMSTPCOL PEmails

From: Chappell, Coley [ccchappell@STPEGS.COM]
Sent: Wednesday, July 09, 2008 12:44 PM
To: George Wunder
Cc: Raj Anand
Subject: RAI response letter
Attachments: ABR-AE-08000047.pdf

Mr. Wunder,

Please find attached a courtesy electronic copy of an RAI response letter with attachments.
On the date of the letter, an official paper copy was sent by overnight delivery to your address.

Coley Chappell
Licensing STP 3&4
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From: Chappell, Coley

Created By: ccchappell@STPEGS.COM

Recipients:
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Tracking Status: None

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July 2, 2008
ABR-AE-08000047

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

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

Reference: Letter, G. Gibson to Document Control Desk, "Request for Extensions for RAI Related to COLA Part 2 Tier 2 Chapters 2.4S and 2.5S" dated June 17, 2008 (ABR-AE-0800047, ML081700523)

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter numbers 32, 36, 39, 40, 49, 50, 54 and 55 related to Combined License Application (COLA) Part 2, Tier 2 Sections 2.4S, 2.5S, 9.1, and 10.4. This submittal includes responses to the following Question numbers:

02.04.03-4	02.04.12-1	02.04.12-15	02.05.01-17
02.04.03-5	02.04.12-3	02.04.12-18	02.05.02-17
02.04.03-7	02.04.12-4	02.04.12-21	09.01.05-1
02.04.03-8	02.04.12-8	02.04.13-6	09.01.05-2
02.04.09-1	02.04.12-12	02.05.01-2	10.04.05-1

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.

Responses to Questions 02.04.12-18, 02.05.02-17 and 09.01.05-1 refer to current NRC commitments (COM 2.4S-2, COM 2.5S-1 and COM 9.1-3 respectively). There are no new commitments made in this letter.

Based on discussions with the NRC project manager for FSAR Chapter 2.5, Raj Anand, a majority of the RAI on FSAR Chapter 2.5 are on hold until after the NRC site audit on Chapter 2.5 scheduled for the week of August 11, 2008. As stated in the referenced letter, the revised due dates for RAI responses related to Chapter 2.5 will be established at the completion of the site audit.

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 2, 2008

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

ccc

Attachments:
1. Question 02.04.03-4
2. Question 02.04.03-5
3. Question 02.04.03-7
4. Question 02.04.03-8
5. Question 02.04.09-1
6. Question 02.04.12-1
7. Question 02.04.12-3
8. Question 02.04.12-4
9. Question 02.04.12-8
10. Question 02.04.12-12
11. Question 02.04.12-15
12. Question 02.04.12-18
13. Question 02.04.12-21
14. Question 02.04.13-6
15. Question 02.05.01-2
16. Question 02.05.01-17
17. Question 02.05.02-17
18. Question 09.01.05-1
19. Question 09.01.05-2
20. Question 10.04.05-1

cc: w/o attachment except*
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RAI 02.04.03-4:

<u>QUESTION</u>:

In FSAR Section 2.4S.3.4.1.4, clarify the following statement: "These initially calibrated model parameters were further adjusted to match the peaks of historic flood frequencies estimated at various stream gauging stations located within the study area."

<u>RESPONSE</u>:

The calibrated United States Army Corps of Engineers (USACE) HEC-HMS model parameters included initial rainfall loss, constant rainfall loss rate, Snyder's basin lag-time, and Snyder's peaking coefficient (see Vol. II-B, Chapter 4, pg. 16 of Reference 2.4S.3-8). Calibration of the parameters is discussed in Section 2.4S.3-3, Section 2.4S.3.4.2.1, and Chapter 4 of Reference 2.4S.3-8. Values for each model parameter in each sub-basin are presented in Table 2.4S.3-2. Since the model parameters and parameter values are already included in the COLA, the COLA will be revised to include the six gauge locations used as key calibration points for matching peak discharges. Calibration results of the HEC-HMS models, or validation of this approach, is summarized in Attachment A of Chapter 4 of Reference 2.4S.3-8.

The second paragraph of Section 2.4S.3.4.1.4 of the COLA will be revised as follows:

> The ~~United States Army Corps of Engineer's~~USACE HEC-HMS model, Version 2.2.2, (Reference 2.4S.3-17) was used for this study as the hydrologic modeling framework to determine frequency flood hydrographs resulting from selected storm events with return periods of 2, 5, 10, 25, 50, 100, and 500-year and the ~~SPS~~Standard Project Storm. The HEC-HMS models developed for the Halff study were initially calibrated using three historic storm events selected based on availability of adequate rainfall gauge data. The selected three storm events occurred in June 1997, October 1998, and November 2000 (see Vol. II-B, ~~Chapter. 4~~Chapter 4, pg. 12 of Reference 2.4S.3-8). The calibrated HEC-HMS model parameters included: initial rainfall loss, constant rainfall loss rate, Snyder's basin lag-time, and Snyder's peaking coefficient (see Vol. II-B, ~~Chapter. 4~~Chapter 4, pg. 16 of Reference 2.4S.3-8). Also, the Halff study noted that "six special Points-of-Interest (POI's) were selected as target locations to compute/calibrate critical peak flow hydrographs (in addition to other, less critical gauge locations). These POI's were selected based on their location in the basin and because they were identified as key calibration points for this study. The six POI's are the Llano River at Llano, the San Saba River at San Saba, Lake Buchanan, Lake Travis, Colorado River at Bastrop, and the Colorado River at Wharton" (Vol. II-B, Chapter 4, pg. 1 of Reference 2.4S.3-8). Additionally, "further adjustments to parameters, specifically loss rates, were necessary to match the peak discharges (historical frequencies) at the six POI's. Results compared closely to the historical frequency analysis results and the period-of-record analysis results." These initially calibrated model parameters were further adjusted to match the peaks of historic flood frequencies estimated at various stream gauging stations located within the study area (see Vol. II-B, ~~Chapter. 4~~Chapter 4, pg. 23 of Reference 2.4S.3-8).

RAI 02.04.03-5:

QUESTION:

In FSAR Section 2.4S.3.4.2.1, (a) explain why the nine dams were not included in the HEC-HMS modeling of PMF Scenario 1 and (b) explain why the antecedent storm event (40% of PMP) was modeled separately from the full PMP storm modeling.

RESPONSE:

In response to item (a), only major reservoirs were included in the Halff study since smaller reservoirs were considered to be insignificant to the overall accuracy of the model and impractical to model over a long period. Additionally, including these reservoirs in the model would be less conservative than the current approach. Therefore, the third paragraph of Section 2.4S.3.4.2.1 of the COLA will be revised as follows:

> In the Halff HEC-HMS model, the flow routing from an upstream reach to a downstream reach was performed using the modified Puls method, which defines a storage-outflow rating curve for each of the channel reaches in the model. As discussed in Subsection 2.4S.3.3, three storage-outflow rating curves (out of 58) in the original Halff HEC-HMS model were extended to accommodate the PMF conditions. Note that there are nine dams/reservoirs with individual storage capacity in excess of 3000 acre-feet, but none of these reservoirs were included in the Halff HEC-HMS model. Only major reservoirs were included in the Halff study since "the effects of numerous other smaller reservoirs in the Colorado River Basin were considered to be insignificant to the overall accuracy of the study and impractical to model on a daily basis for a long period of record" (Vol II-A, Chapter 2, pg. 2 of Reference 2.4S.3-8). Additionally, including these reservoirs in the model would produce a less conservative estimate of discharge due to attenuation of the flood peak by the reservoirs.

In response to item (b), the scenario of the 40% of PMP is based on Alternative I, Part 3, of Section 9.2.1.1, ANSI 2.8 (1992): "Antecedent (or subsequent) rain equal to 40% of PMP or 500-yr rain, whichever is less. This standard is also discussed in Appendix B of ANSI 2.8 (1992) - Interpreted Probabilities of Combined Events, with "the PMP results from a postulated completely saturated atmosphere. A closely time-spaced prior or following rain is unlikely to have such a plentiful moisture source. For practical purposes, the standard specifies 40% of the PMP or a 500-yr rain, whichever is less."

As shown in Figure 2.4S.3-7 and discussed in Section 2.4S.3.4.2.1, for Scenario 1, the peak PMF for the drainage area between Mansfield Dam and Bay City was calculated by assuming an antecedent storm equal to 40% of the PMP occurs over the same area three days before the PMF event itself and combining those flows with the flow release from Mansfield Dam and the base flow at Bay City. The 40% PMP event was modeled three days before the PMF event to produce a more conservative estimate of the PMF. For example, the peak discharge for this PMF hydrograph without an antecedent storm event and a base flow was estimated to be 1,096,807 cfs. The PMF with an antecedent storm event equal to 40% of the PMP occurring three days before the PMF event, the flow release of 90,000 cfs from Mansfield Dam, and the base flow of 5,200 cfs gives a peak PMF discharge at Bay City of 1,397,432 cfs.

No COLA revision is required for the response to item (b).

RAI 02.04.03-7:

<u>QUESTION</u>:

(a) In FSAR Section 2.4S.3, provide a discussion supporting the assumption that "…the major hydrologic features (including dams and reservoirs) in the river basin have not changed since 1985."
(b) In FSAR Section 2.4S.3.1, provide details on how the following conclusion was reached: "…snow melt and antecedent snow pack are not a factor in the production of floods at the STP 3 and 4 site."
(c) In FSAR Section 2.4S.3.4.2.1, provide a discussion of how the constant precipitation loss rate of 0.05 in/hr, adopted for the PMF study, is conservative.
(d) In FSAR Section 2.4S.3.5.3.1, provide a discussion regarding the appropriateness of the boundary conditions used in the HEC-RAS modeling. Also, discuss the appropriateness of Manning's n values used in the study.

<u>RESPONSE</u>:

In response to item (a), the statement that "the major hydrologic features (including dams and reservoirs) in the river basin have not changed since 1985" is not correct. As noted in Table 1 of Chapter 2 of Volume II-A of the Halff Study (Reference 2.4S.3-8, p. 2), O. H. Ivie Reservoir, which was once called Stacy Reservoir, began storing water in 1990. The maximum storage of this reservoir is listed Table 2.4S.1-1 as 1,235,813 acre-feet. Therefore, the fourth paragraph of FSAR Section 2.4S.3 of the COLA will be revised as follows:

> The following probable maximum flood studies were reviewed~~estimates provided in these studies are still applicable to the present hydrologic conditions in the Lower Colorado River basin because a) the major hydrologic features (including dams and reservoirs) in the river basin have not changed since1985 and b) the Probable Maximum Precipitation (PMP) estimates provided in these studies, which are used to estimate the PMF, are based on current hydrologic design procedures. The flood hydrologic studies reviewed are~~:

In response to item (b), previous investigations of the Probable Maximum Flood (e.g., Reference 2.4S.3-2, p. 5) have noted that frequent and intense rainfall events occurring simultaneously over several sub-basins of the Colorado River have produced the largest recorded floods in the watershed. The occurrence of flooding from snow melt or antecedent snowpack is not mentioned in the Probable Maximum Flood Study of Mansfield Dam by the United States Bureau of Reclamation (Reference 2.4S.3-2), the Halff study (Reference 2.4S.3-8), or the Region K Water Plan for the Colorado River Basin (Reference 2.4S.3-23). First, the climate of the Colorado River Basin is not conducive to flooding from snow melt or antecedent snowpack. For example, p. 1-11 of Chapter 1 of Reference 2.4S.3-23 notes that "the amount of rainfall varies across the Lower Colorado Planning Region from an average of 44 inches at the coast to 24 inches in the northwestern portion of the region. The rainfall distribution pattern in this region has two peaks: spring is typically the wettest season with a peak in May, and a second peak usually occurs in September, coinciding with the tropical cyclone season in the late summer/early fall. The spring rains are typified by convective thunderstorms that produce high intensity, short duration precipitation events with rapid runoff. These thunderstorms are generally caused by successive frontal systems that move through the state. These weak cold air masses are overrun by warm Gulf moisture, and the line of instability that develops where the two air masses come in contact produces thunderstorms. The fall seasonal rains are primarily governed by tropical storms and hurricanes that originate in the Caribbean Sea or the Gulf of Mexico and make landfall on the coast from Louisiana to Mexico." Second, the elevation of the Colorado River Basin is not conducive to developing an antecedent snowpack with a high snow-water equivalent (i.e., the amount of water contained within the snowpack). For example, p. 1 of Reference 2.4S.3-2 notes that "the headwaters of the basin begin in New Mexico at a mean sea level (m.s.l.) elevation of 4,500 feet. Near Lamesa, where the main stem of the Colorado River begins, the river elevation drops to about 3,000 feet above m.s.l. At the Colorado City Reservoir, about 125 miles east of the Texas-New Mexico border, the river elevation is about 2,030 feet above m.s.l. Near Austin, the river elevation is about 400 feet above m.s.l."

Therefore, the fifth paragraph of FSAR Section 2.4S.3.1 of the COLA will be revised as follows:

> Investigations of climate, the occurrence of snow, and ice effects ~~and the occurrence of snow~~ within the ~~Lower~~ Colorado River B~~b~~asin and ~~its~~ the effects on flood-producing phenomena are discussed in Section 2.4S.1.2.1.1, Reference 2.4S.3-1, and Subsection 2.4S.7, respectively. Previous investigations of the Probable Maximum Flood (e.g., Reference 2.4S.3-2, p. 5) have noted that frequent and intense rainfall events occurring simultaneously over several sub-basins of the Colorado River have produced the largest recorded floods in the watershed. The occurrence of flooding from snow melt or antecedent snowpack was not considered a factor in the PMF analysis of Mansfield Dam by the US Bureau of Reclamation (Reference 2.4S.3-2), the Halff study (Reference 2.4S.3-8), or 2006 Region K Water Plan (Reference 2.4S.3-23). Therefore, snow melt and antecedent snow pack are not considered as~~a~~ factors in ~~the production of~~ floodings ~~at~~ for the STP 3 & 4 site ~~(see Subsection 2.4S.7)~~.

In response to item (c), the minimum uniform rainfall loss rate of 0.05 in/hr used in the model for the PMF analysis (see Table 2.4S.3-2) was based on a range of values provided in Table 8-8.1 of Reference 3 (0.05 to 0.15 in/hr). These values were used in the model to account for absorption and wet watershed antecedent conditions that would maximize the peak PMF discharges for subbasins listed in FSAR Table 2.4S.3-2. The use of minimum values for the rainfall loss rates increases the runoff volume of the PMF hydrograph and hence provides a conservatively higher peak PMF discharge.

The ninth paragraph in FSAR Section 2.4S.3.4.2.1 in the COLA will be revised as follows:

> The PMF peak flow is often insensitive to the initial rainfall loss (Reference 2.4S.3-12); therefore, this value was conservatively set equal to zero for each of the 80 subbasins in the HEC-HMS model (see Table 2.4S.3-2). Reference 2.4S.3-12 also states that "for PMF runoff computations, the soil should be assumed to be saturated with infiltration

> occurring at the minimum rate applicable to the area-weighted average soil type covering each subbasin." Therefore, based on data provided in Table 8-8.1 of Reference 2.4S.3-12, a minimum uniform rainfall loss rate of 0.05 in/hr was adopted in the model for the PMF analysis (see Table 2.4S.3-2). The minimum uniform rainfall loss rate of 0.05 in/hr used in the model for the PMF analysis was based on a range of 0.05 to 0.15 in/hr provided in Table 8-8.1 of Reference 2.4S.3-12. These conservative values were used in the model to account for absorption and wet watershed antecedent conditions that would maximize the peak PMF discharges for subbasins listed in Table 2.4S.3-2. The use of minimum values for the rainfall loss rates increases the runoff volume of the PMF hydrograph and hence provides a conservatively higher peak PMF discharge.~~These conservative values were used in the model to account for absorption and wet watershed antecedent conditions that would maximize the peak PMF discharges for subbasins listed in Table 2.4S.3-2.~~

The tidal boundary conditions for item (d) are discussed as part of RAI 02.04.03-6. Under PMF flow conditions, the water level in the river at the downstream-most cross-section (RS 383+64.5) is not influenced by tidal effects because the peak PMF water level at the downstream boundary is higher than the maximum tidal level at Matagorda Bay. From 1961 to 2001, the highest water level recorded for National Oceanic and Atmospheric Administration (NOAA) Station #8772440 at Freeport, Texas, is 4.95 feet above mean sea level (MSL) (Reference XX). Because the water surface elevation of the normal depth for an estimated channel slope of 0.0001 is greater than the maximum tidal level at Matagorda Bay, the normal depth is therefore the appropriate boundary condition to use at the downstream-most cross-section of the model.

With respect to the Manning's roughness coefficients, the values for the steady HEC-RAS runs were based on a six-stage "clean-up" procedure discussed on pg. 18-19 of Reference 2.4S.3-8 (Vol. II-C, Ch. 6). Calibration for the unsteady HEC-RAS runs are described on pg. 20 of Reference 2.4S.3-8 (Vol. II-C, Ch. 6). Validation of the calibration results are shown in Attachment A of Vol. II-C, Chapter 6 of Reference 2.4S.3-8.

FSAR Subsection 2.4S.3.5.1 and FSAR Subsection 2.4S.3.5.3 will be revised as described below.

> The third paragraph of FSAR Subsection 2.4S.3.5.1 of the COLA will be revised as follows: "The initial Manning's roughness coefficients used in the Halff HEC-RAS model were estimated from the USGS National Land Cover Dataset coverage and then adjusted using aerial photographs (see Vol. II-C, Chapter 6, Table III-2 of Reference 2.4S.3-8). During the model calibration by Halff Associates, the roughness coefficients were subsequently adjusted in the model to match historical flood levels using USGS gauge data. The cross sections, gauges, and storms used for adjustment are available in Table IV-1 of Reference 2.4S.3-8 (Vol. II-A, Ch. 6, pg. 21). Calibration values for steady HEC-RAS runs were based on a six-stage "clean-up" procedure discussed on pg. 18-19 of Reference 2.4S.3-8 (Vol. II-C, Ch. 6). Calibration for the unsteady HEC-RAS runs are described on pg. 20 of Reference 2.4S.3-8 (Vol. II-C, Ch. 6). Validation of the calibration results are shown in Attachment A of Vol. II-C, Chapter 6 of Reference

> 2.4S.3-8. The calibrated Manning's roughness coefficients used in the model are 0.035 for the river channel, 0.045-0.05 for the overbank, and 0.085-0.095 for the floodplain.

The Manning's roughness coefficient for the Probable Maximum Flood cannot be precisely known a priori to a PMF event. Therefore, the increase of the Manning's roughness coefficient by 20% from the calibrated values in the Halff study (Reference 2.4S.3-8) is based estimates of the Manning's roughness coefficients for the river channel, overbank, and floodplain areas as listed in Table 3-1 of Reference 2.4S.3-18 (pp. 3-13 to 3-15). In addition, a 20% increase in the Manning's roughness coefficient for the Probable Maximum Flood was recommend for flooding in meandering streams (Reference 2.4S.28). This reference will be added to the COLA revision of 2.4S.3 as Reference 2.4S.3-28.

FSAR Section 2.4S.3.5.3 of the COLA will be revised as follows:

> The HEC-RAS hydraulic model (Version 3.1.3) for the STP 3 & 4 site was developed using the above extended cross-sections (from RS 383+64.5 to RS 964+99.7) and Manning's roughness coefficients adjusted for PMF flow conditions. As the flow depth increases, the flow encounters larger size obstructions, e.g. shrubs, trees, etc, which effectively increase the roughness of the floodplain. For this purpose the calibrated Manning's roughness coefficients used in the Halff HEC-RAS model (see Subsection 2.4S.3.5.1) were increased by 20% for the postulated PMF flow condition to provide a conservative estimate of the maximum stream flooding elevation at the site. The Manning's roughness coefficients that were increased by 20% for the PMF had values of 0.042 for the river channel, 0.054-0.06 for the overbank, and 0.102-0.114 for the floodplain. Since the Manning's roughness coefficients cannot be determined a priori to a PMF event occurring in the Lower Colorado River, this increase in the roughness coefficient was based on experimental results of flooding in meandering streams (Reference YY), and from roughness coefficients for the river channel, overbank, and floodplain areas listed in Table 3-1 of Reference 2.4S.3-18.

<u>The following references will be added to FSAR Section 2.4S.3:</u>

2.4S.3-XX "NOAA Tides and Currents", Station #8772440, Available at http://www.co-ops.nos.noaa.gov/data_menu.shtml?stn=8772440%20Freeport,%20TX&type=Datums, accessed May 23, 2008.

2.4S.3-YY Smith, C.D. 1992. Reliability of flood discharge estimates: Discussion. Canadian Journal of Civil Engineering 19: 1085-1087.

RAI 02.04.03-8:

<u>QUESTION</u>:

In FSAR Section 2.4S.3.5.3.1, Model Boundary Conditions, the normal depth of water at the downstream boundary of the site (RS 383+64.5) is estimated using NAVD88 which is different from what was used in the previous section (i.e., NGVD29). Please clarify the mismatch of the datum.

<u>RESPONSE</u>:

As discussed in the response to RAI 02.04.01-2, the geo-referencing datum used for surface elevations throughout Section 2.4S is the National Geodetic Vertical Datum of 1929 (NGVD29). However, the geo-referencing datum used for water surface elevations in the Halff study (Reference 2.4S.3-8) is the North American Vertical Datum of 1988 (NAVD88). As noted on p. 10 of Vol II-B of Chapter 3 of Reference 2.4S.3-8, "elevations from past studies and reports are recorded using the National Geodetic Vertical Datum of 1929 (NGVD29). [The Halff] study used the North American Vertical Datum of 1988 (NAVD88) for all elevation values. Table 3-1 shows the differences between the two vertical datums at selected gauge sites and dams."

Therefore, the shift in the water surface elevation for River Station (RS) 383+64.5 assuming a datum of NAVD88 to a datum of NGVD 29 is approximately 0.19 ft. FSAR Section 2.4S.3.5.3.1 in the COLA will be revised as follows (text that is changed is highlighted with gray shading):

> As shown in Figure 2.4S.3-11, the maximum PMF still water surface elevation at the STP 3 & 4 site (RS 891+46.0) for the normal depth boundary condition was estimated to be equal to 26.1 ft NAVD88 (26.3 ft NGVD29), which is lower than the design plant grade elevation of 35 ft NGVD29 for safety related structures. The PMF water level of 26.1 ft NAVD88 (26.3 ft NGVD29) at STP 3 & 4 was obtained using conservative Manning's n values equal to 1.2 times those used in the original Halff model.
>
> The PMF still water surface profile obtained using the same Manning's n values as those used in the Halff model is shown in Figure 2.4S.3-12. In this case, the maximum PMF still water surface elevation at the STP 3 & 4 site (RS 891+46.0) was estimated as 24.8 ft NAVD88 (25.0 ft NGVD29).

RAI 02.04.09-1:

<u>QUESTION</u>:

Provide an evaluation of the flood of 1935 and a flood that may be expected in the Colorado River without a major breach/failure of upstream dam or dams.

<u>RESPONSE</u>:

The 1935 flood and attenuation effects of the reservoirs are discussed in Section 2.4S.9.4.3 and Section 2.4S.9.5.1. The flood and attenuation effects are also shown in Figure 2.4S.9-5. The flood of 1935, which is shown in Figure 2.4S.9-5, had a peak discharge of almost 500,000 cfs. The impact of this flood on a potential channel diversion into Tres Palacios Creek is discussed in Section 2.4S.9.5.1. Discussion of a flood that may be expected in the Colorado River without a major breach/failure of an upstream dam or dams is discussed in Section 2.4S.9.4.3.

Section 2.4S.9.4.3 will be revised as follows:

> Of the various mechanisms that could cause channel diversion, the most likely scenario for a major channel avulsion would be from a large flood, a series of large floods, the failure of upstream dams, or significant sea-level change. In an unregulated setting, the most likely location for a channel diversion on the Colorado River would be between Eagle Lake, Texas, and Wharton, Texas (Figure 2.4S.9-1). The flood of 1935, which is shown in Figure 2.4S.9-5, had a peak discharge of almost 500,000 cfs. The impact of this flood on a potential channel diversion into Tres Palacios Creek is discussed in Section 2.4S.9.5.1. However, flows on the Lower Colorado River have been regulated since 1938. For example, since the completion of Lake Buchanan (1937) and Lake Travis (1940), the peak discharge for the Colorado River at Austin (USGS Gauge #08158000) was 47,600 cubic feet per second (cfs) in April 1941 (Figure 2.4S.9-5). A flood that occurred in September 1952 would have produced a flow of over 700,000 cfs had Mansfield dam and Lake Travis not been present. However, Lake Travis has sufficient storage capacity to withhold the entire flood volume. Instead of a potentially disastrous flood, the peak discharge recorded at Austin during this period was only 3720 cfs (Reference 2.4S.9 7).

The end of the first paragraph of Section 2.4S.9.5.1 will be revised as follows:

> During the flood of 1935, the major flow of the Colorado River was almost diverted into Tres Palacios Creek and Tres Palacios Bay, one of the arms of Matagorda Bay." Reference 2.4S.9-3 (p. 103) states "the last major flood occurred in 1935, when considerable water from the Colorado River found its way into the head waters of Tres Palacios Creek in Wharton County. If left alone, the Colorado River would have diverted itself again and Tres Palacios Creek might be now the main channel of the Colorado River." ~~Further~~However, as noted in Section 2.4S.9.4.3, "concurrent dam building and flood control measures in the upper Colorado watershed greatly reduced the danger of flooding in the Colorado lowlands."

RAI 02.04.12-1:

<u>QUESTION</u>:

Provide a summary of the process followed to develop the site hydrogeologic conceptual model so staff can better understand the plausible alternative conceptual models that have been considered and rejected. The site hydrogeologic conceptual model provides the background for all to understand (a) the maximum groundwater elevation possible at the site, (b) potential alteration of groundwater gradients, (c) the relationship between the MCR and surrounding relief, observation and production wells, and (d) plausible alternative pathways and points of exposure. This RAI is presented first because the response to it will permeate the whole of Sections 2.4S.12 and 2.4S.13. It is not expected that the applicant's response be contained entirely in the first section of future revisions of 2.4S.12.

<u>RESPONSE</u>:

The final hydrogeologic conceptual model presented in FSAR Subsection 2.4S.12.1 was developed from multiple conceptual hydrogeologic models that were considered, based on framework and scale differences. Consideration of these differences was not mutually exclusive, but was intertwined during a series of steps designed to develop a tenable site hydrogeologic conceptual model. Four steps were involved in the development of the scale-dependent conceptual models:

- A regional "desktop" study based on published state, federal and informational sources;
- A review of documentation from obtainable sources addressing existing STP Units 1 & 2, including the STP Units 1 & 2 UFSAR;
- A site-specific geotechnical, geologic, and hydrogeologic field study conducted for proposed Units 3 & 4; and
- An evaluation of the site-specific data in conjunction with the regional, local and STP site information.

Intertwined with these four steps, two main hydrostratigraphic frameworks were investigated during formulation of the conceptual site model: STP site-specific conceptual models and a regional hydrogeologic conceptual model. The basis for the site-specific conceptual model was provided by data and analyses documented for the existing Units 1 & 2 UFSAR. The regional conceptual model contained greater uncertainty due to limited information on near site conditions and future groundwater development within the county.

The first step of site model conceptualization involved formulating an understanding of the hydrogeologic conditions in Southern Texas and Matagorda County by reviewing regional geologic and hydrogeologic information from the United States Geological Survey (USGS) and the State of Texas. One regional conceptual hydrostratigraphic model considered was based on the USGS Groundwater Atlas of the United Sates – Oklahoma, Texas (FSAR Section 2.4S.12.1.1, Reference 2.4S.12-2) and other USGS publications. This concept includes five permeable zones (denoted A through E) and two confining units (D and E, both units located down dip at the top of permeable zones D and E, respectively) within the Coastal Lowlands Aquifer System. A second regional conceptual hydrostratigraphic model considered was based on information obtained from the Texas Water Development Board. This concept includes three aquifers – the Chicot, Evangeline and Jasper, and two confining units – the Burkeville and Catahoula. The Chicot aquifer includes all of permeable zone A and most of B. The Evangeline aquifer includes the rest of permeable zone B and all of C. The Jasper aquifer is roughly equivalent to permeable zones D and E. Both concepts include the Vicksburg-Jackson confining unit as the basal confining unit to the Coastal Lowlands Aquifer System. Figure 2.4S.12-5 illustrates the correlation between the USGS and Texas nomenclature.

During the first step in model conceptualization, this information along with additional research on the hydrogeologic conditions of Matagorda County was used to evaluate geologic structures, hydrogeologic properties, flow paths, regional sources and sinks, water use, and surface water interactions within the county. The resulting regional conceptual hydrogeologic model is discussed in FSAR Subsection 2.4S.12.1 because of the small scale of the regional conceptual model. A gap in understanding temporal and localized effects on the regional flow systems from groundwater use and surface water interactions in the vicinity of the STP site exists. This included interactions between the shallow and deep aquifer zones within the Chicot Aquifer, groundwater flow directions and gradients within these zones, and current and estimated groundwater use projections.

The second step involved a review of documentation addressing local hydrogeologic conditions to resolve the temporal and localized unknowns. This documentation included the STP Units 1 & 2 UFSAR and the Annual Environmental Operating Report. The information provided a summary of the hydrogeologic conditions beneath the site based on geotechnical borings, observation wells, permeability tests, dewatering activities, Main Cooling Reservoir (MCR) design requirements, groundwater use, and other information previously generated for Units 1 & 2. This information provided a good description of the subsurface conditions that could be expected beneath and in the vicinity of the proposed Units 3 & 4 facility. This included the identification of aquifer units, hydrogeologic parameter values, vertical and horizontal flow gradients and groundwater flow paths that could be expected in the aquifers beneath the STP site.

Incorporating the conceptual site model with regional concepts, the Chicot aquifer was subdivided into two distinct aquifers – the confined "Deep Aquifer" and the semi-confined to confined "Shallow Aquifer" (separated into Upper and Lower Shallow Aquifer zones). This conceptual model is discussed in FSAR Subsection 2.4S.12.1.3. The Shallow Aquifer identified in the Units 1 & 2 UFSAR was targeted for further hydrogeologic investigation as part of the Units 3 & 4 subsurface site investigation (SI). The Deep Aquifer identified in the regional data and the Units 1 & 2 UFSAR was further evaluated through a review of well permits, STP historical records, and literature searches. The UFSAR and supporting information suggested approximately 100 feet of hydraulic separation between the Shallow and Deep Aquifers. The critical hydrogeologic unknowns for Units 3 & 4 were to understand localized flow paths and the possible effects on these flow paths from operating the MCR and the STP maintained wetlands (located to the north of Units 1 & 2).

The third step involved incorporating information gathered from the site-specific Units 3 & 4 SI. The SI included geotechnical borings, cone penetration tests, geotechnical laboratory tests, installation of groundwater observation wells, water level monitoring, water quality analyses, and aquifer tests. The site-specific conceptual model is discussed in FSAR Subsection 2.4S.12.1.4. The SI hydrogeologic target zones identified as the result of the regional and site specific information presented in the Units 1 & 2 UFSAR were, in general, confirmed with the exception of a few outliers (where the sands of the Lower Shallow Aquifer were not well defined at two of the well cluster locations).

The fourth step involved evaluation of the SI field data with the regional and local information, and historical STP information. This included evaluation of:

- regional & local groundwater movement;
- vertical gradients between the aquifers;
- site-specific slug test results and local and regional pumping test results; and
- water levels to assess possible localized influence of the MCR and the northeast wetland on the Shallow Aquifer.

From this effort, site-specific data were integrated with other STP information and regional information to formulate the conceptual site model. The conceptual model was identified during the development of FSAR 2.4S (2.4S.12 and 2.4S.13). The conceptual site model provides an insight to address the following concerns:

(a) The maximum groundwater elevation possible at the site:
Historic data indicate water levels in the Lower Shallow Aquifer and the Deep Aquifer are consistently lower than water levels in the Upper Shallow Aquifer by about 10 feet or more. These data are illustrated by comparing Figures 2.4.13-6, -7, -12, -15 through 19A, and Figures 2.5.4-67, -70 through -70D of the UFSAR for Units 1 & 2, and based on water level data collected during aquifer pumping tests conducted on the Deep Aquifer and the Shallow Aquifer system (Woodward-Clyde Consulting, Inc., 1975).

Historically, the highest groundwater elevation measured in the STP Units 3 & 4 observation wells between December 2006 and June 2007 is 27.38 feet MSL, observed in January 2007 at observation well OW-929 U screened in the Upper Shallow Aquifer (FSAR Table 2.4S.12-7). This well is located approximately 0.5 mile northeast of the STP Units 3 & 4 power block and near an ephemeral surface water body (northeastern duck pond/marsh) that may be losing water to the subsurface, based on the flow patterns noted on recent potentiometric maps of the Upper Shallow Aquifer (FSAR Figure 2.4S.12-19). Groundwater elevation measured in the STP Units 3 & 4 power block observation wells (OW-300 & OW-400 well series) are below 26 ft MSL (FSAR Table 2.4S.12-7).

Additional historic STP site water level data from the Upper Shallow Aquifer were reviewed to access long-term water level variations at the site. The data set included:

- November 8, 1973 Upper Shallow Aquifer potentiomentric surface map (STP Units 1 & 2 UFSAR, Figure 2.4.13-17),

- March 14, 1974 Upper Shallow Aquifer potentiomentric surface map (STP Units 1 & 2 UFSAR, Figure 2.4.13-19),
- June 1986 Upper Shallow Aquifer potentiomentric surface map (STP Units 1 & 2 UFSAR, Figure 2.4.13-19A),
- July 5, 1973 through January 5, 1974 hydrographs of Piezometer 601 (STP Units 1 & 2 UFSAR, Figure 2.4.13-18),
- March 1994 through May 2006 hydrographs of Piezometer 601, 602A and 603B (Units 3 & 4 FSAR, Figure 2.4S.12-23),

The 33-year record provided in the figures referenced above indicates groundwater levels in the Upper Shallow Aquifer for the northern portion of the STP site (includes the STP Units 3 & 4 area) are below an elevation of 27.5 ft. MSL. Based on these findings, it is unlikely that groundwater levels at the Units 3 & 4 power block area will rise above an elevation of 27.5 ft MSL.

(b) Potential alteration of groundwater gradients:
A conceptual approach for construction dewatering was developed and the effect of this approach was evaluated during COL development. A summary of the conceptual dewatering approach is provided in the STP Units 3 & 4 Environmental Report (ER). During STP Units 3 & 4 construction dewatering activities in the Shallow Aquifer, a temporary hydraulic sink would develop in this aquifer within the site boundaries. Flow gradients in the northern portion of the site would induce groundwater to flow toward this sink. After construction and during operation, deep building foundations and backfill material whose hydraulic properties may differ from those of the native soil could also cause localized changes in flow gradients within the facility area. Flow from the northwest and north may be directed easterly and southwesterly around the deep foundations within the power block; however, the general flow conditions described in FSAR Subsection 2.4S.12.2.2 are expected to remain unchanged, diverging around the MCR in the Upper Shallow Aquifer zone and flowing southeasterly in the Lower Shallow Aquifer zone. Engineered fill within the backfilled excavations will be generally coarser-grained than the native soil and may allow increased communication between the Upper and Lower Shallow Aquifers, similar to that at Units 1 & 2 (FSAR Subsections 2.4S.12.5).

(c) Relationship between the MCR and surrounding relief, observation, and production wells:
The design and setting of the 7,000-acre MCR are described in FSAR Subsection 2.4S.12.1.5. The MCR was formed by constructing an earthfill embankment above the natural ground surface. The normal maximum operating water level maintained in the MCR is EL 49 ft MSL. The MCR relief well system is described in the STP Units 1 & 2 UFSAR. Relief well screen interval depths vary, but are typically 30 feet below ground surface (bgs), penetrating the sands of the Upper Shallow Aquifer. Seepage occurs through the reservoir bottom to the shallow groundwater system. Part of this seepage is intercepted by the relief wells installed around the perimeter of the MCR. The relief wells are designed to be flowing wells whose piezometric heads are higher than the top of the well casing. The relief well system passively discharges the intercepted water to drainage ditches along the dike toe, which is then discharged to surface water features at various locations. Seepage not intercepted by the relief wells remains in the groundwater system.

The STP production wells are screened in the Deep Aquifer and are considered to be unaffected by the MCR due to their depth and approximately 100 feet of hydrogeologic separation from the overlying Shallow Aquifer beneath the MCR. Piezometers and observation wells installed before the subsurface investigation for STP Units 3 & 4 are screened in either the Shallow or Deep Aquifer (STP Units 1 & 2 UFSAR). The Units 3 & 4 observation wells are screened in the Upper and Lower Shallow Aquifer zones.

(d) Plausible alternative pathways and points of exposure:
A discussion of alternative pathways and points of exposure for groundwater contaminants has been developed within the context of the site hydrogeologic conceptual model. FSAR Sections 2.4S.12.1.5 ("Groundwater Sources and Sinks"), 2.4S.12.2.2 ("Groundwater Flow Directions") and 2.4S.12.3.1 ("Exposure Point and Pathway Evaluation") provide the basis for determining the plausible pathways and exposure points. Section 2.4S.13.1.2 ("Conceptual Model") evaluates the effects of a postulated release of liquid effluent from the Units 3 & 4 Radwaste Building to groundwater and concludes that the most likely complete exposure pathways are: Pathway 1 – flow within the Lower Shallow Aquifer to a well (Well No. 2004120846) drawing from the Shallow Aquifer and located approximately 9,000 feet southeast of Unit 3 on an adjoining down-gradient property; and Pathway 2 – flow within the Lower Shallow Aquifer to the Colorado River located approximately 17,900 feet east southeast of Unit 3. Other pathways were considered and rejected as stated in Section 2.4S.13.1.2. A sensitivity analysis was performed using the range of average linear velocity/travel times in the aquifer zone from Table 2.4S.12-17 and the range of distribution coefficient (K_d) from Table 2.4S.13-3 to account for subsurface heterogeneities in the subsurface materials and uncertainties with aquifer flow gradients. The sensitivity analysis is summarized in Section 2.4S.13.1.4.

References:

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, 24 p.

2) STP 1 & 2 UFSAR, Revision 13.

Changes to the COLA are proposed based upon this response. The following paragraphs will be inserted at the end of FSAR Section 2.4S.12.1.1:

> The hydrogeologic conceptual model presented in this subsection was developed from multiple conceptual hydrogeologic models that vary in scale and hydrostratigraphic framework. Considerations of the scale and framework were not mutually exclusive, but were intertwined during a series of steps designed to develop a tenable site hydrogeologic conceptual model. Four steps were involved in the development of the scale-dependent conceptual models, and include:

- A regional “desktop” study based on published state, federal and other sources;
- A review of documentation addressing STP Units 1 & 2;
- A site-specific geotechnical, geologic, and hydrogeologic field study conducted for proposed Units 3 & 4; and
- An evaluation of site-specific data in conjunction with regional and local information.

The first step of site model conceptualization involved formulating an understanding of the hydrogeologic conditions in Southern Texas and Matagorda County by reviewing regional geologic and hydrogeologic information available from the USGS and the TWDB. Research indicates that the USGS and the State of Texas developed separate regional hydrogeologic conceptual models to describe the Coastal Lowlands Aquifer System, with the Texas model being the more widely used. Although nomenclature between the two conceptual models varies significantly, the frameworks are largely comparable (Figure 2.4S.12-5).

The second step involved a review of documentation addressing local hydrogeologic conditions, such as the STP Units 1 & 2 UFSAR and the Annual Environmental Operating Report, to resolve the temporal and localized unknowns. Incorporating the conceptual site model with regional concepts, the Chicot aquifer was subdivided into two distinct confined aquifers – the “Deep Aquifer” and the “Shallow Aquifer”.

During the third step, a site-specific subsurface site investigation (SI) was implemented at the proposed Units 3 & 4 site area, concentrated within the STP northern site boundaries and the proposed Units 3 & 4 facility footprint.

The fourth step involved evaluation of the SI field data with the regional and local STP information. This included evaluation of:

- regional & local groundwater movement;
- vertical gradients between the aquifers;
- site-specific slug test results and local and regional pumping test results; and
- natural and manmade (i.e., MCR) impacts on water levels in the Shallow Aquifer.

From this effort, site-specific data were integrated with existing STP Units 1 & 2 information and regional information to formulate the conceptual site model described in the following sections.

RAI 02.04.12-3:

QUESTION:

In FSAR Section 2.4S.12.2.1 the applicant states that in 1985 the Texas Water Development Board (TWDB) made projections that groundwater resource use would drop 48% in Matagorda County by 2030. We are about midway through the projection period. Are there data to suggest this is a valid forecast today? Data in Table 2.4S.12-5 suggest groundwater usage is as high now as before. Please clarify and explain the current relevance of the projections.

RESPONSE:

The Final Safety Analysis Report (FSAR) cited the U.S. Geological Survey (USGS, 1996) regarding the forecasted 48 percent decline in groundwater consumption in Matagorda County by 2030. Between 1980 and 2000, the average groundwater withdrawal in Matagorda County from the Gulf Coast aquifer was 30,233 AF/Y (Turner Collie & Braden, Inc., 2004). Historic groundwater use estimates were obtained from the USGS (Table 1) and the Texas Water Development Board (TWDB) (Table 2) Internet websites to assess groundwater use in the county by water user groups (WUG) (e.g., Municipal, Manufacturing, Mining, Steam Electric Power, Irrigation, and Livestock, or equivalent) since 1985. (The USGS also reported "Domestic" and "Commercial" uses up to 2000.)

Table 1. Historical Groundwater Use in Matagorda County, TX (in acre-ft) by Water User Group from USGS*

Use	1985	1990	1995	2000
Public Supply	5,735	4,805	4,156	4,626
Domestic	571	627	661	0
Commercial	78	45	146	NR
Industrial	1,915	1,971	6,553	4,503
Mining	1,781	3,192	930	0
Livestock	829	683	717	672
Power Gen	0	1,456	829	1,344
Irrigation	24,654	8,894	12,378	3,114
Annual Total	36,000	22,000	26,000	14,000

NR: Not Reported.
*Presented values converted from data obtained from the USGS Internet Weblink, *Estimated Use of Water in the United States*, http://water.usgs.gov/watuse; accessed April 18, 2008.

Table 2. Historical Groundwater Use in Matagorda County, TX (in acre-ft) by Water User Group from TWDB							
Year	Municipal	Manufacturing	Steam Electric	Irrigation	Mining	Livestock	Total
1985	5,778	2,273	1,068	24,666	173	823	34,781
1986	5,625	2,119	1,351	25,127	235	550	35,007
1987	5,769	974	1,296	21,934	266	611	30,850
1988	5,317	1,975	1,451	34,054	185	652	43,634
1989	5,103	2,966	1,462	8,901	250	683	19,365
1990	5,151	3,514	1,158	26,717	250	673	37,463
1991	4,834	4,028	879	26,172	295	687	36,895
1992	4,904	4,033	1,036	18,086	266	614	28,939
1993	5,099	4,834	776	16,827	266	634	28,436
1994	4,823	6,559	833	12,382	273	694	25,564
1995	4,894	6,578	1,201	22,481	277	604	36,035
1996	5,357	7,533	1,457	21,781	277	1,048	37,453
1997	4,792	5,763	1,386	1,581	251	564	14,337
1998	5,059	4,415	1,333	2,249	196	676	13,928
1999	5,009	4,485	1,451	3,119	196	676	14,936
2000	5,332	2,648	1,313	17,283	481	943	28,000
2001	4,663	2,780	1,392	13,794	136	710	23,475
2002	4,464	3,802	1,201	13,751	136	690	24,044
2003	4,754	1,671	1,307	41,954	136	912	50,734
2004*	2,753	4,979	4,656	32,196	131	978	45,693

2004*: Data from "Texas Water Development Board water use projections." Available at http://www.twdb.state.tx.us/DATA/db07/defaultReadOnly.asp, accessed March 12, 2007.

The USGS data (USGS *Estimated Use of Water in the United States* Internet Weblink) exhibit an overall downward trend from 1985 at about 36,000 AF/Y to 2000 at about 14,000 AF/Y with a fair reliability of correlation of $R^2 = 0.73$ (Figure 1). Overall, this represents more than a 48 percent decline and as such may validate the 1985 forecast. The TWDB data (TWDB *Historical Water Use Information* Internet Weblink) exhibit more variability, largely due to irrigation, and as a result the TWDB data have no correlation to the generated trend line (Figure 1).

The USGS database includes data collected every five years in million gallons per day (MGD). Converting the USGS data from MGD to acre-feet per year (AF/Y) (Table 1) to present this analysis may have created some error due to rounding and conversion constants. Consequently, the data presented in Table 1 for annual totals are rounded to the nearest thousand. The TWDB database includes annual data listed in AF/Y, and are presented directly as downloaded from their website. The TWDB historical water use estimates are subject to revision as additional data and corrections are made available to the TWDB. As of June 10, 2008, both databases have neither 2004 nor more recent groundwater use data available for Matagorda County.

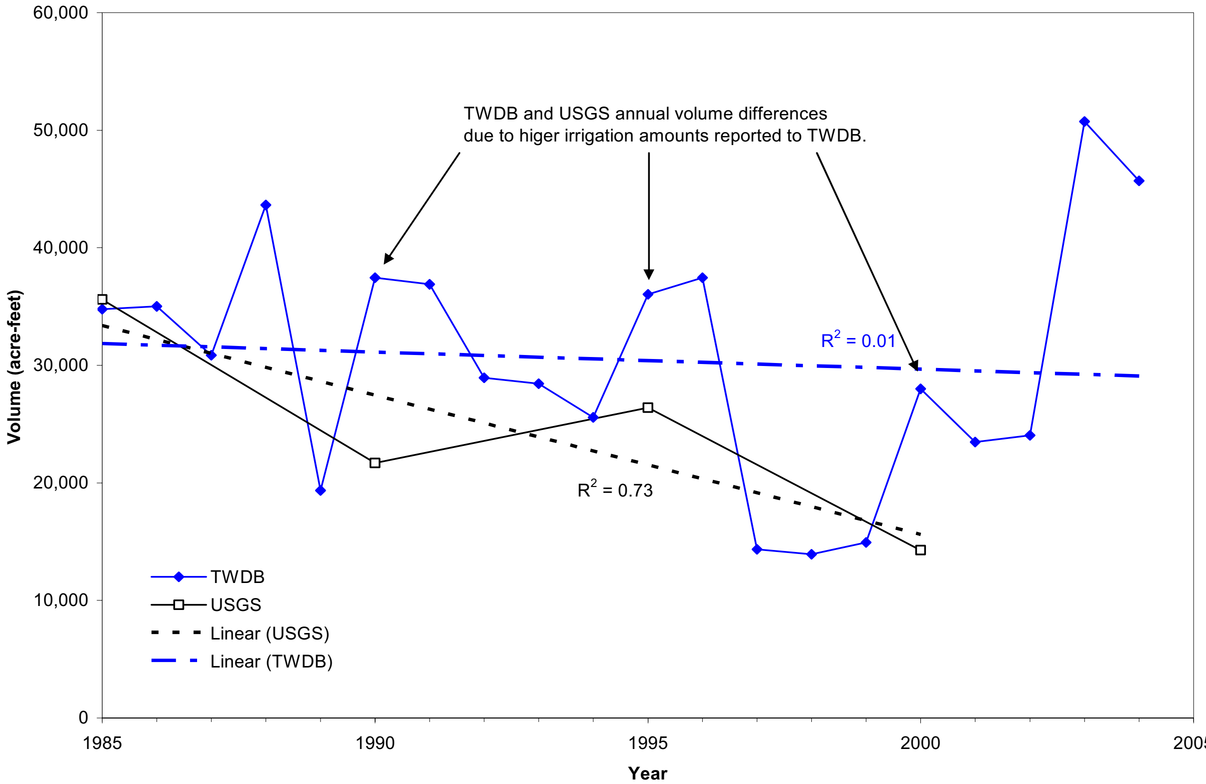


Figure 1- Comparison of TWDB and USGS reported total groundwater withdrawals for Matagorda County from 1985 to 2000.

The discrepancy between the USGS dataset and the TWDB dataset for the years 1990, 1995, and 2000 appears to be a result of the large difference in the reported irrigation use totals. The other WUGs appear to exhibit reasonable correlation between the two datasets. This discrepancy suggests that there remains some uncertainty in whether the Texas 1985 forecast continues to be valid. As a result of the variability and tentativeness in the TWDB dataset, the most recent groundwater usage data in Table 2.4S.12-5 should be considered as an interim trend that may be subject to continued variability such as that observed in recent years.

References:

1) Turner Collie & Braden, Inc., May 2004, *Groundwater Management Plan, prepared for: Coastal Plains Groundwater Conservation District*, 20 p. http://www.twdb.state.tx.us/gwrd/GCD/plans/Coastal_Plains_GCD_Management_Plan_2004.pdf

2) TWDB Internet Weblink*, Historical Water Use Information*, http://www.twdb.state.tx.us/wushistorical/; accessed April 18, 2008.

3) USGS, 1996, Ground Water Atlas Of The United States, Oklahoma, Texas; HA 730-E. http://capp.water.usgs.gov/gwa/ch_e/index.html

4) USGS Internet Weblink, *Estimated Use of Water in the United States*, http://water.usgs.gov/watuse ; accessed April 18, 2008.

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

RAI 02.04.12-4:

QUESTION:

In FSAR Section 2.4S.12.2.1, “Historical and Projected Groundwater Use”, projections through the year 2030 do not cover the expected life of the proposed facility. Provide groundwater use projections through the expected life of the plant. Provide the data in FSAR Table 2.4S.12-6 divided between surface water and groundwater projected water needs.

RESPONSE:

STPNOC projects the continued operation of STP Units 1 & 2 and the construction and operation of STP Units 3 & 4 will increase its groundwater use to its permitted groundwater withdrawal amount of 3,000 acre-feet per year (AF/Y). The 3,000 AF/Y amount is roughly six percent of the 49,221 AF/Y of groundwater projected by the Coastal Plain Groundwater Conservation District (CPGCD) to be available from the Gulf Coast Aquifer (GCA) in Matagorda County through 2060. Projections are not available beyond 2060.

The data provided in FSAR Table 2.4S.12-6 are official state projections that are not divided between projected groundwater and surface water use. As a result, a breakdown cannot be provided. According to the CPGCD, STP withdrew an average of 1,101 AF/Y of groundwater from the GCA between 1980 and 2000 as indicated by Table 1 (Turner Collie & Braden, Inc., 2004). (STP is the only power plant in Matagorda County as indicated in Table 1 below.)

Table 1 – Groundwater Use (AF/Y) in the CPGCD from TWDB Water Use Survey.

Aquifer	Year	Municipal	Manu.	Power	Mining	Irrigation	Livestock	Total
Gulf Coast	1980	6,022	1,607	0	357	29,997	600	38,583
Gulf Coast	1984	5,924	1,931	553	172	30,639	833	40,052
Gulf Coast	1985	5,778	2,273	1,068	173	24,666	823	34,781
Gulf Coast	1986	5,625	2,119	1,351	235	25,127	550	35,007
Gulf Coast	1987	5,769	974	1,296	266	21,934	611	30,850
Gulf Coast	1988	5,317	1,975	1,451	185	34,054	652	43,634
Gulf Coast	1989	5,103	2,966	1,462	250	8,901	683	19,365
Gulf Coast	1990	5,151	3,514	1,158	250	26,717	673	37,463
Gulf Coast	1991	4,834	4,028	879	295	26,172	687	36,895
Gulf Coast	1992	4,904	4,033	1,036	266	18,086	614	28,939
Gulf Coast	1993	5,099	4,834	776	266	16,827	634	28,436
Gulf Coast	1994	4,823	6,559	833	273	12,382	694	25,564
Gulf Coast	1995	4,894	6,578	1,201	277	22,481	604	36,035
Gulf Coast	1996	5,357	7,533	1,457	277	21,781	1,048	37,453
Gulf Coast	1997	4,792	5,763	1,386	251	1,581	564	14,337
Gulf Coast	1998	4,978	4,733	1,333	196	2,249	676	14,165
Gulf Coast	1999	5,009	4,485	1,230	196	3,119	676	14,715
Gulf Coast	2000	5,211	2,650	1,343	481	17,283	943	27,911
Average (all years) =		**5,255**	**3,809**	**1,101**	**259**	**19,111**	**698**	**30,233**

Projections to 2060 for steam-electric water demand in Matagorda County are provided in the Lower Colorado River Water Planning Group (LCRWPG) Water Management Plan (WMP) as indicated in Table 2 (LCRWPG, 2006). Data summarized by Table 2 are taken directly from the LCRWPG WMP. Projections for this use are not available beyond 2060.

Table 2 – Table of Projected Surface Water Demand for STP.

County	1996	2000	2010	2020	2030	2040	2050	2060
Bastrop	5,715	7,846	12,000	14,000	16,000	18,000	19,500	19,500
Blanco	0	0	0	0	0	0	0	0
Burnet	0	0	0	0	0	0	0	0
Colorado	0	0	0	0	0	0	0	0
Fayette	24,334	21,306	42,720	43,200	52,500	63,840	63,840	69,750
Gillespie	0	0	0	0	0	0	0	0
Hays (p)	0	0	0	0	0	0	0	0
Llano	1,976	1,271	1,057	843	985	1,159	1,371	1,629
Matagorda	40,362	65,948	80,000	80,000	102,000	102,000	102,000	102,000
Mills	0	0	0	0	0	0	0	0
San Saba	0	0	0	0	0	0	0	0
Travis	9,028	7,494	17,500	18,500	22,500	23,500	27,500	28,500
Wharton (p)	0	10	245	351	411	483	572	679
Williamson (p)	0	0	0	0	0	0	0	0
TOTAL	**81,415**	**103,875**	**153,522**	**156,894**	**194,396**	**208,982**	**214,783**	**222,058**

(p) Denotes that only the portion of the county in Region K was considered.

The surface water demand at STP is projected to increase from 80,000 AF/Y in 2010 to the yearly permitted amount of 102,000 AF/Y in 2060, and STP will continue to meet its demands with a variety of supplies from run of river (ROR) rights, existing off-channel reservoirs, and groundwater (LCRWPG, 2006).

The published data from Tables 1 and 2 indicate STP used 40,362 acre-feet (AF) and 65,948 AF of surface water during 1996 and 2000, respectively and withdrew 1,457 and 1,343 AF from the Gulf Coast aquifer during 1996 and 2000, respectively. Summing these two amounts for each year, STP's water demand was about 41,819 AF in 1996 and 67,291 AF in 2000, suggesting that groundwater constituted about two to 3.5 percent of STP's water demand for these two years, respectively. Considering the permitted groundwater withdrawal amount of 3,000 AF/Y is expected to be reached when Units 3 & 4 are operational, and using the 2060 surface water demand projection of 102,000 AF/Y (Table 2), groundwater is expected to constitute about three percent of STP's projected total water demand to 2060, suggesting STP's future reliance on groundwater is likely to remain proportional to its historic total water demand.

Although separate groundwater and surface water use projections are not available, using the estimated six percent historic use of the available groundwater resource at STP and the official projected groundwater availability to 2060 of 49,211 AF, it appears reasonable that STP's groundwater use may remain at about 3,000 AF in 2060.

References:

1) LCRWPG, January 2006, *"Region "K" Water Plan for the Lower Colorado Regional Planning Group", Lower Colorado River Planning Group, prepared for the Texas Water Development Board*. Available at: http://www.twdb.state.tx.us/rwpg/2006_RWP/RegionK/

2) Turner Collie & Braden, Inc., May 2004, *Groundwater Management Plan, prepared for: Coastal Plains Groundwater Conservation District*, 20 p. Available at: http://www.twdb.state.tx.us/gwrd/GCD/plans/Coastal_Plains_GCD_Management_Plan_2004.pdf

Similar responses were provided for RAIs for ER 2.3-11 and ER 2.3-12, but involved groundwater availability projections. Considering that water use and availability are different, the following clarifications are proposed for the last paragraph of FSAR 2.4S.12.2.1, followed by additional text to provide further explanation of projected water demands.

The TWDB also prepares estimates of future total water ~~use~~ demand as part of water supply planning. These estimates have uncertainties associated with population growth projections, assumptions about climatic conditions (drought or wet years), and schedules for implementation of water conservation measures. The estimates of future water ~~use~~ demand for steam electric power generation include increased demand based on higher generation capacity and increased reservoir blowdown to maintain water quality. Table 2.4S.12-6 presents projected water ~~use~~ demand through the year 2060 (Reference 2.4S.12-14). This information was combined with historical water use to prepare the graphical representation of historic water use and projected water demand, as shown on Figure 2.4S.12-14. The relative percentages of water use categories are projected to remain the same as the historical data.

The CPGCD Groundwater Management Plan approved by TWDB on October 10, 2004, states (Reference 2.4S.12-XX):

- The Regional Water Planning Group (Region K) estimates 49,221 acre-feet per year (AF/Y) of usable groundwater is available from the Gulf Coast aquifer in Matagorda County.
- The average total groundwater withdrawn in Matagorda County from the Gulf Coast aquifer was 30,233 AF/Y between 1980 and 2000.
- The 2050 groundwater supply for Matagorda County is projected to be 35,785 AF/Y.

However, the CPGCD claims that little science was used in the development of these estimates and cautions their use (Reference 2.4S.12-XX).

Further complicating the situation, the TWDB-approved projected water demands are not presented with separate surface water and groundwater amounts. Using

Region K estimates, CPGCD projects surface and groundwater demands for Matagorda County will exceed projected supplies in the future. Water conservation strategies and desalination of sea water and deeper brackish groundwater have been proposed by Region K and the CPGCD to help meet the projected demand.

The following change to the end of FSAR Section 2.4S.12 is recommended to insert a citation referenced in this response:

2.4S.12-XX "Groundwater Management Plan, Prepared for: Coast Plains Groundwater Conservation District," Turner Collie & Braden, Inc., May 2004.

RAI 02.04.12-8:

<u>QUESTION</u>:

An inconsistency exists in FSAR Section 2.4S.12.2.3, Page 2.4S.12-10, and Figure 2.4S.12-23 – Upper Shallow Aquifer panel. Review the seasonal variability observed in 601 and 603B. Please clarify.

<u>RESPONSE</u>:

The data used to produce the hydrographs of Wells 601 and 603B as presented in Figure 2.4S.12-23 were reviewed for seasonal variability. The period from March 1995 to October 1996 includes data that exhibit the greatest observed potentiometric surface elevation change in Well 601 with about a nine-foot fluctuation from a high during June 1995 to a low during October 1996. During the same period, the hydrograph of Well 603B exhibits a similar fluctuation of about five feet.

Based on this response, the fifth sentence to the second paragraph of FSAR Section 2.4S.12.2.3 will be revised to incorporate the following changes:

Groundwater levels are monitored in site observation wells as part of STP 1 & 2 operations. Selected observation wells in proximity to STP 3 & 4 were used to prepare hydrographs of the Shallow and Deep Aquifers, as shown on Figure 2.4S.12-23. The monitoring data set selected extends from March 1995 through May 2006. Upper Shallow Aquifer Wells 603B and 601 are located to the west and east, respectively, of STP 3 & 4 and well 602A, which is located immediately north of the STP 3 area. Well 603B shows ~~some seasonal~~ variability ~~on the order~~ of ~~1 ft to 2~~ 5 ft, while Well 601 shows ~~little seasonal~~ variability of 9 ft. Well 602A shows some seasonal variability, with a peak groundwater elevation over the period of record of 25.8 ft MSL and with a long term variability of approximately 4 ft. Lower Shallow Aquifer wells 603A and 601A are located to the west and east, respectively, of STP 3 & 4. These wells show some seasonal variability with an overall decreasing trend in groundwater elevation. The elevation difference between the two wells suggests that they may be screened in different sand units within the Lower zone. Deep Aquifer observation wells 613 and 605 are located to the southwest and north, respectively, of STP 3 & 4. These wells show a notable increase in water level elevation between 1996 and 1998. Water levels in Well 613 show a slight declining trend between 2004 and 2006. Well 613 is located within the influence of STP Production Well 6, which may be the cause of the slight decrease in groundwater levels.

RAI 02.04.12-12:

<u>QUESTION</u>:

Describe the relationship (e.g., hydrologic profile of the screened intervals) of the test well and the production wells where the former is completed to 819 ft and the latter are completed to 600-700 ft below the ground surface.

<u>RESPONSE</u>:

In FSAR Section 2.4S.12.2.4.1, regional well screen lengths that range from 16 ft (County Well No. TA-81-10-901) to 819 ft (County Well No. TA-80-15-401), not depths, were mentioned to explain the use of screen length in the calculation of aquifer transmissivity. Information pertaining to these regional wells is summarized in Table 2.4S.12-9. County Well No. TA-80-15-401, an off-site regional well, is noted on Table 2.4S.12-9 as having a screen interval depth of 225-1,044 feet, which is a length of 819 ft. This is a regional well the State of Texas used to obtain a value for aquifer transmissivity and is not an on-site test well.

FSAR Section 2.4S.12.1.6 mentions that the five site production wells are screened between 600 ft and 700 ft in the Deep Aquifer. Information pertaining to onsite test and production wells is summarized in Table 2.4S.12-10. Test wells WW-1 through WW-4 are Shallow Aquifer test wells and did not penetrate depths exceeding 140 ft, the approximate base of the Lower Shallow Aquifer. The Deep Aquifer test well (production well 5) is screened to a depth of 670 ft similar to the other production wells.

Based on the above, there is no relationship between the offsite test well and the onsite production wells.

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

RAI 02.04.12-15:

<u>QUESTION</u>:

In FSAR Section 2.4S.12.2.4.1, “Hydrogeological Parameters”, the presence of a paleochannel is suggested by the applicant. How far could the suggested paleochannel extend to the northwest and south? Could this longer but higher conductivity pathway release to the Colorado River sooner than the projected pathway through less conductive material? What process was used to eliminate this alternate conceptual model and pathway from consideration for the analysis in FSAR Section 2.4S.13?

<u>RESPONSE</u>:

The term paleochannel as used in FSAR Section 2.4S.12.2.4.1 describes a zone of apparent higher hydraulic conductivity in the Lower Shallow Aquifer beneath the STP plant site. Generally, slug tests provide highly localized data on formation hydraulic conductivity. Use of such data alone is not considered sufficient to recognize the presence and extent of a paleochannel. A review of geologic boring logs indicates the substrata beneath STP 1 & 2 (Reference 1) and STP 3 & 4 (FSAR Section 2.5S.4) consist of interfingering and discontinuous sand, silt and clay sequences, which resemble floodplain deposits, with less evidence of channel deposits (e.g., gravel and basal lag deposits). In addition, geotechnical evaluations that include interpretation and correlation of downhole geophysical and lithologic data from the various boreholes conducted for STP Units 1 and 2, do not indicate the presence of such a zone in the area in question (Reference 2). Nevertheless, alternative interpretations, including the presence of a paleochannel were included in the alternative conceptual models considered.

The effects of a higher conductivity pathway to the Colorado River were considered in the analysis performed for FSAR Section 2.4S.13. FSAR Section 2.4S.13.1.2 describes the conceptual model used to evaluate an accidental release of liquid effluent to groundwater. Four of six pathways considered for evaluation based on criteria discussed in FSAR Section 2.4S.13 were rejected and 2 were selected. Of the two selected pathways, Pathway 1 considered groundwater flow in the Lower Shallow Aquifer from STP 3 to an off-site well southeast of STP, and Pathway 2 considered groundwater flow from STP 3 east-southeast to the Colorado River. These two pathways were screened using the representative travel times from Table 2.4S.12-17, as described in FSAR Section 2.4S.13.1.3.2. A sensitivity analysis was performed using the range of average linear velocities and travel times from FSAR Table 2.4S.12-17, and is further discussed in FSAR Section 2.4S.13.1.4. The transport pathways are presented in FSAR Figure 2.4S.13-2. The result of the sensitivity analysis indicates that radionuclides are not predicted to exceed the effluent concentration limits for Pathway 2. The sensitivity analysis considered both the lower range and higher range of the average linear velocities from Table 2.4S.12-17, and thus is considered to account for the hypothetical presence of a pathway of higher conductivity.

References:

1. STP 1 & 2 UFSAR, Revision 13, Figures 2.4.13-3A, -3B, and -3C.

2. Woodward-Clyde Consultants, August 29, 1975, Basic Data Report – Site Geology, South Texas Project, and Basic Data Report – Ground Water, South Texas Project.

The fourth paragraph of FSAR Section 2.4S.12.2.4.1 will be revised as shown below based on this response:

> Hydraulic conductivity can also be determined by the slug test method. This method measures the water level response in the test well to an instantaneous change in water level in the well. A disadvantage of this method is that it measures hydraulic conductivity only in the immediate vicinity of the test well. However, because the slug test requires minimal equipment and can be performed rapidly, slug tests can be performed in many wells, allowing a determination of spatial variability in hydraulic conductivity. Table 2.4S.12-11 presents a summary of slug tests performed in observation wells installed as part of the STP 3 & 4 subsurface investigation program. The test results indicate a range of hydraulic conductivity from 9 gpd/ft^2 to 561 gpd/ft^2. The slug test results for the Upper and Lower zones of the Shallow Aquifer were contoured, as shown on Figure 2.4S.12-26 to delineate spatial trends. The Upper Shallow Aquifer contour map indicates areas of higher hydraulic conductivity in the vicinity of STP 3 and to the northwest of STP 4. The surrounding measurements suggest these areas are localized. The Lower Shallow Aquifer map indicates an area of higher hydraulic conductivity between STP 3 & 4, which may extend to the southeast. ~~and extending to the south of the units. This area corresponds to the area of higher groundwater elevation identified on the February 22, 2007 potentiometric surface map for the Lower Shallow Aquifer shown on Figure 2.4S.12-19. The correspondence between a higher hydraulic conductivity area and higher potentiometric elevation suggests the presence of a flow pathway, such as a paleochannel, from the MCR toward STP 3 & 4.~~

RAI 02.04.12-18:

<u>QUESTION</u>:

In FSAR Section 2.4S.12.3.1, "Exposure Point and Pathway Evaluation", the applicant has placed an emphasis on present day well location. During the period of licensing being considered, nothing prevents a domestic groundwater well completed in the Shallow Aquifer, albeit of poor water quality, from being located at the site boundary. Provide a rationale for moving beyond the site boundary for off-site exposure.

<u>RESPONSE</u>:

The postulated exposure identified in Pathway 1 is based upon current use of the adjoining down-gradient property for grazing livestock. The well in question was cited in the discussion because the property east of the site consists of existing property structures and is being used for livestock grazing. The well cited is the first well encountered along in the path of the predominant groundwater flow direction in the Shallow Aquifer. Additional wells exist within the property, but all are Deeper Aquifer wells.

Although groundwater quality in the Shallow Aquifer is inferior to that in the Deep Aquifer where most domestic supplies are developed, future development of a potable domestic water supply from the Shallow Aquifer at another location closer to the STP property line cannot be precluded. To provide a more conservative analysis, an additional point of exposure will be located on the property line with the adjoining down-gradient neighbor southeast of STP 3 & 4. The exposure point will be hypothetical future domestic water well in the Shallow Aquifer. This point of exposure would result in a groundwater pathway approximately 7,300 feet long from STP Unit 3.

There is a current NRC commitment (COM 2.4S-2) to update FSAR 2.4S.12 and 2.4S.13 (if required) to reflect groundwater level measurements collected and analyzed for one year of data from STP 3 & 4 observation wells. The groundwater pathway evaluation for the hypothetical future domestic water well as an exposure point will be reflected in this revision of FSAR Section 2.4S12 (subsections 2.4S.12.3.1, 2.4S.12.3.2 and Table 2.4S.12-17) and in FSAR Section 2.4S.13.

RAI 02.04.12-21:

QUESTION:

In FSAR Section 2.4S.12.3.1, Page 2.4S.12-16, with regard to the Upper Shallow Aquifer and the unnamed tributary into which it discharges, where does this stream enter the public domain? Why is effluent release into the Lower Shallow Aquifer described as “conservative”?

RESPONSE:

The unnamed tributary stream enters the public domain as an ephemeral stream about one mile southeast of Units 1 and 2 where it exits the STP property west of Farm to Market Road/State Route 521 (Figure 2.4S.12-10). After that point, the unnamed tributary stream changes from an ephemeral stream to a perennial stream that flows south into Kelly Lake, which reenters the STP property.

Effluent release into the Lower Shallow Aquifer is considered conservative for the reasons stated in FSAR Section 2.4S.13.1.4;

> The analysis presented in this section is considered to be conservative because:
>
> - The analysis does not consider dispersion or dilution; both of these mechanisms would act to reduce the concentrations of the radionuclides.
> - The analysis assumes that no mitigative measures are implemented to reduce offsite exposure. Because the travel times to the receptors are on the order of hundreds of years, it would be possible to implement measures to further reduce off site exposure.
> - No credit is taken for the radwaste system components designed to prevent environmental releases, such as a stainless steel lined compartment to contain tank spillage and specially constructed building components surrounding the tanks to capture and prevent releases from the Radwaste Building. In accordance with Branch Technical Position 11-6 in NUREG-0800 (Reference 2.4S.13-3), these design components would mitigate potential release from the building tanks to the subsurface environment.
> - The radwaste building foundation level is below the groundwater potentiometric surface of both the Upper and Lower Shallow Aquifer zones. In the unlikely event the basement exterior walls leaked and associated steel liners and sump pumps were to fail simultaneously, groundwater would flow into the Radwaste Building, precluding the release of liquid effluents out of the building unless the water level in the building is higher in elevation than that of the surrounding groundwater potentiometric head.

The word “conservative” in FSAR Section 2.4S.12.3.1 is related to the release of contaminants (FSAR Section 2.4S.13) rather than the groundwater flow paths being discussed in FSAR Section 2.4S.12.3.

The third and fourth paragraphs in FSAR Subsection 2.4S.12.3.1 will be revised based on this response:

> The ~~Upper~~ Shallow Aquifer is the most likely hydrogeologic unit to be impacted by an accidental liquid effluent release onsite at Units 3 & 4. ~~Due to the shallow depth of this unit, a conservative release scenario would be a direct injection of liquid effluent into the Upper and Lower Shallow Aquifer.~~ The Upper Shallow Aquifer has a flow direction toward the southeast, as discussed in Subsection 2.4S.12.2.2. Examination of Figure 2.4S.12-31 indicates that a potential Upper Shallow Aquifer groundwater discharge area would be the unnamed tributary, located to the east of the STP 1 & 2 Essential Cooling Pond (ECP), which flows into Kelly Lake, approximately 7300 ft from STP 3. A second possible discharge area for both the Upper and Lower Shallow Aquifer is at Well 2004120846, which is an 80 ft deep livestock well, located east of the site boundary approximately 9000 ft from STP 3. This pathway assumes the well discharges to stock watering containers and that the groundwater is consumed by livestock, which would be an indirect human exposure pathway. Information from Appendix 2.4S.12-A3 indicates this well is estimated to produce 200,000 gallons per year or approximately 0.4 gpm. A third possible discharge area for both Shallow Aquifer units would be the Colorado River, approximately 17,800 ft from STP 3.
>
> The Lower Shallow Aquifer is isolated over much of the site by the Lower Shallow Aquifer Confining Layer. However, aquifer pumping test data (Subsection 2.4S.12.2.4.1) and hydrogeochemical data (Subsection 2.4S.12.2.5) suggest that leakage through the less permeable confining layer is occurring. Additionally, excavations for the foundations of some of the deeper structures are projected to enter the Lower Shallow Aquifer. Subsection 2.4S.12.2.2 indicates that a consistent downward vertical hydraulic gradient exists between the Upper and Lower Shallow Aquifer, which would provide the driving force for movement of groundwater from the Upper to the Lower Shallow Aquifer in the ~~leakage~~ Units 3 & 4 site area~~s~~. Therefore, ~~A conservative effluent release scenario would be~~ a direct effluent release into the Lower Shallow Aquifer is possible. Subsection 2.4S.12.2.2 indicates the Lower Shallow Aquifer has an east to southeast flow direction. Due to the depth to the top of the aquifer and the downward vertical hydraulic gradient in the Lower Shallow Aquifer, it is unlikely that discharge would occur into the unnamed tributary to the east of the STP 1 & 2 ECP. Likely discharge points are Well 2004120846, as discussed above, or the Colorado River alluvium, where the river channel has incised into the Lower Shallow Aquifer, approximately 17,800 ft from STP 3 & 4.

RAI 02.04.13-6:

QUESTION:

In FSAR Section 2.4S.13.1.3.2, Transport Considering Advection, Radioactive Decay, and Retardation and FSAR Section 2.4S.13.4, "Compliance with 10 CFR 20", the applicant describes the Kd values selected for use differently. In the former the applicant states "The Kd values from the reference are assumed to be lognormally distributed, and, for conservatism, the selected Kd values were taken as the lowest 10 percentile probability in the data distribution." Later, the applicant states, "…incorporated the minimum laboratory Kd values (or 10 percent of the literature value for those isotopes without site-specific laboratory tests)." These are not equivalent statements. Please clarify.

RESPONSE:

FSAR Section 2.4S.13.1.4, "Compliance with 10 CFR 20", inaccurately states that a K_d value of 10 percent of the literature value was used for those isotopes for which no site-specific value was determined by laboratory testing of soil samples. In fact, a K_d value equal to the 10th percentile of the data distribution provided in Reference 2.4S.13-9 was used for those isotopes for which no site-specific K_d value was available.

The second paragraph of FSAR Section 2.4S.13.1.4 will be revised as follows:

> A sensitivity analysis was performed using the range of average linear velocities/travel times from Table 2.4S.12-17 and the range of distribution coefficients (K_d) from Table 2.4S.13-3. For example, the maximum average linear velocity (shortest travel time) incorporated the minimum laboratory K_d values (or ~~10 percent of the literature value~~ the 10th percentile of the data distribution provided in Reference 2.4S.13-9 for those isotopes without site specific laboratory tests) and the minimum average linear velocity (longest travel time) incorporated the maximum laboratory K_d values (or ~~10 percent of the literature value~~ the 10th percentile of the data distribution provided in Reference 2.4S.13-9 for those isotopes without site specific laboratory tests).

RAI 02.05.01-2:

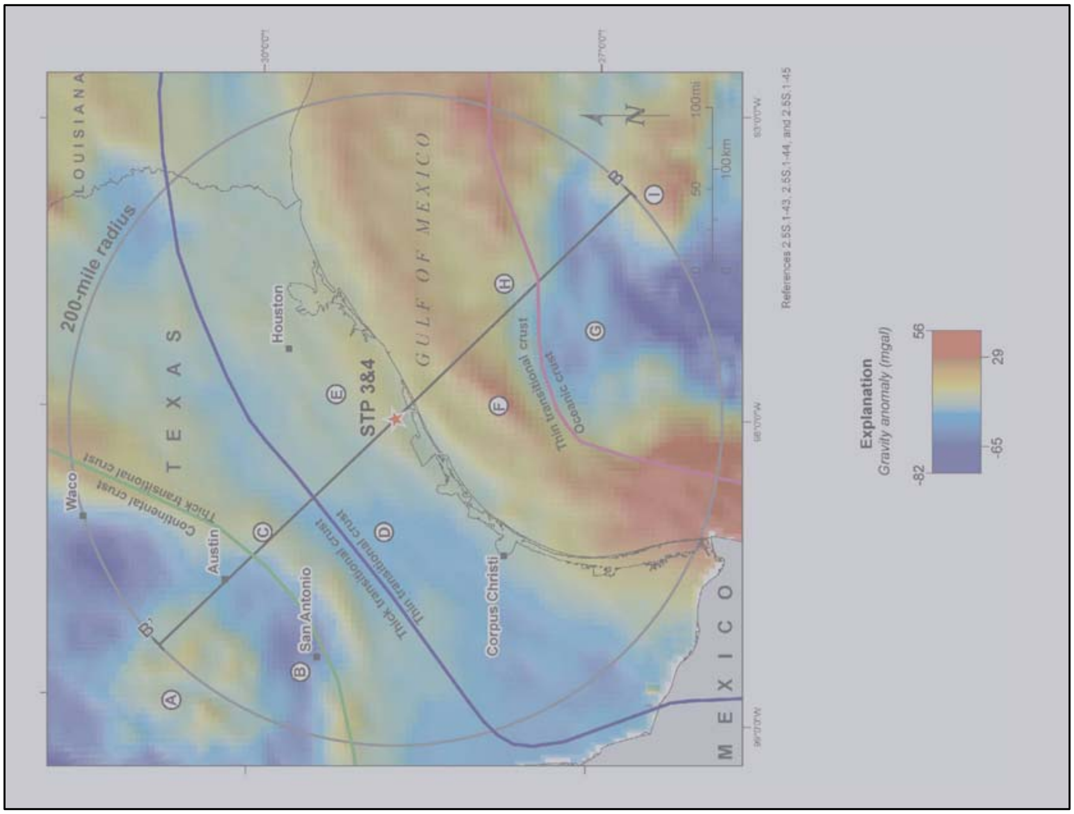
QUESTION:

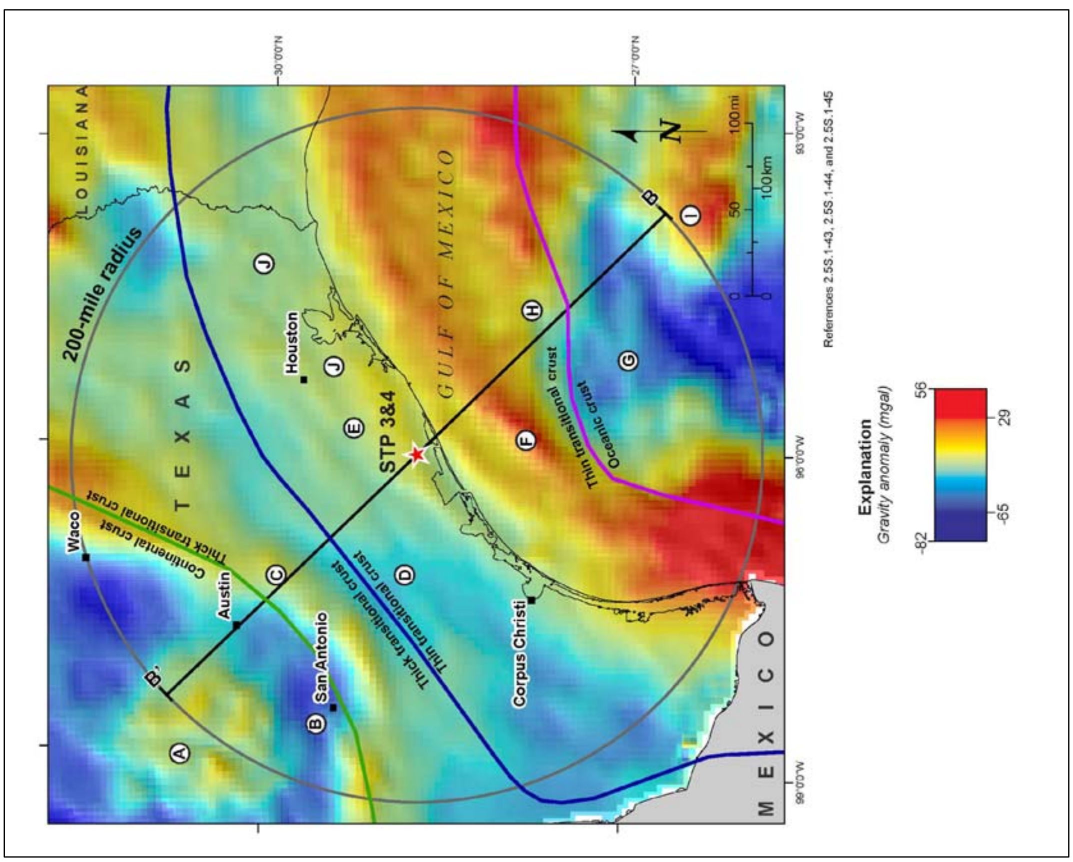
Please label examples of Gravity Feature J on Figure 2.5S.1-15 or Figure 2.5S.1-20 and Gravity Feature E on Figure 2.5S.1-21 and 1-22.

RESPONSE:

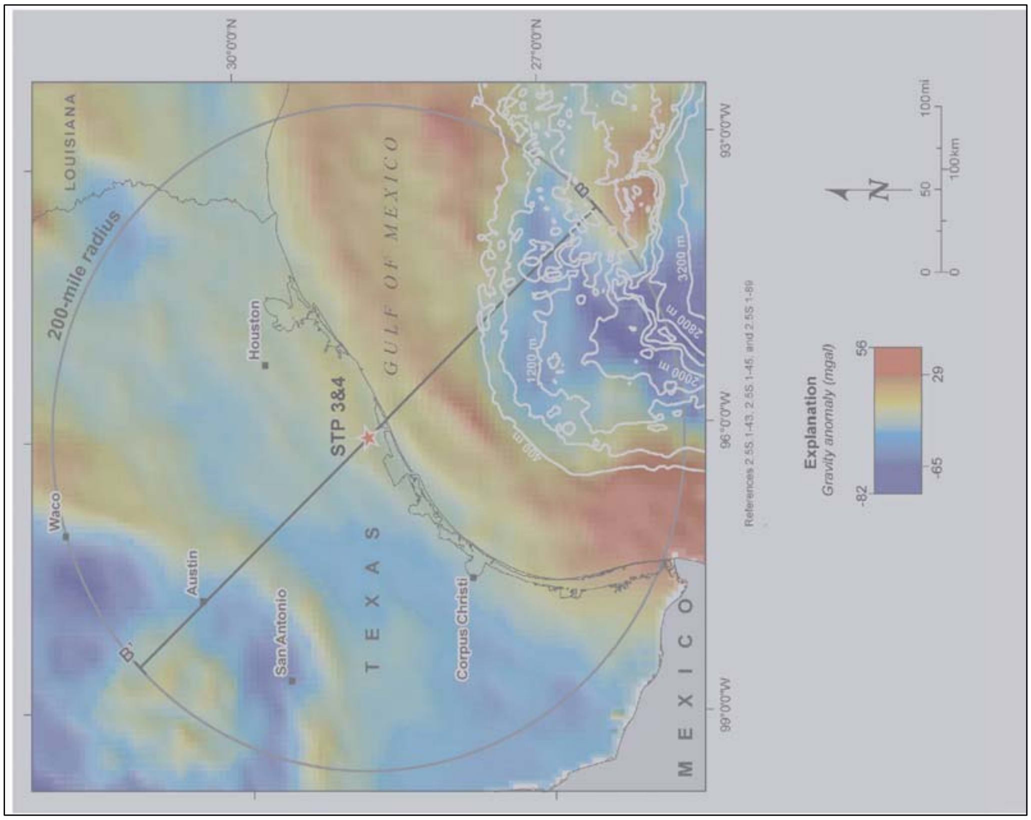
See Figure 2.5S.1-15 with updated labels of Gravity Feature J and Figures 2.5S.1-21 and 2.5S.1-22 with updated labels of Gravity Feature E on the next three pages. Copies of the old figures are attached and grayed out to indicate figures being replaced. The COLA will be revised to replace Figures 2.5S.1-15, 2.5S.1-21, and 2.5S.1.22.

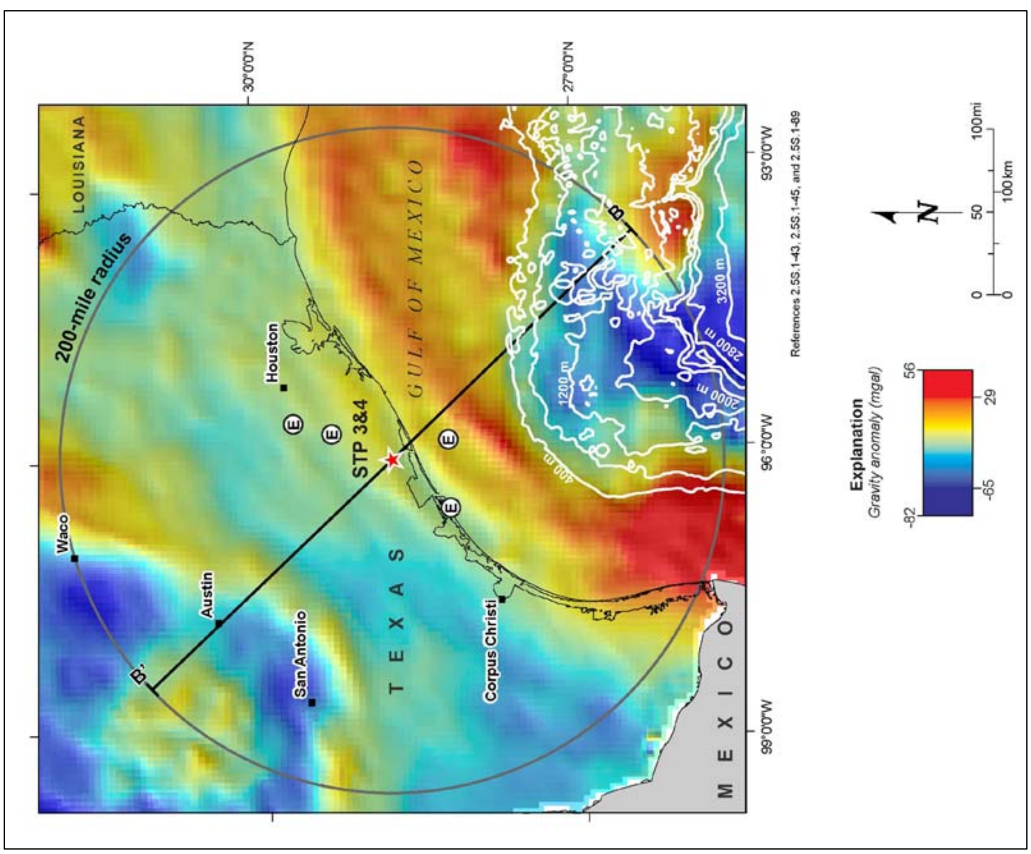
Replace Figure 2.5S.1-15 with a revised version that has updated labels of Gravity Feature J.



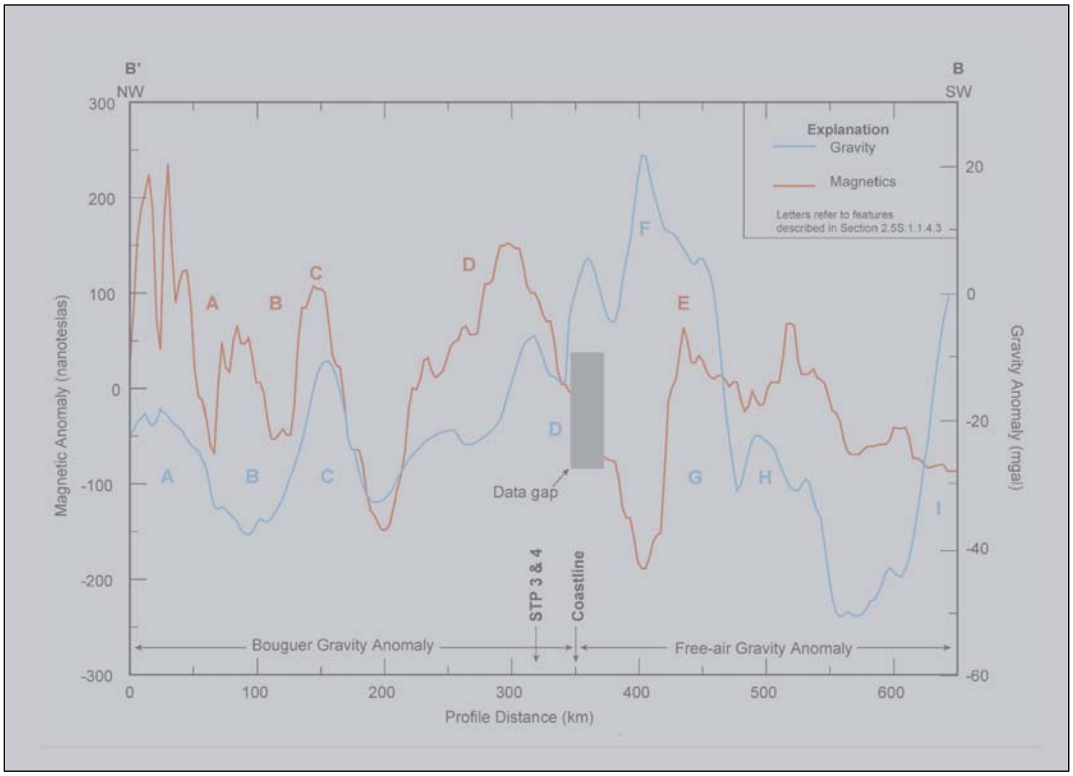


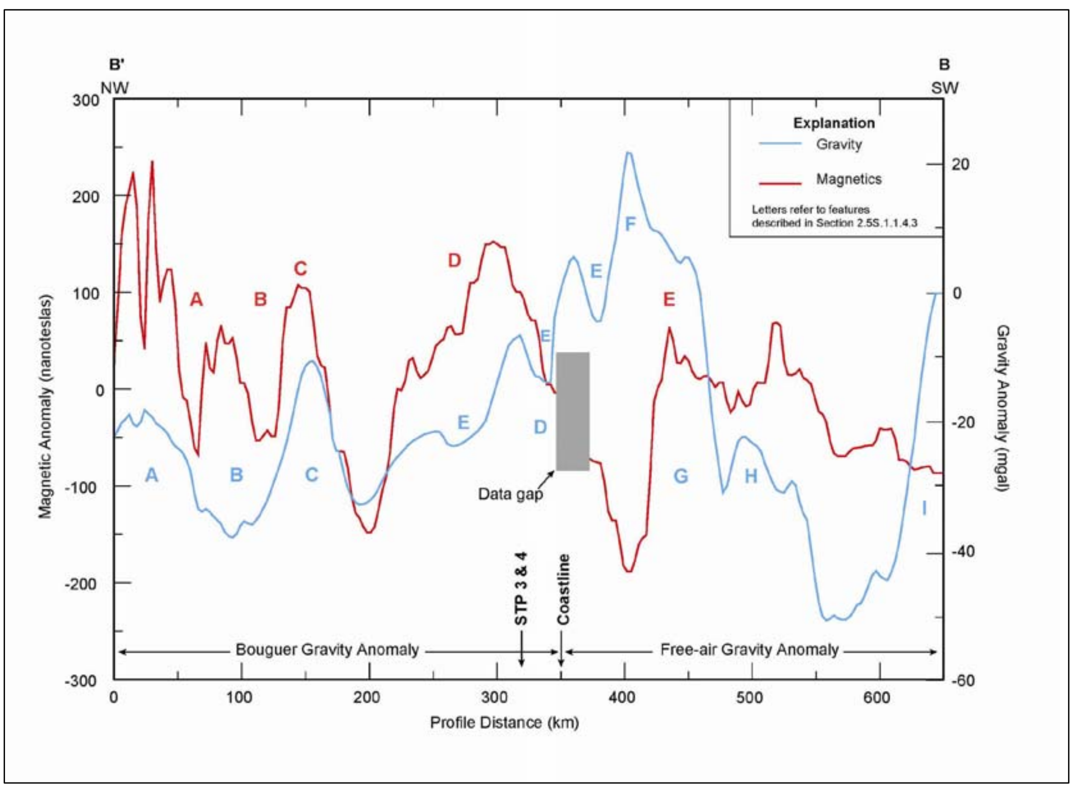
Replace Figure 2.5S.1-21 with a revised version that has updated labels of Gravity Feature E.





Replace Figure 2.5S.1-22 with a revised version that has updated labels of Gravity Feature E.





RAI 02.05.01-17:

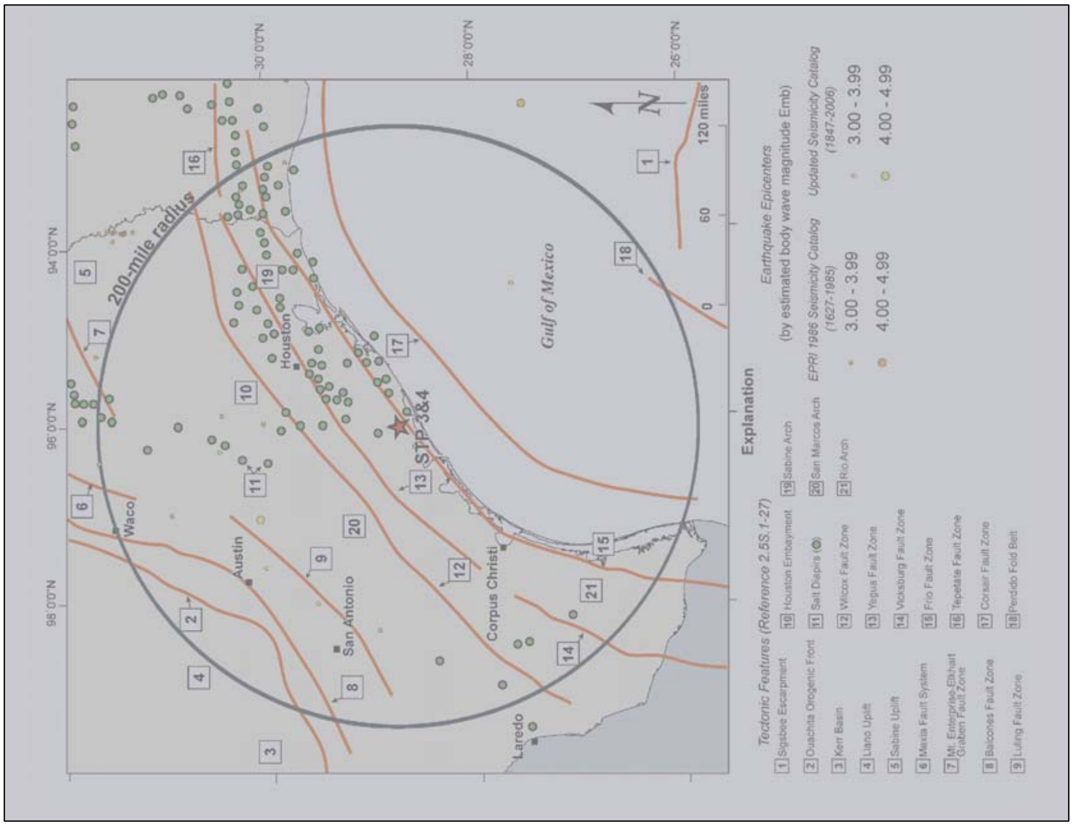
QUESTION:

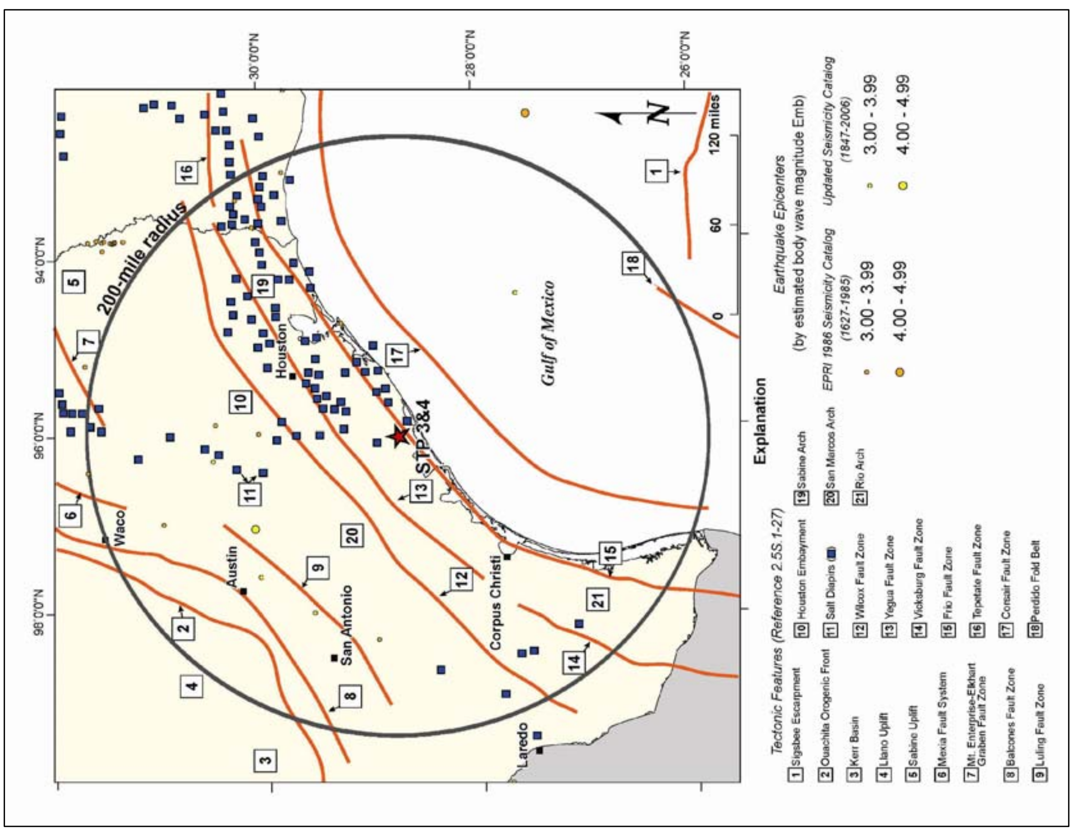
Figure 2.5S.1-17 shows earthquakes and salt diapirs with similar symbols and colors. Please provide a new version of the figure with earthquakes clearly distinguished from the diapirs.

RESPONSE:

Figure 2.5S.1-17 will be revised with updated symbols as shown on the next page. A copy of the old figure is attached and grayed out to indicate the figure is being revised. The COLA will be revised to replace Figure 2.5S.1-17.

Replace COLA Figure 2.5S.1-17 with the revised version.





RAI 02.05.02-17:

QUESTION:

Section 2.5S.2.5.2, "Seismic Wave Transmission Characteristics of the Site," used generic curves from the EPRI report (1993) and did not use the Resonant Column/Torsional Shear (RCTS) data in the site-specific response analyses. The limited soil degradation curves from five samples deviate from the generic EPRI curves at close to 0.01% strain level ("approximately 0.02% level," according to your description) for the subsurface soil layers of M and N (load bearing layers). Therefore, the GMRS may not necessarily reflect the site–specific soil dynamic properties without incorporating sufficient site-specific RCTS test results. Please incorporate sufficient RC/TS test results into the GMRS calculation to characterize the site-specific soil dynamic properties.

RESPONSE:

The site specific RCTS data will be used and the site response analysis will be repeated to evaluate the effects on the ground motion and GMRS. If necessary, GMRS will be revised and COLA Section 2.5 will be updated (COM 2.5S-1).

No COLA revision is required as a result of this RAI response. COLA revision will be made, as necessary, as a result of the associated commitment.

RAI 09.01.05-1:

<u>QUESTION</u>:

RAI-SRP 9.1.4/9.1.5-SBPB-01 COL License Information Item 9.6 stated that the applicant shall provide a list of all cranes, hoists, and elevators and their lifting capacities, including any limit and safety devices required for automatic and manual operation. Additionally, information was requested on all such equipment describing operating and maintenance procedures, operating and maintenance manuals, system and equipment inspection test plans, load paths and routing plans, QA program to assure implementation and compliance, and operator qualification, training and control program. The applicant responded to the first part of the COL Information Item by stating that this information is vendor specific and will be provided after equipment procurement but before receipt of fuel. Appropriate descriptions will be added with an FSAR amendment in accordance with 10 CFR 50.71 (e) prior to receipt of fuel (COM 9.1-3). The commitment only involves cranes, hoists, and elevators and their lifting capacities be added to the FSAR. Heavy load handling at the plant will begin during plant construction and therefore a heavy load handling program that meets Section 5.1.1 of NUREG 0612 should be in place at the time that heavy load handing begins. The applicant did not respond to the other information requested by the COL Information Item. Information was requested on all such equipment describing operating and maintenance procedures, operating and maintenance manuals, system and equipment inspection test plans, load paths and routing plans, QA program to assure implementation and compliance, and operator qualification, training and control program. The applicant has not provided this information, nor committed to provide the information following equipment procurement. Therefore, the staff requests that the applicant provide the information as requested by COL Information Item 9.6.

<u>RESPONSE</u>:

The original response to COL License Information Item 9.6 should have indicated that all the information requested will be provided as it becomes available.

In regard to the application of a heavy load handling program during construction, conditions do not exist during construction prior to fuel load that require a heavy loads handling program in accordance with NUREG 0612, Control of Heavy Loads at Nuclear Power Plants. The abstract section of NUREG 0612 indicates that its coverage of the subject of heavy loads is for loads that if dropped might impact spent fuel, fuel in the core, or equipment that may be required to achieve safe shutdown and continue decay heat removal. Further definition of criteria requiring a heavy loads handling program is provided in the Design Basis portion of COLA Section 9.1.5, Overhead Heavy Load Handling Systems (OHLH). During construction, lifts of significant loads are regarded and addressed as occupational safety hazards and recognized risks to cost and schedule.

Section 9.1.6.6 will be revised to read as follows:

The following standard supplement addresses COL License Information Item 9.6.

The COL applicant shall provide a list of all cranes, hoists, and elevators and their lifting capacities, including any limit and safety devices required for automatic and manual operation. ~~This information is vendor specific and will be established following equipment procurement. Appropriate descriptions will be added with an FSAR amendment in accordance with 10 CFR 50.71(e) prior to receipt of fuel. (COM 9.1-3)~~

In addition, for all such equipment, the COL applicant shall provide the following information:

(1) *Heavy load handling system operating and equipment maintenance procedures.*
(2) *Heavy load handling system and equipment maintenance procedures and/or manuals.*
(3) *Heavy load handling system and equipment inspection and test plans; NDE, visual, etc.*
(4) *Heavy load handling safe load paths and routing plans.*
(5) *QA program to monitor and assure implementation and compliance of heavy load handling operations and controls.*
(6) *Operator qualifications, training and control program.*

The information above is either vendor specific and will be established following equipment procurement, or involves associated programs that will be developed as the equipment is procured. Appropriate descriptions will be added with an FSAR amendment in accordance with 10 CFR 50.71(e) prior to receipt of fuel. (COM 9.1-3).

RAI 09.01.05-2:

QUESTION:

RAI-SRP 9.1.5-SBPB-02 Standard Review Plan (SRP) 9.1.5 states that cranes designed to the criteria of ASME NOG-1 2004 for a Type 1 crane are acceptable under the guidelines of NUREG-0554 for construction of a single failure-proof crane. Section 9.1.5.1 of the STP 3 and 4 COLA for the Reactor Building Crane specifies ASME NOG-1 without a year of edition. Please specify the edition year in the COLA for ASME NOG-1 and if different than 2004, provide reconciliation between the edition and the 2004 edition.

RESPONSE:

The 2004 edition of ASME NOG-1 will be applied to the Reactor Building Crane. Section 9.1.5.1 will be revised to read as follows:

> *The lifting capacity of each crane or hoist is designed to at least the maximum actual or anticipated weight of equipment and handling devices in a given area serviced. The hoists, cranes, or other* special *lifting devices* for handling heavy loads *shall comply with the requirements of ANSI N14.6, ANSI B30.9, ANSI B30.10 and NUREG-0612, Subsection 5.1.1(4) or 5.1.1(5). Cranes and hoists are also designed to criteria and guidelines of NUREG-0612, Subsection 5.1.1(7), ANSI B30.2 and CMAA-70 specifications for electrical overhead traveling cranes, including ANSI B30.11, ANSI B30.16, ~~and~~ NUREG-0554*, and ASME NOG-1 2004, *as applicable.*

RAI 10.04.05-1:

<u>QUESTION</u>:

The interface requirement for the circulating water system (CWS) in ABWR DCD, Tier 1, Section 2.10.23 states, "The parts of the CWS system (including the power cycle heat sink) which are not within the Certified Design shall meet the following requirements: (1) Design features shall be provided to limit flooding in the Turbine Building." The staff reviewed the STP RCOL FSAR Section 10.4.5 for the CWS, which does not specifically address this interface requirement as specified in the DCD. Further, the staff noticed that in FSAR Sections 10.4.5.7.2 and 10.4.5.8.2, "Power Generation Design Basis (Interface Requirements)," the applicant characterized these items as COL information items, which is not clear as to which is interface item and which is COL information item. Furthermore, with respect to flooding, the "Acceptance Criteria," in STP ITAAC Table 3.0-9,"Circulating Water System (CWS)," states that the circulating water condenser valves close and the CWS pumps are tripped following receipt of a system isolation signal from the condenser area level switches. However, the criteria do not include closure of the CW pump valves on receipt of the above signal. Therefore, the staff requests the applicant to provide additional information and clarifications as they relate to the circulating water system interface requirements and COL information items.

<u>RESPONSE</u>:

DCD Sections 10.4.5.7.2 and 10.4.5.8.2 require the applicant to provide "Interface Requirements" information for the Circulating Water System (CWS). This information was provided in the STP 3 & 4 COLA; however, it was incorrectly identified as COL License Information. There is no COL License Information required by Section 10.4.5.

DCD Section 10.4.5.2.3, incorporated by reference in the STP 3 & 4 COLA, provides the following: "The circulation water pumps are tripped and the pump and condenser isolation valves are closed in the event of a system isolation signal from the condenser pit high-high level switches." As stated in DCD Section 10.4.5.5, when a CWS pump is stopped, the pump discharge valve will close.

Tier 1 Section 2.10 was incorporated by reference in the STP 3 & 4 COLA with no changes from the certified design and contains ITAAC Table 2.10.23 for the parts of the CWS within the certified design. ITAAC Table 2.10.23 Item 2 Design Commitment states "The circulating water condenser valves are closed in the event of a system isolation signal from the condenser area level switches," thereby covering this aspect of the flooding prevention provisions within the certified design. However, "Interface Requirements" as specified in DCD Tier 1 Section 2.10.23 pertain to the parts of the CWS which are not within the certified design. The intent of STP 3 & 4 COLA Part 9 Table 3.0-9 was to fulfill this interface requirement by providing additional verification of features designed to limit flooding in the Turbine Building. Therefore Table 3.0-9 will be revised to indicate additional Design Requirement and Acceptance Criteria for the CWS pumps and pump discharge valves as described above.

The opening sentences in COLA Sections 10.4.5.7.2 and 10.4.5.8.2 will be revised as follows:

10.4.5.7.2 Power Generation Design Basis (Interface Requirements)

The following site-specific supplements address the ~~COL License Information Items in~~ interface requirements for this subsection:

10.4.5.8.2 Power Generation Design Basis (Interface Requirements)

The following site-specific supplements address the ~~COL License Information Items in~~ interface requirements for this subsection:

In addition, Table 3.0-9 Circulating Water System (CW) of COLA Part 9 will be revised as follows:

Design Requirement	Inspections, Tests, Analyses	Acceptance Criteria
1. The circulating water ~~condenser~~ system pumps are tripped and the discharge valves are closed in the event of a system isolation signal from the condenser area ~~flood~~ level switches.	1. Testing of the as-built CW System will be performed using simulated flood level signals.	1. The circulating water ~~condenser valves close and the CW~~ system pumps are tripped and the discharge valves are closed in the event of ~~following receipt of~~ a system isolation signal from the condenser area level switches.