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July 26, 2011

Michael M. Gibson, Chair
Dr. Anthony J. Baratta
Dr. Mark O. Barnett
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Docket: Exelon Nuclear Texas Holdings, LLC, Early Site Permit for Victoria County Station Site, Docket No. 52-042

Re: Notification of Filing Related to Admitted Contentions

Dear Licensing Board Members:

The purpose of this letter is to provide notification that Exelon Nuclear Texas Holdings, LLC, applicant in the above-captioned matter, recently filed the attached letter, dated July 25, 2011, with the NRC on the docket for the Victoria County Station. The attached letter responds to requests for additional information (RAIs) submitted by the NRC staff, including RAIs related to growth faults and cooling basin seepage. The attached letter relates to admitted contentions TSEP-SAFETY-1, TSEP-SAFETY-2, and TSEP-ENV-1.

Respectfully submitted,

Signed (electronically) by Jonathan M. Rund
Jonathan M. Rund
Counsel for Exelon Nuclear Texas Holdings, LLC

cc: Service List

Exelon Generation

NP-11-0034
July 25, 2011

10 CFR 52, Subpart A

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station Early Site Permit Application
Response to Request for Additional Information Letter No. 10
NRC Docket No. 52-042

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) Letter No. 10, dated May 24, 2011, related to Early Site Permit Application (ESPA), Part 2, Sections 02.05.04, 02.05.05, 11.02 and 11.03. NRC RAI Letter No. 10 contained thirty-six (36) Questions. This submittal comprises a partial response to RAI Letter No. 10, and includes responses to the following eleven (11) Questions:

02.05.04-5	02.05.05-1	02.05.05-15
02.05.04-10	02.05.05-6	02.05.05-16
02.05.04-15	02.05.05-9	02.05.05-17
02.05.04-17	02.05.05-12	

When a change to the ESPA is indicated by a Question response, the change will be incorporated into the next routine revision of the ESPA, planned for no later than March 31, 2012.

Of the remaining twenty-five (25) RAIs associated with RAI Letter No. 10, responses to eight (8) Questions were submitted to the NRC in Exelon Letter NP-11-0026, dated June 23, 2011, and responses to twelve (12) Questions were submitted to the NRC in Exelon Letter NP-11-0029, dated July 8, 2011. The response to RAI Questions 02.05.04-13, 02.05.04-14, 02.05.05-2, 02.05.05-3, and 02.05.05-8 will be provided by August 5, 2011. These response times are consistent with the response times described in NRC RAI Letter No. 10, dated May 24, 2011.

Regulatory commitments established in this submittal are identified in Attachment 12.

If any additional information is needed, please contact David J. Distel at (610) 765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 25th day of July, 2011.

Respectfully,

Marilyn C. Kray

Marilyn C. Kray
Vice President, Nuclear Project Development

Attachments:
1. Question 02.05.04-5
2. Question 02.05.04-10
3. Question 02.05.04-15
4. Question 02.05.04-17
5. Question 02.05.05-1
6. Question 02.05.05-6
7. Question 02.05.05-9
8. Question 02.05.05-12
9. Question 02.05.05-15
10. Question 02.05.05-16
11. Question 02.05.05-17
12. Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO (w/Attachments)
USNRC, Project Manager, VCS, Division of New Reactor Licensing (w/Attachments)
USNRC Region IV, Regional Administrator (w/Attachments)

RAI 02.05.04-5:

Question:

SSAR Section 2.5.4.5 provides three potential structural fill types, but does not specify a source for the backfill nor the DOT requirements. In addition, the applicant states that "structural fill below and/or surrounding major power block area structures alternatively consists of lean concrete fill, or concrete fill. The selection of structural fill, lean concrete fill, and/or concrete fill is determined during detailed design." In order for the staff to evaluate the suitability of the foundation design, additional specificity is required on the source type and location, properties of the fill, and placement of the various fill types (structural fill, lean concrete, and/or concrete fill).

Response:

Structural Fill

Properties

SSAR Section 2.5.4.5.1.1.1 describes samples of structural fill material obtained from local suppliers. These materials were selected because they are readily available. The amount of structural fill required will depend on the technology selected. The quantities quoted in Section 2.5.4.5.1.1.1 (up to one-half million cubic yards of structural fill) are conservative, and it is expected that the actual amount will be significantly less if the technology selected requires substantially less excavation. At the time of the application for the combined operating license, the reactor technology will have been chosen, and the source options for the structural fill, described in Section 2.5.4.5.1.1.1 (and discussed further below), will be identified. The final source of the fill will be selected during (or before) detailed design.

Structural fill materials identified in Section 2.5.4.5.1.1.1 were:

1. A sample supplied by Cw&a, Inc., of Victoria, Texas, and identified as CWA #4. The tested bulk sample was sandy gravel with trace amounts (7%) of fines. USCS classification was GW-GC. Grain size distribution is shown on Figure 1 (from Reference 1).

   Coefficient of Uniformity, $C_U = D_{60}/D_{10}$ = 7 mm/0.13 mm = 54. Values of $C_U > 4$ meet GW requirements (ASTM D 2487). This is extremely well graded.

   Coefficient of Curvature, $C_C = (D_{30})^2/D_{10} \times D_{60}$ = (1.2 mm)^2/0.13 x 7 mm = 1.58. Values of C_C between 1 and 3 meet the GW requirements (ASTM D 2487).

   A modified Proctor compaction test (ASTM D 1557) gave maximum dry unit weight of 136.5 pcf at an optimum moisture content of 6%.

A direct shear test on a compacted sample of the material gave an internal friction angle of 42 degrees.

Chemical analyses of a sample of the material showed:

pH = 5.7

Chloride = 1.4 mg/kg

Sulfate = 5.6 mg/kg

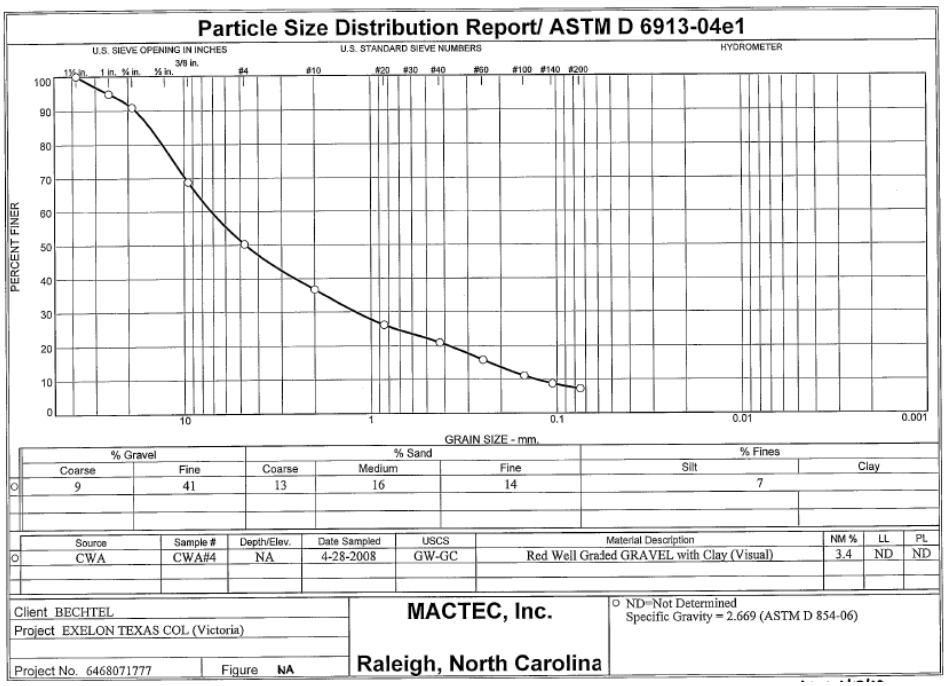


Figure 1: Grain Size Distribution for Sample CWA #4

2. A sample supplied by Cw&a, Inc., of Victoria, Texas, and identified as CWA #6. The tested bulk sample was sandy gravel with trace amounts (7%) of fines. USCS classification was GP-GC. Grain size distribution is shown on Figure 2 (from Reference 1).

   C_U = 7 mm/0.075 mm = 93. Values of C_U > 4 meet GW requirements. This is extremely well graded.

   C_C = $(0.5\ mm)^2$/0.075 x 7 mm = 0.48. Values of C_C between 1 and 3 meet the GW requirements. Since C_C < 1, the material falls into the GP rather than GW grouping.

   A modified Proctor compaction test (ASTM D 1557) gave maximum dry unit weight of 133 pcf at an optimum moisture content of 6.5%.

A direct shear test on a compacted sample of the material gave an internal friction angle of 39 degrees.

Chemical analyses of a sample of the material showed:

pH = 8.1

Chloride = 2.3 mg/kg

Sulfate = 11.8 mg/kg

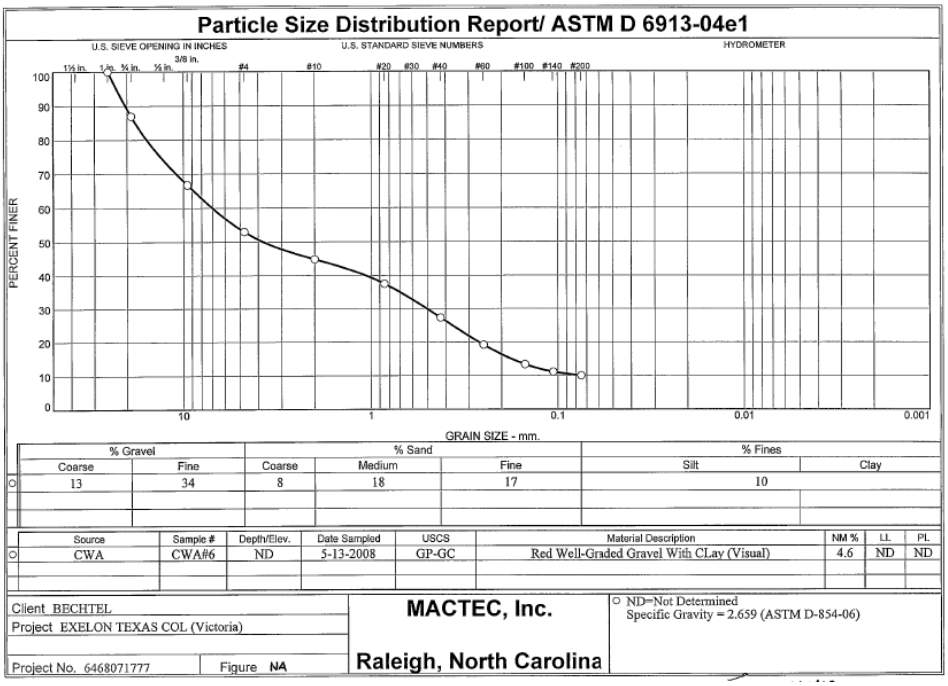


Figure 2: Grain Size Distribution for Sample CWA #6

3. A sample obtained from the Fordyce Briggs Pit in Victoria, Texas. The tested bulk sample was gravelly sand with trace amounts (3%) of fines. USCS classification was SP. Grain size distribution is shown on Figure 3 (from Reference 1).

   $C_U = D_{60}/D_{10}$ = 5.4 mm/0.29 mm = 18.6. Values of $C_U > 6$ meet SW requirements

   Coefficient of Curvature, $C_C = (D_{30})^2/D_{10} \times D_{60} = (0.51\text{ mm})^2/0.29 \times 5.4\text{ mm} = 0.17$. Values of C_C between 1 and 3 meet the SW requirements. Since $C_C < 1$, the material falls into the SP rather than SW grouping.

   A modified Proctor compaction test (ASTM D 1557) gave maximum dry unit weight of 120.5 pcf at an optimum moisture content of 12.5%.

A direct shear test on a compacted sample of the material gave an internal friction angle of 40 degrees.

Chemical analyses of a sample of the material showed:

pH = 9.4

Chloride = 7.9 mg/kg

Sulfate = 10.2 mg/kg

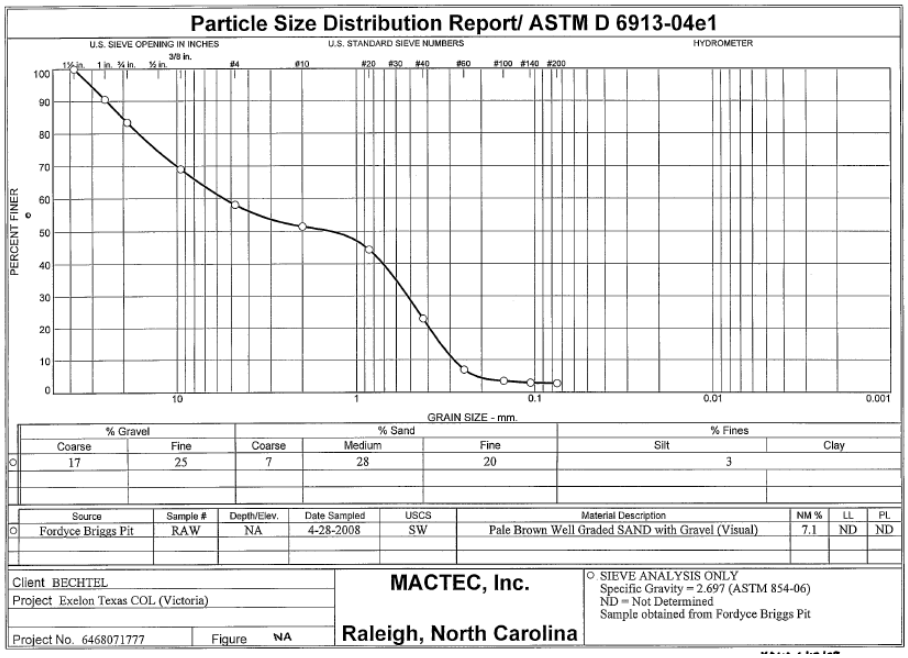


Figure 3: Grain Size Distribution for Fordyce Briggs Pit Sample

Placement, Compaction and Testing

Structural fill placement and compaction are described in SSAR Section 2.5.4.5.3. Details of fill placement and compaction will be addressed in a specification that will be prepared during detailed design. A range of acceptable material gradation will be specified – the gradations of the first two samples described above are expected to fall within this range.

For power block area structures and for backfill against underground structures, structural fill will be compacted to a minimum of 95 percent of modified Proctor (ASTM D 1557) maximum dry density, within plus or minus 2 percent of optimum moisture content. The testing requirements of the compacted fill in the field will include frequent in-place density and moisture content testing. Typically, a minimum of one field density and moisture content test per 10,000 ft^2 is specified, with at least one test per lift and per shift.

Concrete Fill

Concrete fill will be used when schedule and access considerations make it a better solution than granular structural fill. Athough the decision about where to use concrete fill (if at all) and details of the concrete fill will be determined during detailed design, there are some valuable guidelines available when selecting details of the concrete fill.

The concrete fill should have a relatively low strength, probably in the 1,000 to 1,500 psi range, which is more than adequate from a strength and bearing capacity standpoint. An advantage of lower strength concrete used in mass concrete fill is that it has a lower heat of hydration and thus less chance of cracking. Portland cement substitutes such as slag or Class F flyash help minimize the heat of hydration.

Another advantage of low strength concrete is its lower shear wave velocity. This helps reduce the shear wave velocity contrast between the in-situ soil and the concrete fill and reduces potential response amplification.

Concrete placing temperature can be controlled by use of chilled water, ice, spray for evaporative cooling and scheduling placements to take advantage of coolest temperatures (such as at night). When pouring another lift on top of an existing one, the top lift will be poured only after the bottom lift is properly cooled down.

Response References:

1. MACTEC Engineering and Consulting, Inc. “Final Data Report, Revision 1, Geotechnical Exploration and Testing, Exelon Texas COL Project, Victoria County, Texas, Power Block,” November 5, 2009. (SSAR Reference 2.5.4-1)

Associated ESPA Revision:

SSAR Section 2.5.4.5.1.1.1, Power Block Area, will be updated in a future revision of the ESPA, as indicated. It is noted that a commitment was included in the response to RAI 02.05.05-9 to provide the source of backfill materials in the COLA.

For the power block area, preliminary structural fill sources from local suppliers are identified as follows:

- A material processed to meet Texas DOT, Grade 4 requirements. The tested bulk sample is a well-graded gravel with trace amounts of fines (USCS classification, GW-GC)

- A material processed to meet Texas DOT, Grade 6 requirements. The tested bulk sample is a slightly finer well-graded gravel with trace amounts of fines (USCS classification, ~~GW~~GP-GC)

- Raw material sampled at the conveyor. The tested bulk sample is a ~~still~~ slightly finer ~~well-graded~~ sand with gravel and trace amounts of fines (USCS classification, ~~SW~~SP)

RAI 02.05.04-10:

Question:

In accordance with 10 CFR 100.23(d)(4), the staff request that the applicant provide the following information regarding liquefaction potential:

a) The staff noted that the liquefaction analysis discussion presented in SSAR Subsection 2.5.4.8.2 only pertained to those data points that exhibited a factor of safety (FS) of less than 1.1. RG 1.198 recommends values that are equal to 1.1 should also be considered as liquefiable and should be evaluated. Please verify that you considered FS values equal to 1.1 as well as those less than 1.1.

b) For FS values between 1.1 and 1.4, stability and deformation analyses should be performed with reduced strength values. Please provide the recommended evaluation for zones with FS values between 1.1 and 1.4 at the site.

Response:

Part (a)

The data used as the basis for the liquefaction analysis were reexamined to determine what samples had a computed FS of exactly 1.1. There were eight samples with computed FS = 1.1, with one based on SPT N-values, five based on CPT q_c values, and two based on shear wave velocity (Vs) values. All were clay samples, and none of these samples possess potential liquefaction problems, as explained below.

SPT N-value

B-2174A at 3 ft depth. This is C1 (top) Clay classified as CH, and is under the center of the reactor building. CH materials are non-liquefiable. This soil will be excavated for the reactor building.

CPT q_c value

C-2206S at 1.25 ft depth. This is C1 (top) Clay material (CL or CH). It is therefore non-liquefiable. The sample is located beneath the reactor building and will thus be excavated.

C-2209S at 4.25 ft depth. This is C1 (top) Clay material (CL or CH). It is therefore non-liquefiable.

C-2303S at 88.75 ft depth. This is C5 Clay, classified as CH or CL. It is therefore non-liquefiable. In the analysis, Ic > 2.6 with n = 1. According to Youd et al (2001), this is non-liquefiable.

C-2311A at 4.25 ft depth. This is C1 (top) Clay material (CL or CH). It is therefore non-liquefiable. Also, in the analysis, Ic > 2.6 with n = 1. According to Youd et al (2001), this is non-liquefiable.

C-2322 at 48.75 ft depth. This is C3 Clay material (CH or CL). It is therefore non-liquefiable. Also, in the analysis, Ic > 2.6 with n = 1. According to Youd et al (2001), this is non-liquefiable.

Vs value

B-2282A at 14.8 ft depth. This is C1 (top) Clay material (CL or CH). It is therefore non-liquefiable.

B-2303G at 21.3 ft depth. This is C1 (bottom) Clay material (CL or CH). It is therefore non-liquefiable.

Part (b)

The liquefaction analyses for VCS were performed using a peak ground acceleration of 0.10g. This value was selected before the peak ground acceleration was finalized for the GMRS. As shown in SSAR Table 2.5.2-27, the GMRS acceleration (both horizontal and vertical) at a frequency of 100 Hz (which is taken as zero period acceleration or peak ground acceleration) is 0.0769g. The liquefaction analyses could have been repeated using 0.0769g peak ground acceleration. However, because the analyses using 0.10g showed essentially no liquefaction potential, the analyses were not repeated at the lower acceleration value.

If liquefaction were reanalyzed using the lower acceleration value, the resulting FS values would be increased by a factor of 1.3 (0.10/0.0769 = 1.3), because FS is inversely proportional to peak ground acceleration, as shown in Youd et al (2001). Equation 23 of Youd et al (2001) indicates:

$FS = (CRR_{7.5}/CSR) \times MSF$

Where $CRR_{7.5}$ = cyclic resistance ratio, computed from SPT, CPT or Vs for 7.5 magnitude event.

CSR = cyclic stress ratio which represents the seismic demand on the soil

MSF = magnitude scaling factor.

Equation 1 of Youd et al (2001) indicates:

$CSR = 0.65(a_{max}/g) \times (\sigma_{vo}/ \sigma'_{vo}) \times r_d$

Where a_{max} = peak ground acceleration

g = acceleration of gravity

σ_{vo} and σ'_{vo} = total and effective vertical overburden stresses, respectively

r_d = stress reduction coefficient

Because neither $CRR_{7.5}$ nor MSF is a function of peak ground acceleration, FS is inversely proportional to peak ground acceleration. Therefore, the FS = 1.1 value obtained using 0.10g would be 1.1 x 1.3 = 1.43 using 0.0769g peak ground acceleration. Samples with an FS between 1.1 and 1.4 (inclusive) using 0.10g would have an FS higher than 1.4, using 0.0769g. Thus, a reduced strength value would not need to be assigned to these samples. Also note that the eight samples with values of FS equal to exactly 1.1 using 0.10g are described in part (a) of this response, and are non-liquefiable clays, thus no further analysis is required.

Samples with an FS less than 1.1, using 0.10g, would have an FS value as high as 1.4, using 0.0769g, and thus further analysis would be required to determine if reduced strength parameters are necessary. Samples with FS values < 1.1 using 0.10g acceleration are described in SSAR Tables 2.5.4-76 through 2.5.4-81. They identify those samples that have possible liquefaction potential (i.e., FS < 1.1, are not clays, and will not be excavated). The samples with possible liquefaction potential from those tables are discussed in the following paragraphs with reference to a peak ground acceleration of 0.0769g.

In the power block area, using SPT N-values to compute FS against liquefaction (SSAR Table 2.5.4-76), one out of the 2505 N-values analyzed indicated possible liquefaction potential, i.e., where the FS against liquefaction is less than 1.1 using peak ground acceleration of 0.10g, and the material is not a clay and will not be excavated. This is for a sand sample with FS = 1.27 using 0.0769g. As noted in SSAR Section 2.5.4.8.2.1, this is an isolated occurrence which does not present a risk to safety-related structures. Assigning a reduced strength value to this single sample would have negligible impact on stability or settlement analyses.

In the cooling basin area, using SPT N-values to compute FS against liquefaction (SSAR Table 2.5.4-77), two out of the 1171 N-values analyzed indicated possible liquefaction potential. These are sand samples with FS = 1.21 and 1.31 using 0.0769g. As noted in SSAR Section 2.5.4.8.2.2, the N-values on samples immediately below these samples had high FS values and that the two samples with lower FS values represent isolated occurrences. Assigning a reduced strength value to these isolated samples would have negligible impact on stability or settlement analyses.

In the power block area, using CPT q_c values to compute FS against liquefaction (SSAR Table 2.5.4-78), none of the 5367 CPT results analyzed indicated possible liquefaction potential.

In the cooling basin area, using CPT q_c values to compute FS against liquefaction (SSAR Table 2.5.4-79), ten out of the 3629 CPT q_c values analyzed indicated possible liquefaction potential. These are sands with FS ranging from 1.16 to 1.40 using 0.0769g peak ground acceleration. As noted in SSAR Section 2.5.4.8.3.2, the CPT q_c values immediately below and/or above these samples had high FS values and the q_c values that gave lower FS values represent isolated occurrences. Assigning a reduced strength

value to these isolated thin zones would have negligible impact on stability or settlement analyses.

In the power block area, using Vs values to compute FS against liquefaction (SSAR Table 2.5.4-80), ten out of the 2149 Vs values analyzed indicated possible liquefaction potential. These are sands with FS ranging from 0.38 to 1.34 using 0.0769g peak ground acceleration. As noted in SSAR Section 2.5.4.8.4.1, these results represent isolated occurrence which do not present a risk to the power block structures. Assigning a reduced strength value to these isolated zones would have negligible impact on stability or settlement analyses.

In the cooling basin area, using Vs values to compute FS against liquefaction (SSAR Table 2.5.4-81), four out of the 1236 Vs values analyzed indicated possible liquefaction potential. These are sands with FS ranging from 0.55 to 1.42 using 0.0769g peak ground acceleration. As noted in SSAR Section 2.5.4.8.4.2, these results represent isolated occurrence which do not present a risk to the non-safety related cooling basin. Assigning a reduced strength value to these isolated zones would have negligible impact on stability or settlement analyses.

Associated ESPA Revision:

No ESPA revision is required as a result of this response.

RAI 02.05.04-15:

Question:

In accordance with 10 CFR 100.23(d)(4), the staff request that the applicant provide the following information regarding Appendix 2.5.4-A:

a) Many tables in this appendix are labeled "Not Used." Please explain why this appendix was included in the SSAR.

b) Appendix 2.5.4-A Tables 2.5.4-A-5, 2.5.4-A-8 and 2.5.4-A-10 present N values for the layers Clay 7 through Sand 18 that are lower than those presented in tables 2.5.4-5, 2.5.4-8 and 2.5.4-10. Explain if the values presented in Appendix 2.5.4-A were considered when determining the design parameters presented in Table 2.5.4-32.

c) Appendix 2.5.4-A Table 2.5.4-A-20 present the shear strength value for Clay 7. Was this new value considered in your analyses?

d) Appendix 2.5.4-A Table 2.5.4-A-26 present the overconsolidation ratios. The staff noticed that the “values for use” presented in this table are lower than those presented in Table 2.5.4-26. Please explain if the values presented in Appendix 2.5.4-A were considered in your design.

e) Appendix 2.5.4-A Tables 2.5.4-A-28 and 2.5.4-A-30 present the Elastic Moduli and Shear Moduli values respectively based on the subsurface data obtained in the additional soil exploration conducted by the applicant at the VCS site in 2009. Some of the values presented are lower than those listed in Tables 2.5.4-28 and 2.5.4-30. Please explain if the values presented in Appendix 2.5.4-A were considered in your design.

Response:

Part (a)

Appendix 2.5.4-A describes the supplemental subsurface investigation evaluation and presents the data produced by that investigation. As noted in Section 2.5.4-A the initial subsurface investigation at the VCS site accommodated a typical LWR power block arrangement with an integral UHS structure. The supplemental subsurface investigation was planned and executed to a COLA level of detail to support other power block area arrangements, including other typical LWR plant layouts with independent UHS structures.

Additional soils data were obtained as a result of the supplemental subsurface investigation. These data were added to the data obtained in the original investigation (reported in the main body of SSAR Section 2.5.4). The total data (original plus supplemental) are included in the tables and figures of Appendix 2.5.4-A. The numbering system of these tables and figures is the same as that employed in the main body of SSAR Section 2.5.4 but with an embedded “A” to indicate that it is the table or figure in Section 2.5.4-A. Where additional data were not obtained in the supplemental

investigation (e.g., in a specific area or for a specific property), the corresponding table or figure is labeled as “Not Used” in Appendix 2.5.4-A. For example, no additional field electrical resistivity testing was performed for the supplemental investigation, and thus Table 2.5.4-A-50 is labeled “Not Used” in Appendix 2.5.4-A. All of the available field electrical resistivity test results can be found in SSAR Table 2.5.4-50 in the main body of SSAR Section 2.5.4.

Part (b)

SSAR Table 2.5.4-32 in the main body of Section 2.5.4 summarizes the geotechnical engineering parameters selected for design, based on the results of the original subsurface investigation. For example, for Clay 7, the average uncorrected N-value for the power block area is 66 bpf in Table 2.5.4-5. This is the value for Clay 7 summarized in Table 2.5.4-32. Similarly, the average corrected N-value for Clay 7 in the power block is 40 bpf in Table 2.5.4-8, and this is the value summarized in Table 2.5.4-32. The value selected for design in Table 2.5.4-10 is the same as the average value in Table 2.5.4-8.

Table 2.5.4-A-32 in Appendix 2.5.4-A summarizes the geotechnical engineering parameters selected for design based on the results of the original subsurface investigation plus the supplemental subsurface investigation. For example, for Clay 7, the average uncorrected N-value for the power block area is 64 bpf in Table 2.5.4-A-5. This is the value for Clay 7 summarized in Table 2.5.4-A-32 and represents the average of 102 N-values from the original plus supplemental investigations, compared with the average from 21 original tests given in Table 2.5.4-5. Similarly, the average corrected N-value for Clay 7 in the power block is 38 bpf in Table 2.5.4-A-8, and this is the value summarized in Table 2.5.4-A-32. The value selected for design in Table 2.5.4-A-10 is the same as the average value in Table 2.5.4-A-8.

Part (c)

Four separate tables make up Table 2.5.4-20 (and Table 2.5.4-A-20). The upper left table presents shear strength values measured by laboratory testing. It is noted that no testing was performed on Clay 7 samples during the original investigation. One unconsolidated-undrained triaxial test was performed on a Clay 7 sample during the supplemental testing giving an undrained shear strength of about 6.5 ksf, as reported in Table 2.5.4-A-20.

As noted in response (b) above, the corrected N-value based on the 21 results from the initial investigation was 40 bpf. This was reduced to 38 bpf based on the 102 results from the combined investigations. The estimated undrained shear strength based on these results dropped from 5.0 ksf (reported in the lower left table in Table 2.5.4-20) to 4.8 ksf (reported in Table 2.5.4-A-20).

It is important to note that the value of undrained shear strength selected for use (in the lower right table) remains the same, i.e., 6.0 ksf in both Tables 2.5.4-20 and 2.5.4-A-20. Thus, there was no change in the value for undrained shear strength assumed for Clay 7 in the various analyses. The undrained shear strength assumed for Clay 7 is discussed further in the response to RAI 02.05.04-3.

Part (d)

The overconsolidation ratios provided in Tables 2.5.4-26 and 2.5.4-A-26 are not used directly in the design process. However, the preconsolidation pressures from these tables are used in the settlement calculation to confirm that a clay stratum will not go into virgin compression due to the applied load of the structure. If the preconsolidation pressure is greater than the in-situ vertical stress plus the applied pressure from the structure (based on a Boussinesq-type distribution), then the clay is considered to be in recompression, and an elastic approach to computing settlement is adopted in the analysis. In all of the various cases considered, the preconsolidation pressures in the clay strata were greater than the in-situ vertical stress plus the applied pressure from the structure using the values of preconsolidation pressure from Table 2.5.4-26. The comparison was also made using the reduced values of preconsolidation pressure from Table 2.5.4-A-26. Again, the preconsolidation pressures were consistently higher. The settlement calculations were not revised to incorporate the Table 2.5.4-A-26 values, because the conclusions regarding overconsolidation did not change, and there would have been no change in computed settlement.

Part (e)

The values of high strain shear and elastic modulus were not used in most of the geotechnical analyses performed to provide bases for the SSAR (bearing capacity, lateral earth pressure, liquefaction, and slope stability). However, elastic modulus values do form the basis of the settlement calculations performed for the SSAR. The settlements reported in SSAR Table 2.5.4-89 for a Typical LWR with Integral UHS were estimated using the iterative procedure described in SSAR Subsection 2.5.4.10.3, beginning with an initial elastic modulus and then using the modulus degradation with strain curve for each stratum to compute a strain compatible settlement.

The settlement values in Table 2.5.4-89 were computed starting with the low strain modulus value and iterating to lower modulus values at higher strains. In this analysis, the strains are generally low and the analysis is influenced very little or not at all by the high strain elastic modulus values (refer to sample settlement calculation for RAI 02.05.04-13 response). The low strain modulus values used are a function of shear wave velocity and, since additional shear wave velocity measurements were made for the supplemental investigation reported in Appendix 2.5.4-A, the values for some of the strata changed. The low strain elastic modulus (E) values are not reported in Tables 2.5.4-32 or 2.5.4-A-32, but the low strain shear modulus (G) values are. E is G x 2 x (1 + Poisson's ratio), and because Poisson's ratio remains constant or essentially constant for each stratum, then an increase in G will result in an increase in E, and vice versa. Referring to Tables 2.5.4-32 and 2.5.4-A-32, the low strain G values are higher in Table 2.5.4-A-32 in eight layers, lower in two layers, and unchanged in the remaining layers. Because higher modulus values mean lower settlements, it can be concluded that a revised settlement analysis based on the Table 2.5.4-A-32 values would result in a slightly lower settlement. Settlement was not reanalyzed because the reported results are conservative.

<u>Associated ESPA Revision:</u>

No ESPA revision is required as a result of this response.

RAI 02.05.04-17:

Question:

SSAR Tables 2.5.4-36 and Table 2.5.4-37 summarizes borings location for the power block area and cooling basin respectively. Following the Northing and Easting provided, these borings appear to be located in Oklahoma instead of Texas. In accordance with 10 CFR 100.23(d)(4), the staff request the boring locations in latitude and longitude coordinates and clarification of the horizontal datum.

Response:

The projected coordinate system for the borings is Texas South Central State Plane (Zone 4204), and the horizontal datum used is North American Datum 1983 (NAD 83). The horizontal units are U.S. Survey Feet. Table 1 provides the coordinates for each of the borings at the VCS site in both northing/easting and latitude/longitude (decimal degrees).

Table 1: VCS Boring Locations

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-01	13404257.08	2606680.96	-97.0112691	28.5909992
B-02	13411511.00	2607865.77	-97.0071925	28.6108916
B-03	13414926.74	2609291.47	-97.0025679	28.6202177
B-04	13414277.17	2607437.06	-97.0083817	28.6185184
B-05	13414770.02	2605821.89	-97.0133892	28.6199493
B-06	13415884.18	2604971.12	-97.0159818	28.6230529
B-07	13418366.17	2606567.82	-97.0108739	28.6298036
B-08	13415809.85	2598937.51	-97.0347902	28.6231287
B-09	13414943.90	2604897.77	-97.0162601	28.6204706
B-10	13418474.15	2604736.80	-97.0165751	28.6301861
B-11	13411479.49	2607866.27	-97.0071926	28.6108049
B-12	13418446.37	2606546.46	-97.0109362	28.6300252
B-2150	13412560.45	2599590.93	-97.0329241	28.6141628
B-2151	13412636.54	2599654.12	-97.0327231	28.6143691
B-2152	13412705.76	2599720.24	-97.0325135	28.6145564
B-2153	13412821.99	2599842.54	-97.0321262	28.6148703
B-2154	13412450.91	2599619.84	-97.0328397	28.6138602
B-2155	13412471.13	2599698.69	-97.0325929	28.6139122
B-2156	13412548.01	2599760.77	-97.0323954	28.6141207
B-2157	13412623.72	2599823.05	-97.0321974	28.6143260
B-2158	13412749.59	2599928.77	-97.0318613	28.6146673
B-2159	13412476.54	2599788.95	-97.0323114	28.6139229
B-2160	13412180.67	2599627.24	-97.0328308	28.6131167
B-2161	13412263.41	2599698.18	-97.0326054	28.6133410
B-2162A	13412385.92	2599799.34	-97.0322837	28.6136732
B-2162A Offset	13412378.65	2599792.16	-97.0323065	28.6136535
B-2163	13412463.50	2599862.07	-97.0320842	28.6138836
B-2164	13412537.94	2599925.58	-97.0318824	28.6140854
B-2165	13412661.24	2600035.28	-97.0315340	28.6144194
B-2166	13412109.03	2599713.14	-97.0325669	28.6129157
B-2167	13412192.20	2599781.27	-97.0323502	28.6131413
B-2168	13412294.30	2599891.10	-97.0320026	28.6134170
B-2169	13412350.21	2599938.43	-97.0318522	28.6135685
B-2170	13412413.86	2599989.72	-97.0316890	28.6137412
B-2170R	13412396.19	2599989.32	-97.0316912	28.6136926
B-2171	13412488.43	2600092.96	-97.0313633	28.6139415
B-2171R	13412479.95	2600074.23	-97.0314221	28.6139190
B-2172	13412096.23	2599829.90	-97.0322037	28.6128751
B-2173	13412224.54	2599944.52	-97.0318398	28.6132227
B-2174A	13412299.46	2600000.64	-97.0316609	28.6134261
B-2174A Offset	13412316.51	2599991.79	-97.0316876	28.6134734
B-2174UD	13412276.56	2600005.51	-97.0316470	28.6133629
B-2174UDR	13412303.29	2600012.41	-97.0316241	28.6134361
B-2175	13412370.49	2600062.81	-97.0314635	28.6136185
B-2176A	13412511.69	2600175.17	-97.0311059	28.6140016

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-2176A Offset	13412522.55	2600178.10	-97.0310962	28.6140314
B-2177	13412196.92	2600000.49	-97.0316668	28.6131441
B-2178	13412315.44	2600107.24	-97.0313279	28.6134651
B-2179	13412424.96	2600168.71	-97.0311306	28.6137634
B-2180	13412247.39	2600062.56	-97.0314707	28.6132800
B-2181	13412143.28	2600062.56	-97.0314762	28.6129937
B-2182A	13412219.77	2600133.20	-97.0312520	28.6132008
B-2182A Offset	13412209.92	2600137.01	-97.0312407	28.6131736
B-2182UD	13412207.39	2600143.80	-97.0312196	28.6131663
B-2183	13412265.91	2600166.16	-97.0311469	28.6133262
B-2184	13412295.45	2600305.41	-97.0307114	28.6134010
B-2185	13412320.56	2600808.84	-97.0291412	28.6134467
B-2250	13413327.46	2600233.62	-97.0308810	28.6162423
B-2251	13413404.52	2600297.97	-97.0306764	28.6164512
B-2252	13413478.24	2600360.51	-97.0304776	28.6166510
B-2253	13413587.94	2600484.98	-97.0300839	28.6169469
B-2254	13413216.45	2600262.92	-97.0307955	28.6159356
B-2255	13413238.32	2600340.81	-97.0305516	28.6159922
B-2256	13413314.37	2600403.14	-97.0303534	28.6161984
B-2257	13413389.48	2600466.52	-97.0301519	28.6164020
B-2258	13413515.61	2600571.48	-97.0298182	28.6167440
B-2259	13413243.36	2600432.64	-97.0302651	28.6160018
B-2260	13412945.84	2600269.60	-97.0307889	28.6151912
B-2261	13413029.99	2600340.99	-97.0305620	28.6154193
B-2262A	13413146.75	2600442.41	-97.0302398	28.6157356
B-2262A Offset	13413146.80	2600433.53	-97.0302674	28.6157362
B-2263	13413227.48	2600506.73	-97.0300351	28.6159547
B-2264	13413303.45	2600569.40	-97.0298358	28.6161607
B-2265	13413424.28	2600677.27	-97.0294933	28.6164880
B-2266	13412873.85	2600353.67	-97.0305306	28.6149893
B-2267	13412957.87	2600424.20	-97.0303064	28.6152171
B-2268	13413056.37	2600528.54	-97.0299761	28.6154831
B-2269	13413117.17	2600582.50	-97.0298047	28.6156478
B-2269UD	13413092.19	2600593.55	-97.0297716	28.6155786
B-2270	13413179.24	2600633.41	-97.0296428	28.6158161
B-2271	13413253.44	2600735.25	-97.0293216	28.6160155
B-2272	13412863.17	2600472.73	-97.0301602	28.6149544
B-2273	13412991.36	2600585.49	-97.0298020	28.6153017
B-2274A	13413066.34	2600642.97	-97.0296190	28.6155052
B-2274A Offset	13413070.52	2600633.47	-97.0296484	28.6155172
B-2274UD	13413047.70	2600652.45	-97.0295904	28.6154535
B-2275	13413133.62	2600702.31	-97.0294305	28.6156875
B-2276A	13413276.30	2600822.55	-97.0290483	28.6160743
B-2276A Offset	13413289.36	2600817.99	-97.0290618	28.6161104
B-2277	13412961.61	2600644.66	-97.0296192	28.6152172

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-2278	13413084.23	2600745.84	-97.0292974	28.6155497
B-2279	13413192.06	2600811.88	-97.0290860	28.6158431
B-2280	13413014.25	2600704.09	-97.0294312	28.6153592
B-2281	13412908.71	2600705.43	-97.0294326	28.6150689
B-2282A	13412970.74	2600757.69	-97.0292665	28.6152370
B-2282A Offset	13412962.40	2600766.39	-97.0292398	28.6152137
B-2283	13413031.52	2600808.58	-97.0291047	28.6154018
B-2284	13413060.61	2600948.44	-97.0286673	28.6154753
B-2285	13412682.80	2600322.38	-97.0306382	28.6144654
B-2301A	13414429.68	2596278.37	-97.0431497	28.6194559
B-2301	13414414.60	2596251.62	-97.0432339	28.6194157
B-2302A	13407371.01	2598389.30	-97.0369403	28.5999476
B-2302	13407401.61	2598386.93	-97.0369460	28.6000319
B-2302UD	13407373.35	2598406.10	-97.0368878	28.5999533
B-2303A	13402308.03	2600478.63	-97.0306957	28.5859281
B-2303	13402314.55	2600497.11	-97.0306378	28.5859452
B-2304A	13396556.48	2608686.75	-97.0054290	28.5697291
B-2304	13396541.80	2608710.01	-97.0053573	28.5696877
B-2304UD	13396571.12	2608693.06	-97.0054086	28.5697691
B-2305A	13406652.71	2621646.04	-96.9645136	28.5968789
B-2305	13406649.21	2621680.51	-96.9644064	28.5968676
B-2306A	13411450.19	2615249.64	-96.9841859	28.6103763
B-2306	13411472.15	2615253.02	-96.9841742	28.6104365
B-2307A	13420888.12	2603157.79	-97.0213694	28.6368980
B-2307	13420917.89	2603184.91	-97.0212833	28.6369786
B-2308	13404197.77	2599333.56	-97.0341642	28.5911777
B-2309PL	13405491.59	2600445.06	-97.0306333	28.5946842
B-2309PU	13405492.30	2600435.20	-97.0306640	28.5946867
B-2310	13406601.70	2601353.57	-97.0277442	28.5976949
B-2311PL	13407702.98	2602296.89	-97.0247470	28.6006796
B-2311PU	13407705.71	2602287.63	-97.0247757	28.6006875
B-2312PL	13410694.32	2604153.23	-97.0188049	28.6088192
B-2312PU	13410699.82	2604161.16	-97.0187799	28.6088340
B-2313PL	13412115.55	2605606.11	-97.0142022	28.6126597
B-2313PU	13412117.40	2605610.94	-97.0141871	28.6126646
B-2314PL	13413940.63	2607732.57	-97.0074786	28.6175791
B-2314PU	13413937.97	2607776.49	-97.0073419	28.6175698
B-2315	13416228.72	2609409.27	-97.0021314	28.6237926
B-2316	13413189.22	2608491.76	-97.0051526	28.6154772
B-2317	13410598.40	2600511.90	-97.0301570	28.6087246
B-2318	13401612.98	2601154.61	-97.0286262	28.5839854
B-2319	13403601.01	2603048.72	-97.0226205	28.5893644
B-2319UD	13403595.98	2603062.86	-97.0225767	28.5893499
B-2320	13407573.79	2606839.75	-97.0105986	28.6001125
B-2321	13410953.82	2610037.97	-97.0004531	28.6092574
B-2321 UD	13410937.49	2610017.10	-97.0005190	28.6092135
B-2322	13413528.90	2612528.69	-96.9925538	28.6162213
B-2324	13416308.77	2612208.94	-96.9934016	28.6238809

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-2325PL	13401292.30	2603696.51	-97.0207240	28.5829855
B-2325PU	13401233.29	2603699.18	-97.0207188	28.5828231
B-2326PL	13403074.73	2605620.44	-97.0146359	28.5877974
B-2326PU	13403069.23	2605616.46	-97.0146486	28.5877824
B-2327PL	13404712.18	2607384.02	-97.0090545	28.5922178
B-2327PU	13404711.41	2607393.78	-97.0090241	28.5922152
B-2328PL	13406222.90	2609021.23	-97.0038731	28.5962954
B-2328PU	13406233.26	2609021.31	-97.0038723	28.5963239
B-2329PL	13407871.37	2610784.65	-96.9982907	28.6007457
B-2329PU	13407877.98	2610791.88	-96.9982679	28.6007636
B-2330PL	13410088.73	2613185.03	-96.9906926	28.6067301
B-2330PU	13410096.27	2613183.99	-96.9906954	28.6067509
B-2331	13409862.54	2612278.74	-96.9935288	28.6061509
B-2332	13414435.21	2603735.80	-97.0199083	28.6191259
B-2333	13398864.77	2603981.87	-97.0199630	28.5762967
B-2334	13400634.86	2606130.71	-97.0131753	28.5810641
B-2335	13404183.94	2610412.10	-96.9996481	28.5906231
B-2336	13409474.40	2616874.85	-96.9792278	28.6048659
B-2337	13407263.05	2614846.26	-96.9856677	28.5988811
B-2338	13398220.80	2606385.80	-97.0125084	28.5744136
B-2339PL	13399911.22	2608674.69	-97.0052883	28.5789550
B-2339PU	13399918.45	2808870.14	-96.3816851	28.5681165
B-2340	13400762.63	2609812.65	-97.0016979	28.5812429
B-2341PL	13401817.83	2810954.24	-96.3750611	28.5732106
B-2341PU	13401810.51	2810947.05	-96.3750840	28.5731910
B-2342PL	13402781.03	2812528.25	-96.3700910	28.5757618
B-2342PU	13402788.89	2812523.28	-96.3701059	28.5757838
B-2343PL	13404159.35	2814395.88	-96.3641768	28.5794361
B-2343PU	13404159.36	2614386.73	-96.9872660	28.5903679
B-2344	13404997.85	2615527.11	-96.9836679	28.5926197
B-2345PL	13405831.44	2616657.32	-96.9801017	28.5948584
B-2345PU	13405835.31	2616662.51	-96.9800853	28.5948688
B-2346	13407540.56	2618951.51	-96.9728613	28.5994492
B-2348	13409626.85	2621653.06	-96.9643304	28.6050572
B-2349	13417352.46	2607239.49	-97.0088342	28.6269846
B-2350	13395764.08	2610122.62	-97.0009985	28.5674827
B-2351	13398915.88	2613285.96	-96.9909762	28.5760008
B-2352	13402480.47	2617531.27	-96.9775593	28.5856019
B-2352UD	13402493.35	2617543.73	-96.9775198	28.5856367
B-2353	13406185.70	2620582.19	-96.9678536	28.5956456
B-2354	13418119.59	2607884.13	-97.0067843	28.6290639
B-2355	13412008.12	2611224.44	-96.9966996	28.6121008
B-2356	13409147.49	2614293.88	-96.9872878	28.6040893
B-2357	13404654.33	2620736.11	-96.9674570	28.5914271
B-2358	13402101.51	2611620.85	-96.9959933	28.5848396
B-2359	13417294.57	2605500.03	-97.0142587	28.6269067
B-2359UD	13417325.03	2605493.44	-97.0142776	28.6269908
B-3101	13412433.30	2599834.66	-97.0321712	28.6138018
B-3101UD	13412439.45	2599827.43	-97.0321934	28.6138191

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-3102	13412513.20	2599902.00	-97.0319571	28.6140184
B-3103	13412938.79	2599652.69	-97.0327118	28.6152003
B-3104	13412202.33	2599516.82	-97.0331738	28.6131814
B-3105	13412124.15	2599612.05	-97.0328811	28.6129620
B-3120	13412271.47	2599685.23	-97.0326453	28.6133637
B-3121	13412285.94	2599732.88	-97.0324961	28.6134013
B-3122	13412236.14	2599763.21	-97.0324042	28.6132630
B-3123	13412303.63	2599850.58	-97.0321284	28.6134445
B-3124	13412384.10	2599937.33	-97.0318538	28.6136618
B-3125	13412466.08	2599991.90	-97.0316794	28.6138847
B-3126	13412174.89	2599783.81	-97.0323432	28.6130936
B-3127	13412252.85	2599968.07	-97.0317649	28.6132994
B-3128	13412354.30	2600018.94	-97.0316010	28.6135761
B-3129	13411995.23	2599817.41	-97.0322479	28.6125980
B-3130	13412171.36	2599965.05	-97.0317786	28.6130755
B-3131	13412262.16	2600044.89	-97.0315250	28.6133215
B-3132	13412156.19	2600019.76	-97.0316089	28.6130312
B-3133	13412232.17	2600080.73	-97.0314149	28.6132373
B-3134	13412307.93	2600144.95	-97.0312108	28.6134427
B-3150	13412363.96	2599708.26	-97.0325687	28.6136170
B-3151	13412601.54	2599907.98	-97.0319339	28.6142611
B-3152	13412666.93	2599964.39	-97.0317546	28.6144383
B-3170A	13411920.22	2599278.60	-97.0339309	28.6124166
B-3170A Offset	13411915.24	2599287.68	-97.0339029	28.6124025
B-3171	13411943.98	2599565.10	-97.0330369	28.6124687
B-3172	13411885.94	2599615.55	-97.0328827	28.6123068
B-3173	13411880.20	2599376.72	-97.0336273	28.6123020
B-3174	13411986.60	2599453.62	-97.0333820	28.6125911
B-3175	13411911.53	2599430.38	-97.0334584	28.6123857
B-3176	13412070.79	2599439.29	-97.0334223	28.6128232
B-3177	13411787.89	2599435.89	-97.0334477	28.6120454
B-3178	13412145.80	2599455.30	-97.0333685	28.6130288
B-3179	13412080.02	2599530.84	-97.0331365	28.6128444
B-3179B	13412088.18	2599525.43	-97.0331529	28.6128671
B-3180	13411994.56	2599329.41	-97.0337687	28.6126187
B-3181	13412057.76	2599554.50	-97.0330639	28.6127821
B-3182	13411777.24	2599588.12	-97.0329739	28.6120091
B-3183	13411924.45	2599713.35	-97.0325759	28.6124081
B-3184	13411652.94	2599602.59	-97.0329353	28.6116666
B-3185A	13411833.03	2599722.22	-97.0325531	28.6121563
B-3185A Offset	13411826.65	2599726.94	-97.0325387	28.6121386
B-3186	13411693.36	2599689.25	-97.0326631	28.6117738
B-3187	13412013.89	2599728.28	-97.0325247	28.6126534
B-3194	13411840.05	2599813.20	-97.0322692	28.6121714
B-3201	13413199.23	2600478.73	-97.0301238	28.6158783
B-3202	13413278.38	2600546.43	-97.0299087	28.6160928
B-3203	13413704.80	2600295.99	-97.0306668	28.6172770

Station	Texas South Central State Plane (NAD 83, Feet)		Longitude	Latitude
	Northing	Easting	Decimal Degrees	Decimal Degrees
B-3204	13412969.79	2600159.57	-97.0311305	28.6152621
B-3205	13412890.30	2600253.76	-97.0308411	28.6150392
B-3220	13413038.65	2600329.99	-97.0305958	28.6154436
B-3221	13413050.44	2600375.52	-97.0304533	28.6154739
B-3222	13413000.60	2600409.71	-97.0303493	28.6153353
B-3223	13413068.13	2600491.68	-97.0300904	28.6155172
B-3224	13413149.85	2600580.51	-97.0298092	28.6157378
B-3225	13413231.70	2600635.22	-97.0296344	28.6159603
B-3226	13412942.00	2600423.84	-97.0303084	28.6151735
B-3227	13413022.23	2600606.30	-97.0297356	28.6153856
B-3228	13413109.76	2600679.85	-97.0295018	28.6156229
B-3229	13412764.61	2600458.23	-97.0302105	28.6146840
B-3230	13412942.18	2600604.56	-97.0297452	28.6151656
B-3231	13413029.48	2600686.21	-97.0294861	28.6154019
B-3232	13412922.28	2600661.21	-97.0295697	28.6151082
B-3233	13412996.09	2600724.96	-97.0293671	28.6153082
B-3234	13413073.73	2600787.16	-97.0291692	28.6155189
B-3234UD	13413081.49	2600780.76	-97.0291888	28.6155405
B-3250	13413129.73	2600351.61	-97.0305236	28.6156930
B-3251	13413367.88	2600552.94	-97.0298837	28.6163386
B-3252	13413433.44	2600606.15	-97.0297144	28.6165164
B-3270A	13413806.35	2600963.12	-97.0285824	28.6175254
B-3270A Offset	13413799.21	2600956.76	-97.0286026	28.6175060
B-3271	13413662.26	2601056.45	-97.0282991	28.6171248
B-3272	13413580.96	2600954.08	-97.0286224	28.6169060
B-3273	13413726.75	2601028.78	-97.0283819	28.6173034
B-3274	13413659.47	2600812.95	-97.0290581	28.6171284
B-3275	13413717.05	2600944.49	-97.0286451	28.6172807
B-3276	13413655.40	2600721.81	-97.0293423	28.6171215
B-3277	13413665.44	2601131.40	-97.0280653	28.6171301
B-3278	13413658.66	2600844.38	-97.0289602	28.6171247
B-3279	13413517.67	2600996.95	-97.0284921	28.6167300
B-3280	13413800.24	2600844.41	-97.0289526	28.6175141
B-3281	13413568.70	2600821.85	-97.0290351	28.6168784
B-3282	13413584.99	2601102.66	-97.0281591	28.6169102
B-3283	13413436.23	2600979.48	-97.0285508	28.6165068
B-3285A	13413442.17	2601072.10	-97.0282619	28.6165189
B-3285A Offset	13413451.41	2601067.99	-97.0282742	28.6165445
B-3286	13413498.60	2601204.05	-97.0278477	28.6166679
B-3287	13413394.33	2600911.93	-97.0287635	28.6163947
B-3288	13413285.93	2601038.97	-97.0283733	28.6160907
B-3289	13413160.23	2600933.39	-97.0287090	28.6157500
B-3290	13413566.86	2601255.83	-97.0276827	28.6168532
B-3291	13412951.38	2600555.75	-97.0298968	28.6151931
B-3292	13413352.05	2601079.59	-97.0282433	28.6162707

Associated ESPA Revisions:

During the conversion, minor coordinate value errors were discovered for several of the boring locations. SSAR Tables 2.5.4-36, 2.5.4-37, and 2.5.4-A-36 are being revised to correct these minor errors, and these updates will be included in a future revision of the ESPA, as indicated.

Table 2.5.4-36 (Sheet 1 of 3)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
Power Block Area (Unit 1)					
B-2150	13,412,560.45	2,599,590.93	80.44	150.00	–69.56
B-2151	13,412,636.54	2,599,654.12	80.41	200.00	–119.59
B-2152	13,412,705.76	2,599,720.24	80.26	150.00	–69.74
B-2153	13,412,821.99	2,599,842.54	80.23	150.10	–69.87
B-2154	13,412,450.91	2,599,619.84	80.54	150.00	–69.46
B-2155	13,412,471.13	2,599,698.69	80.36	150.00	–69.64
B-2156	13,412,548.01	2,599,760.77	80.25	201.50	–121.25
B-2157	13,412,623.72	2,599,823.05	80.07	150.00	–69.93
B-2158	13,412,749.59	2,599,928.77	80.45	100.00	–19.55
B-2159	13,412,476.54	2,599,788.95	80.40	211.50	–131.10
B-2160	13,412,180.67	2,599,627.24	80.43	200.00	–119.57
B-2161	~~13,412,263.42~~ 13,412,263.41	2,599,698.18	80.49	150.00	-69.51
B-2162A	13,412,385.92	2,599,799.34	80.16	202.80	–122.64
B-2162A Offset	13,412,378.65	2,599,792.16	80.05	210.00	–129.95
B-2163	13,412,463.50	2,599,862.07	79.85	150.00	–70.15
B-2164	13,412,537.94	2,599,925.58	80.38	151.40	–71.02
B-2165	13,412,661.24	2,600,035.28	80.13	150.00	–69.87
B-2166	13,412,109.03	2,599,713.14	80.50	150.00	–69.50
B-2167	13,412,192.20	2,599,781.27	80.19	150.00	–69.81
B-2168	13,412,294.30	2,599,891.10	80.12	201.50	–121.38
B-2169	13,412,350.21	2,599,938.43	79.47	400.00	–320.53
B-2170	13,412,413.86	2,599,989.72	79.68	300.00	–220.32
B-2170R	13,412,396.19	2,599,989.32	79.18	300.00	–220.82
B-2171	13,412,488.43	2,600,092.96	80.03	81.50	–1.47
B-2171R	13,412,479.95	2,600,074.23	79.97	300.00	–220.03
B-2172	13,412,096.23	2,599,829.90	80.10	100.00	–19.90
B-2173	13,412,224.54	2,599,944.52	79.59	300.00	–220.41
B-2174A	13,412,299.46	2,600,000.64	80.11	601.00	–520.89
B-2174A Offset	13,412,316.51	2,599,991.79	79.28	617.00	–537.72
B-2174UD	13,412,276.56	2,600,005.51	78.58	301.40	–222.82
B-2174UDR	13,412,303.29	2,600,012.41	78.98	593.00	–514.02
B-2175	13,412,370.49	2,600,062.81	80.12	200.00	–119.88
B-2176A	13,412,511.69	2,600,175.17	79.81	200.00	–120.19
B-2176A Offset	13,412,522.55	2,600,178.10	79.99	210.00	–130.01
B-2177	13,412,196.92	2,600,000.49	79.61	150.00	–70.39
B-2178	13,412,315.44	2,600,107.24	79.53	151.10	–71.57
B-2179	13,412,424.96	2,600,168.71	79.78	200.00	–120.22
B-2180	13,412,247.39	2,600,062.56	78.85	200.00	–121.15
B-2181	13,412,143.28	2,600,062.56	79.24	151.30	–72.06
B-2182A	13,412,219.77	2,600,133.20	79.69	399.80	–320.11
B-2182A Offset	13,412,209.92	2,600,137.01	79.70	410.00	–330.30
B-2182UD	13,412,207.39	2,600,143.80	79.47	401.90	–322.43
B-2183	13,412,265.91	2,600,166.16	79.63	151.30	–71.67
B-2184	13,412,295.45	2,600,305.41	79.71	151.20	–71.49
B-2285	13,412,682.80	2,600,322.38	80.35	151.20	–70.85

Table 2.5.4-36 (Sheet 3 of 3)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
Outside Power Block Area					
B-08	13,415,809.85	2,598,937.51	81.71	150.00	–68.29
B-10	13,418,474.15	2,604,736.80	77.69	150.20	–72.51
B-2185	13,412,320.56	2,600,808.84	79.48	151.10	–71.62
B-2301A	13,414,429.68	2,596,278.37	81.23	300.00	–218.77
B-2301	13,414,414.60	2,596,251.62	80.79	310.00	–229.21
B-2307A	13,420,888.12	2,603,157.79	76.75	299.40	–222.65
B-2307	13,420,917.89	2,603,184.91	76.38	310.00	–233.62

(a) Northings and Eastings are referenced to ~~NAD 83~~ the Texas South Central State Plane (Zone 4204) projected coordinate system, using a horizontal datum of NAD 83 and are in U.S. Survey Feet.
(b) Elevations are referenced to North American Vertical Datum 1988 (NAVD 88).

Table 2.5.4-37 (Sheet 1 of 2)
As-Built Boring Information (Cooling Basin)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
B-01	13,404,257.08	2,606,680.96	71.46	150.00	–78.54
B-02	13,411,511.00	2,607,865.77	74.68	150.00	–75.32
B-03	13,414,926.74	2,609,291.47	74.89	150.00	–75.11
B-04	13,414,277.17	2,607,437.06	78.97	150.20	–71.23
B-05	13,414,770.02	2,605,821.89	77.56	150.20	–72.64
B-06	13,415,884.18	2,604,971.12	78.98	150.20	–71.22
B-07	13,418,366.17	2,606,567.82	77.39	150.20	–72.81
B-09	13,414,943.90	2,604,897.77	77.36	150.20	–72.84
B-11	13,411,479.49	2,607,866.27	74.77	310.00	–235.23
B-12	13,418,446.37	2,606,546.46	76.70	310.00	–233.30
B-2302A	13,407,371.01	2,598,389.30	80.32	150.00	–69.68
B-2302	13,407,401.61	2,598,386.93	80.00	315.00	–235.00
B-2302UD	13,407,373.35	2,598,406.10	80.00	147.30	–67.30
B-2303A	13,402,308.03	2,600,478.63	75.36	300.00	–224.64
B-2303	13,402,314.55	2,600,497.11	75.56	310.00	–234.44
B-2304A	~~13,396,566.48~~ 13,396,556.48	2,608,686.75	68.33	296.50	–228.17
B-2304	13,396,541.80	2,608,710.01	68.12	310.00	–241.88
B-2304UD	13,396,571.12	2,608,693.06	68.46	143.50	–75.04
B-2305A	13,406,652.71	2,621,646.04	65.45	300.00	–234.55
B-2305	13,406,649.21	2,621,680.51	65.58	305.00	–239.42
B-2306A	13,411,450.19	2,615,249.64	64.28	100.00	–35.72
B-2306	13,411,472.15	~~2,615,253.03~~ 2,615,253.02	64.68	310.00	–245.32
B-2308	13,404,197.77	2,599,333.56	76.39	100.00	–23.61
B-2310	13,406,601.70	2,601,353.57	75.95	100.00	–24.05
B-2315	13,416,228.72	2,609,409.27	47.06	101.10	–54.04
B-2316	13,413,189.22	2,608,491.76	75.17	100.80	–25.63
B-2317	13,410,598.40	2,600,511.90	76.73	101.00	–24.27
B-2318	13,401,612.98	2,601,154.61	75.31	101.50	–26.19
B-2319	13,403,601.01	2,603,048.72	74.16	151.50	–77.34
B-2319UD	13,403,595.98	2,603,062.86	74.16	115.00	–40.84
B-2320	13,407,573.79	2,606,839.75	71.46	151.50	–80.04
B-2321	13,410,953.82	2,610,037.97	71.62	150.00	–78.38
B-2321UD	13,410,937.49	2,610,017.10	71.81	132.50	–60.69
B-2322	13,413,528.90	2,612,528.69	68.53	100.00	–31.47
B-2324	13,416,308.77	2,612,208.94	24.47	151.20	–126.73
B-2331	13,409,862.54	2,612,278.74	69.37	101.10	–31.73
B-2332	13,414,435.21	2,603,735.80	78.68	100.20	–21.52
B-2333	13,398,864.77	2,603,981.87	76.07	101.50	–25.43
B-2334	13,400,634.86	2,606,130.71	71.85	61.50	10.35
B-2335	13,404,183.94	2,610,412.10	66.75	61.50	5.25
B-2336	13,409,474.40	2,616,874.85	68.00	100.00	–32.00
B-2337	13,407,263.05	2,614,846.26	67.23	100.00	–32.77
B-2338	13,398,220.80	2,606,385.80	68.15	101.70	–33.55

Table 2.5.4-37 (Sheet 2 of 2)
As-Built Boring Information (Cooling Basin)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
B-2340	13,400,762.63	2,609,812.65	68.09	61.50	6.59
B-2344	13,404,997.85	2,615,527.11	65.78	61.50	4.28
B-2346	13,407,540.56	2,618,951.51	67.09	100.00	–32.91
B-2348	13,409,626.85	2,621,653.06	50.63	150.00	–99.37
B-2349	13,417,352.46	2,607,239.49	76.66	101.20	–24.54
B-2350	13,395,764.08	2,610,122.62	65.25	100.10	–34.85
B-2351	13,398,915.88	2,613,285.96	63.73	100.00	–36.27
B-2352	13,402,480.47	2,617,531.27	62.91	150.00	–87.09
B-2352UD	13,402,493.35	2,617,543.73	62.84	94.50	–31.66
B-2353	13,406,185.70	2,620,582.19	65.60	99.90	–34.30
B-2354	13,418,119.59	2,607,884.13	76.83	100.20	–23.37
B-2355	13,412,008.12	~~2,613,846.60~~ 2,611,224.44	71.04	101.70	–30.66
B-2356	13,409,147.49	~~2,617,797.63~~ 2,614,293.88	67.71	101.90	–34.19
B-2357	13,404,654.33	2,620,736.11	65.67	100.00	–34.33
B-2358	13,402,101.51	2,611,620.85	66.47	151.50	–85.03
B-2359	13,417,294.57	2,605,500.03	77.57	151.30	–73.73
B-2359UD	13,417,325.03	2,605,493.44	77.35	121.70	–44.35

(a) Northings and Eastings are referenced to ~~NAD 83~~ the Texas South Central State Plane (Zone 4204) projected coordinate system, using a horizontal datum of NAD 83 and are in U.S. Survey Feet.
(b) Elevations are referenced to North American Vertical Datum 1988 (NAVD 88).

Table 2.5.4-A-36 (Sheet 1 of 6)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
Power Block Area	**(Unit 1)**				
B-2150	13,412,560.45	2,599,590.93	80.44	150.00	–69.56
B-2151	13,412,636.54	2,599,654.12	80.41	200.00	–119.59
B-2152	13,412,705.76	2,599,720.24	80.26	150.00	–69.74
B-2153	13,412,821.99	2,599,842.54	80.23	150.10	–69.87
B-2154	13,412,450.91	2,599,619.84	80.54	150.00	–69.46
B-2155	13,412,471.13	2,599,698.69	80.36	150.00	–69.64
B-2156	13,412,548.01	2,599,760.77	80.25	201.50	–121.25
B-2157	13,412,623.72	2,599,823.05	80.07	150.00	–69.93
B-2158	13,412,749.59	2,599,928.77	80.45	100.00	–19.55
B-2159	13,412,476.54	2,599,788.95	80.40	211.50	–131.10
B-2160	13,412,180.67	2,599,627.24	80.43	200.00	–119.57
B-2161	~~13,412,263.42~~ 13,412,263.41	2,599,698.18	80.49	150.00	–69.51
B-2162A	13,412,385.92	2,599,799.34	80.16	202.80	–122.64
B-2162A Offset	13,412,378.65	2,599,792.16	80.05	210.00	–129.95
B-2163	13,412,463.50	2,599,862.07	79.85	150.00	–70.15
B-2164	13,412,537.94	2,599,925.58	80.38	151.40	–71.02
B-2165	13,412,661.24	2,600,035.28	80.13	150.00	–69.87
B-2166	13,412,109.03	2,599,713.14	80.50	150.00	–69.50
B-2167	13,412,192.20	2,599,781.27	80.19	150.00	–69.81
B-2168	13,412,294.30	2,599,891.10	80.12	201.50	–121.38
B-2169	13,412,350.21	2,599,938.43	79.47	400.00	–320.53
B-2170	13,412,413.86	2,599,989.72	79.68	300.00	–220.32
B-2170R	13,412,396.19	2,599,989.32	79.18	300.00	–220.82
B-2171	13,412,488.43	2,600,092.96	80.03	81.50	–1.47
B-2171R	13,412,479.95	2,600,074.23	79.97	300.00	–220.03
B-2172	13,412,096.23	2,599,829.90	80.10	100.00	–19.90
B-2173	13,412,224.54	2,599,944.52	79.59	300.00	–220.41
B-2174A	13,412,299.46	2,600,000.64	80.11	601.00	–520.89
B-2174A Offset	13,412,316.51	2,599,991.79	79.28	617.00	–537.72
B-2174UD	13,412,276.56	2,600,005.51	78.58	301.40	–222.82
B-2174UDR	13,412,303.29	2,600,012.41	78.98	593.00	–514.02
B-2175	13,412,370.49	2,600,062.81	80.12	200.00	–119.88
B-2176A	13,412,511.69	2,600,175.17	79.81	200.00	–120.19
B-2176A Offset	13,412,522.55	2,600,178.10	79.99	210.00	–130.01

Table 2.5.4-A-36 (Sheet 2 of 6)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
Power Block Area	**(Unit 1) (cont.)**				
B-2177	13,412,196.92	2,600,000.49	79.61	150.00	–70.39
B-2178	13,412,315.44	2,600,107.24	79.53	151.10	–71.57
B-2179	13,412,424.96	2,600,168.71	79.78	200.00	–120.22
B-2180	13,412,247.39	2,600,062.56	78.85	200.00	–121.15
B-2181	13,412,143.28	2,600,062.56	79.24	151.30	–72.06
B-2182A	13,412,219.77	2,600,133.20	79.69	399.80	–320.11
B-2182A Offset	13,412,209.92	2,600,137.01	79.70	410.00	–330.30
B-2182UD	13,412,207.39	2,600,143.80	79.47	401.90	–322.43
B-2183	13,412,265.91	2,600,166.16	79.63	151.30	–71.67
B-2184	13,412,295.45	2,600,305.41	79.71	151.20	–71.49
B-2285	13,412,682.80	2,600,322.38	80.35	151.20	–70.85
B-3101	13,412,433.30	2,599,834.66	79.78	300.50	–220.72
B-3101UD	13,412,439.45	2,599,827.43	79.78	291.50	–211.72
B-3102	13,412,513.20	2,599,902.00	79.86	200.00	–120.14
B-3103	13,412,938.79	2,599,652.69	80.02	150.00	–69.98
B-3104	13,412,202.33	2,599,516.82	80.64	300.10	–219.46
B-3105	13,412,124.15	2,599,612.05	80.50	300.30	–219.80
B-3120	13,412,271.47	2,599,685.23	79.96	200.00	–120.04
B-3121	13,412,285.94	2,599,732.88	80.10	200.00	–119.90
B-3122	13,412,236.14	2,599,763.21	79.98	200.00	–120.02
B-3123	13,412,303.63	2,599,850.58	80.09	404.00	–323.91
B-3124	13,412,384.10	2,599,937.33	79.58	299.80	–220.22
B-3125	13,412,466.08	2,599,991.90	78.10	299.90	–221.80
B-3126	13,412,174.89	2,599,783.81	79.94	200.10	–120.16
B-3127	13,412,252.85	2,599,968.07	79.71	402.30	–322.59
B-3128	13,412,354.30	2,600,018.94	79.35	402.40	–323.05
B-3129	13,411,995.23	2,599,817.41	79.80	150.00	–70.20
B-3130	13,412,171.36	2,599,965.05	79.71	150.30	–70.59
B-3131	13,412,262.16	2,600,044.89	78.91	406.80	–327.89
B-3132	13,412,156.19	2,600,019.76	79.32	401.60	–322.28
B-3133	13,412,232.17	2,600,080.73	78.41	400.00	–321.59
B-3134	13,412,307.93	2,600,144.95	79.67	401.50	–321.83
B-3150	13,412,363.96	2,599,708.26	80.09	200.00	–119.91
B-3151	13,412,601.54	2,599,907.98	78.55	200.00	–121.45
B-3152	13,412,666.93	2,599,964.39	79.66	200.00	–120.34

Table 2.5.4-A-36 (Sheet 5 of 6)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[a]	Easting (feet)[a]	Ground Surface Elevation (feet)[b]	Depth (feet)	Base Elevation (feet)[b]
Power Block Area	**(Unit 2) (cont.)**				
B-3221	13,413,050.44	2,600,375.52	80.01	200.10	–120.09
B-3222	13,413,000.60	2,600,409.71	79.96	199.80	–119.84
B-3223	13,413,068.13	2,600,491.68	80.33	400.00	–319.67
B-3224	13,413,149.85	2,600,580.51	80.00	300.00	–220.00
B-3225	13,413,231.70	2,600,635.22	79.87	300.00	–220.13
B-3226	13,412,942.00	2,600,423.84	80.40	199.80	–119.40
B-3227	13,413,022.23	2,600,606.30	80.10	401.00	–320.90
B-3228	13,413,109.76	2,600,679.85	80.32	400.00	–319.68
B-3229	13,412,764.61	2,600,458.23	80.11	148.90	–68.79
B-3230	13,412,942.18	2,600,604.56	80.28	149.90	–69.62
B-3231	13,413,029.48	2,600,686.21	80.19	400.00	–319.81
B-3232	13,412,922.28	2,600,661.21	80.51	400.00	–319.49
B-3233	13,412,996.09	2,600,724.96	80.10	400.50	–320.40
B-3234	13,413,073.73	2,600,787.16	80.56	404.00	–323.44
B-3234UD	13,413,081.49	2,600,780.76	80.57	394.80	–314.23
B-3250	13,413,129.73	2,600,351.61	80.07	200.20	–120.13
B-3251	13,413,367.88	2,600,552.94	80.26	200.90	–120.64
B-3252	13,413,433.44	2,600,606.15	80.28	199.80	–119.52
B-3270A	13,413,806.35	2,600,963.12	80.63	300.80	–220.17
B-3270A Offset	13,413,799.21	2,600,956.76	80.15	315.00	–234.85
B-3271	13,413,662.26	2,601,056.45	80.22	175.00	–94.78
B-3272	13,413,580.96	2,600,954.08	80.26	180.00	–99.74
B-3273	13,413,726.75	2,601,028.78	80.34	176.00	–95.66
B-3274	13,413,659.47	2,600,812.95	80.10	300.00	–219.90
B-3275	13,413,717.05	2,600,944.49	80.69	175.00	–94.31
B-3276	13,413,655.40	2,600,721.81	80.50	175.00	–94.50
B-3277	13,413,665.44	2,601,131.40	80.17	300.70	–220.53
B-3278	13,413,658.66	2,600,844.38	80.18	175.00	–94.82
B-3279	13,413,517.67	2,600,996.95	79.73	150.00	–70.27
B-3280	~~16,413,800.24~~ 13,413,800.24	2,600,844.41	80.49	175.00	–94.51
B-3281	13,413,568.70	2,600,821.85	79.96	175.00	–95.04
B-3282	13,413,584.99	2,601,102.66	80.24	249.90	–169.66
B-3283	13,413,436.23	2,600,979.48	80.27	175.00	–94.73
B-3285A	13,413,442.17	2,601,072.10	80.14	250.10	–169.96
B-3285A Offset	13,413,451.41	2,601,067.99	80.14	265.00	–184.86

Table 2.5.4-A-36 (Sheet 6 of 6)
As-Built Boring Information (Power Block Area)

Boring Number	Northing (feet)[(a)]	Easting (feet)[(a)]	Ground Surface Elevation (feet)[(b)]	Depth (feet)	Base Elevation (feet)[(b)]
Power Block Area	**(Unit 2) (cont.)**				
B-3286	13,413,498.60	2,601,204.05	80.08	174.50	–94.42
B-3287	13,413,394.33	2,600,911.93	80.34	150.00	–69.66
B-3288	13,413,285.93	2,601,038.97	80.19	151.00	–70.81
B-3289	13,413,160.23	2,600,933.39	80.44	150.00	–69.56
B-3290	13,413,566.86	2,601,255.83	80.52	300.00	–219.48
B-3291	13,412,951.38	2,600,555.75	80.21	150.10	–69.89
B-3292	13,413,352.05	2,601,079.59	80.52	174.90	–94.38
Outside Power Block					
B-08	13,415,809.85	2,598,937.51	81.71	150.00	–68.29
B-10	13,418,474.15	2,604,736.80	77.69	150.20	–72.51
B-2185	13,412,320.56	2,600,808.84	79.48	151.10	–71.62
B-2301A	13,414,429.68	2,596,278.37	81.23	300.00	–218.77
B-2301	13,414,414.60	2,596,251.62	80.79	310.00	–229.21
B-2307A	13,420,888.12	2,603,157.79	76.75	299.40	–222.65
B-2307	13,420,917.89	2,603,184.91	76.38	310.00	–233.62

(a) Northings and Eastings are referenced to ~~NAD 83~~ the Texas South Central State Plane (Zone 4204) projected coordinate system, using a horizontal datum of NAD 83 and are in U.S. Survey Feet.
(b) Elevations are referenced to North American Vertical Datum 1988 (NAVD 88).

RAI 02.05.05-1:

Question:

SSAR Subsection 2.5.5.1.6 states that the exit gradient at the outboard toe of the embankments dams will approach or exceed critical values. To reduce the exit gradients to an acceptable value, a 10-ft deep trench at the toe of the embankment dam will be excavated. In accordance with 10 CFR 100.23(d)(4), please provide the critical exit gradient value and describe how a depth of 10-ft was determined for the trench. Also, indicate the percentage of each vertical soil layer will be penetrated by the 10 ft trench.

Response:

The response to this RAI also includes the response to RAI 02.05.05-12.

In designing earth embankments that are subjected to steady state seepage, it is essential to ensure that the hydraulic gradient at the outboard slope toe stays below a critical value to prevent foundation soil erosion due to piping. Hydraulic gradient (i) is defined as the head difference (h) divided by the distance (L), corresponding to the head difference. The critical condition occurs when the effective stresses at the bottom of the soil column become zero. The critical hydraulic gradient (i_c) can be computed as follows (Reference 1, Eq. 7-20):

$$i_c = \frac{1}{1+e}\left(\frac{\rho_s}{\rho_w} - 1\right) = \frac{1}{1+e}(G_s - 1)$$

where, ρ_s = density of the soil solids

ρ_w = density of water

e = void ratio

G_s = specific gravity of soil solids

Reference 1, Table 7.1 provides the typical values of the critical hydraulic gradient for G_s=2.68 and void ratios representative of loose, medium, and dense sands (i.e., e = 1.0, 0.75 and 0.5, respectively). The resulting critical hydraulic gradients (i_c) are 0.84, 0.96 and 1.12, respectively. It is also noted that for estimation purposes, i_c is often taken to be about 1.0 (Reference 1, p. 235). Reference 2, p. 4-24 mentions that the proposed factors of safety (FS) for exit gradients are in the range of 4 to 5 or 2.5 to 3 depending on the source of the recommendation, where FS= i_c/i.

Although there were no void ratio measurements performed on foundation sands, these sands can be treated as medium dense (Reference 3, Table 2.43) based on the friction angle values derived in SSAR Subsection 2.5.5.1.9.1.3. Hence, for design purposes it is reasonable to use a critical hydraulic gradient of 1.0. In order to minimize the head loss and resulting hydraulic gradient, a 10 ft-deep vertical well drain (trench) is constructed in the vicinity of the outboard slope toe below each horizontal drainage blanket. An example is provided in Figure 1, in which the pressure heads computed for cross-section B-2352 using SEEP/W software are presented. The results of the slope stability

analyses show that a 10-ft deep vertical well drain reduces the pressure head to 0.5 ft at the bottom of the trench. This results in a pressure difference of 0.5 ft between the bottom of the trench and the ground surface. The resulting hydraulic gradient is calculated to be equal to i = 0.5/10 = 0.05. This results in FS = 10/0.05 = 20, which satisfies the recommended factors of safety. This also indicates that piping will not occur underneath the embankment (RAI 02.05.05-12).

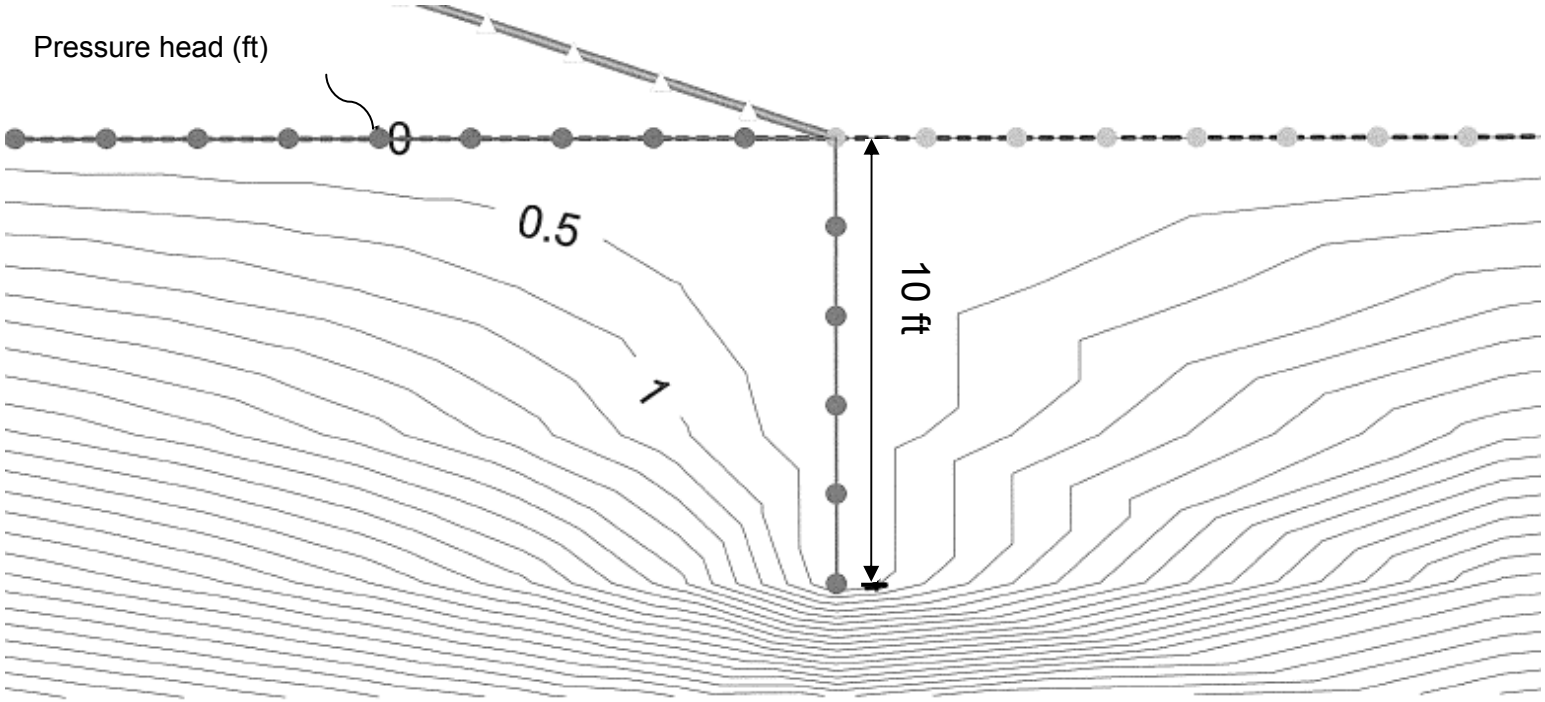
As stated in SSAR Subsection 2.5.5.2.3, at this preliminary stage of design, subsurface and groundwater conditions along the alignment of the embankments are defined by investigations (e.g., borings, CPTs) on plan spacings on the order of 1500 feet center-to-center. Subsurface and groundwater conditions at locations beyond the outboard toe of the embankments (particularly beyond the easternmost embankments) are defined by supplemental investigations (see RAI 02.05.05-5 response). The preliminary engineering analysis reported on here conservatively assumes that the groundwater level to distances considerably beyond the outboard toe of the embankments coincides with the ground surface, an assumption that is unlikely to occur. Under these conservative conditions the analyses show that zones of high hydraulic gradient could develop at distances away from the toe of the embankment. Supplemental investigations to be conducted at the COL stage (see the response to RAI 02.05.05-5) will provide the means to analyze this potential occurrence in more detail.

The depth and percentage of penetration of each soil layer by the 10-ft deep vertical drain are provided in Table 1 for the cross-sections B-05, B-2333, B-2337, B-2352 and C-2302.

Table 1: Depth and percentage of penetration of each soil layer by the 10-ft deep vertical drain

Point ID	Existing Ground Surface El.	Depth of Penetration	CLAY 1 - top		SAND 1		CLAY 1 - bottom	
			Thickness	Penetration	Thickness	Penetration	Thickness	Penetration
	(ft) NAVD88	(ft)	(ft)	(%)	(ft)	(%)	(ft)	(%)
B-05	77.56	10.0	9.7	100	14.0	2	15.0	0
B-2333	76.07	10.0	20.0	50	N/A	N/A	25.0	0
B-2337	67.23	10.0	18.5	54	10.0	0	15.0	0
B-2352	62.91	10.0	13.5	74	N/A	N/A	30.4	0
C-2302	77.49	10.0	8.8	100	9.0	14	29.5	0

Figure 1 - The pressure heads computed for cross-section B-2352 using SEEP/W software



Response References:

1. Holtz, R.D. and Kovacs, W.D. “An Introduction to Geotechnical Engineering,” Prentice-Hall, New Jersey, 1981.
2. U.S. Army Corps of Engineers. “Seepage Analysis and Control for Dams,” Engineer Manual EM 1110-2-1901, Department of the Army, Washington, DC, April 1993.
3. Winterkorn, H.F. and Fang, H-Y. “Soil Technology and Engineering Properties of Soils,” Foundation Engineering Handbook, Winterkorn, H.F. and Fang, H-Y., Editors, Van Nostrand Reinhold Company, NY, 1975.

Associated ESPA Revisions:

No ESPA revision is required as a result of this response.

RAI 02.05.05-6:

Question:

In SSAR Subsection 2.5.5.2.5.2 the applicant indicated a berm is required along the east and south of the cooling basin embankment dams. In accordance with 10 CFR 100.23(d)(4), please indicate the source and material type that will be used for the construction of this berm.

Response:

The fill material used for the embankment dams, with the properties provided in SSAR Subsection 2.5.5.1.9.1.1, will be used for the construction of both the inboard and outboard berms.

The source of the fill material is discussed in SSAR Subsection 2.5.5.4.1.3.2. Fill material for the embankment dams construction will be obtained from the excavated area within the footprint of the cooling basin, and from adjacent areas, if required. As stated in the response to RAI 02.05.05-9, the source of the fill material will be provided in the combined operating license application.

Associated ESPA Revision:

SSAR Subsections 2.5.5.2.5.2, 2.5.5.2.5.3, and 2.5.5.4.1.2 will be revised in a future revision to the ESPA, as indicated:

2.5.5.2.5.2 **Steady-State Seepage Case**

Critical slip surfaces are shown on Figures 2.5.5-19 through 2.5.5-23. Calculated factors of safety are shown in Table 2.5.5-6. In all cases the factors of safety exceed the minimum required factor of safety of 1.50.

Note that an outboard berm, 30 feet wide with top elevation 75 feet, is required along the east and south cooling basin embankment dams, to achieve the minimum slope stability FOS of 1.50 for the steady-state seepage cases. Refer to Embankment Profiles B and D (Figures 2.5.4-82 and 2.5.4-84, respectively). The fill material used for the embankments, with the soil properties provided in SSAR Subsection 2.5.5.1.9.1.1, will be used for the construction of the outboard berms.

2.5.5.2.5.3 **Rapid Drawdown Case**

Critical slip surfaces are shown on Figures 2.5.5-24 through 2.5.5-28. Calculated factors of safety are shown in Table 2.5.5-7. In all cases, the calculated factors of safety exceed the minimum required design factor of safety of 1.30.

Note that an inboard berm, 100 feet wide with top elevation 69 feet, is required at the maximum-height embankment areas along the east embankment dam, to achieve the

minimum slope stability FOS of 1.30 under the rapid drawdown case. Refer to Embankment Profiles B and D (Figure 2.5.4-82 and Figure 2.5.4-84, respectively). The fill material used for the embankments, with the soil properties provided in SSAR Subsection 2.5.5.1.9.1.1, will be used for the construction of the inboard berms.

2.5.5.4.1.2 Backfill

Overall, at the cooling basin, current estimates are that the material moved during earthwork to establish site grades comprise approximately 27 million cubic yards of excavation, 20 million cubic yards of fill to construct dams/dikes, heavy haul road, power block area, and rail spur, and 1 million cubic yards of drainage sand (from offsite sources) for the outboard toe drainages of embankment dams, and 7 million cubic yards of topsoil to reestablish vegetation in disturbed areas.

As stated above, the bottom of the cooling basin is at elevation 69 feet. Backfilling within the footprint of the basin (i.e., inboard toe of the embankment) is additionally required in certain portions of the lower elevation areas, especially along the eastern and southern cooling basin embankment dams at the highest embankment sections. In these limited areas an inboard berm is constructed to elevation 69 feet (refer to embankment profiles B and D shown in Figures 2.5.4-82 and 2.5.4-84 [also shown in plan in Figure 2.5.4-80]), ensuring stability of the inboard embankment slope in the rapid drawdown case The fill material used for the embankments, with the soil properties provided in SSAR Subsection 2.5.5.1.9.1.1, will be used for the construction of the berms.

RAI 02.05.05-9:

Question:

In SSAR Subsection 2.5.5.4.1.3.2, the applicant stated that two types of fill material to be used in the cooling basin area are Composite "A" and Composite "B." These materials will be obtained from the excavated material in the footprint of the basin and from adjacent areas. The applicant also stated that the drainage materials to be used for the drainage blankets will be obtained from offsite sources. In accordance with 10 CFR 100.23(d)(4), please specify the location and properties of fill material located at "adjacent areas" and "offsite sources."

Response:

The specific source locations of fill materials are not known at this time. The source of the embankment fill material from "adjacent areas," and the properties and source of the drainage materials from "offsite sources" will be provided in the combined operating license application (COLA). The SSAR will be revised to include a statement that the source of the embankment fill and drainage materials will be provided in the COLA.

Associated ESPA Revision:

Subsection 2.5.5.4.1.3.2 is being updated in a future revision of the ESPA, as indicated:

2.5.5.4.1.3.2 Material Sources

Fill material for embankment dam construction is obtained from the excavated area within the footprint of the basin (refer to Figure 2.5.4-80), and from adjacent areas, if required. Two types of construction materials are used, identified in test results as Composite "A" (an excavated sand material) and Composite "B" (an excavated clay material). Particle size constituents and compaction characteristics of these two materials are presented in Table 2.5.4-45.

Drainage sand materials for the construction of drainage blankets are obtained from offsite sources (refer to Subsection 2.5.4.5.1 for additional detail). Properties of these granular materials are presented in Table 2.5.4-33.

The sources of the embankment fill material from "adjacent areas" and the drainage materials from "offsite sources" will be provided in the COL application.

RAI 02.05.05-12:

Question:

SSAR Subsection 2.5.5.1.6 discusses the groundwater and seepage conditions. In accordance with 10 CFR 100.23(d)(4), indicate how piping conditions were considered and addressed in the analysis.

Response:

The description of how piping conditions were considered and addressed in the slope stability analysis has been included in the response to RAI 02.05.05-1.

Associated ESPA Revision:

No ESPA revision is required as a result of this response.

RAI 02.05.05-15:

Question:

SSAR Subsection 2.5.5.1.6 indicates that the ratio of horizontal to vertical conductivity was set to five. In accordance with 10 CFR 100.23(d)(4), explain how this values was determined and describe any sensitivity analyses that were performed on the permeability values used in the seepage and slope stability analyses.

Response:

SSAR Subsection 2.5.5.1.6 notes that the ratio of horizontal to vertical hydraulic conductivity is five for the embankment fill material. As provided in Subsection 2.5.5.4.1.3.2, the fill material for the embankments will be excavated from within the basin area, and from adjacent areas if required. The ratio of horizontal to vertical hydraulic conductivity, as developed for the VCS groundwater model and discussed in SSAR Subsection 2.4.12-C-3.5, is three for the underlying sand layers and ten for the underlying clays layers. Considering that the embankment fill will be constructed of composite materials consisting of clays and sands, as described in SSAR Subsection 2.5.5.4.1.3.2, a ratio of five selected for the seepage and slope stability analyses is reasonable based on engineering judgment.

Given the properties of the proposed fill material and the inclusion of a drainage blanket in the embankment design, it is anticipated that the effects of small variations in hydraulic conductivity would not significantly affect slope stability. Thus, sensitivity analyses were not performed on permeability (hydraulic conductivity) values for the slope stability analysis. However, sensitivity analyses were conducted on vertical seepage through the cooling basin bottom (not the embankment) and are discussed in SSAR Appendix 2.4.12-C-6.1.

Associated ESPA Revision:

The second paragraph of SSAR Subsection 2.5.5.1.6 will be updated in a future revision to the ESPA as indicated.

2.5.5.1.6 Groundwater and Seepage

Subsection 2.5.4.6 addresses the history of groundwater fluctuations in the area, site-specific groundwater measurements, and the results of hydraulic conductivity testing (i.e., slug testing, borehole permeameter testing, and pump testing). Groundwater levels measured in the observation wells are presented in Figures 2.5.4-88 through 2.5.4-92. As-built observation well information is shown in Table 2.5.4-47. As-built borehole permeameter test information and as-built pumping test information are presented in Tables 2.5.4-48 and 2.5.4-49, respectively.

As described in Subsection 2.4.12, a complete groundwater model is prepared for the VCS site to evaluate post-construction groundwater levels resulting from the maximum water level in the cooling basin. The effect of this contained water is a general rise in groundwater levels site-wide. Overall seepage loss through the cooling basin is

estimated from the groundwater model, as described in Subsection 2.4.12. Lateral seepage loss through the cooling basin embankment is estimated to be in the order of 22.5 gpm (assuming embankment fill horizontal hydraulic conductivity of 3.3×10^{-7} feet per second) to 225 gpm (assuming embankment fill horizontal hydraulic conductivity of 3.3×10^{-6} feet per second) for the cooling basin perimeter. ~~Note that the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity is set to five.~~ Considering that the embankment fill will be constructed of composite materials consisting of clays and sands, as described in SSAR Subsection 2.5.5.4.1.3.2, a ratio of five selected for the seepage and slope stability analyses is reasonable based on engineering judgment.

RAI 02.05.05-16:

Question:

In accordance with 10 CFR 100.23(d)(4), indicate if the soils located in the embankment zone contains dispersible soils and explain how the dispersible soils will be treated to prevent seepage or migration of materials.

Response:

The subsurface investigation performed for the embankment zone did not include tests to identify the dispersive behavior of those soils. However, if found to be warranted, supplemental investigations, conducted at the COL stage or early construction, would provide the means to further analyze the potential of dispersive behavior of foundation soils and embankment fill in more detail.

Hunt (1984) and Mitchell & Soga (2005) recommend several methods to mitigate the adverse effects of dispersive soils. One such practical preventive measure is to place a filter, on the discharge side of dams (embankments), designed to retain small particles and control internal seepage. Studies by Sherard et al. (1992) and USACE (1993), also listed as SSAR References 2.5.5-10 and -22, propose the criteria for filter design that would permit water to pass freely without loss of fines to the drain systems. Although the detailed design will be proposed in the COL stage, if this method is selected, the summary of the design criteria proposed to be used for the horizontal drainage blanket of the cooling basin embankments has been provided in SSAR Subsection 2.5.5.1.9.2. As indicated by Mitchell & Soga (2005), the addition of 2 to 3 percent hydrated lime during construction could be another method to convert dispersive soils to a non-dispersive form, if encountered. If warranted by the above-referenced COL stage evaluation of the potential for dispersive behavior, practicable measures will be determined to mitigate the potential adverse effects of dispersive soils.

Response References:

1. Hunt, R.E., *Geotechnical Engineering Investigation Manual*, McGraw-Hill Book Co., 1984

2. Mitchell, J.K., and Soga, K., *Fundamentals of Soil Behavior*, Third Edition, John Wiley & Sons. Inc., 2005.

3. Sherard, J.L., Dunnigan L.P., and Talbot, J.R., “Filters for Silts and Clays”, Geotechnical Special Publication No 32, *Embankments: James L. Sherard Contributions*, S. Singh, Editor, American Society of Civil Engineers, 1992.

4. US Army Corps of Engineers, *Engineering and Design Seepage Analysis and Controls for Dams*, EM 1110-2-1901, April 30, 1993.

Associated ESPA Revision:

SSAR Subsection 2.5.5.1.9.2 will be updated in a future revision to the ESP, as indicated:

2.5.5.1.9.2 Drainage Materials

Two sand samples collected from a local quarry operation (Fordyce Company, Victoria Texas) are studied for the construction of embankment dam drains (refer to Subsection 2.5.4.5.1 for additional detail): one sample of material meeting the requirements of ASTM C 33 (Reference 2.5.4-20), fine aggregate for concrete, and a second sample of material meeting the requirements of ASTM C 144 (Reference 2.5.4-21), mortar sand. The 15 percent diameter (D15) size of the two sands is 0.26 millimeters (mm). To meet filter criteria, drainage sand materials need to be compatible with the particle size distributions of the four base materials that they are in contact with, namely: embankment fill materials (Composite "A" and Composite "B"), foundation sand materials (Stratum Sand 1), and foundation clay materials (Stratum Clay 1 [Top]). Filter criteria are described in References 2.5.5-10 and 2.5.5-~~11~~22.

Filter criteria proposed in Reference 2.5.5-10 are as follows:

- Sands having D15 of approximately 0.5 mm or less are suitable filters even for the finest clays.
- For sandy silts and clays with significant sand content (i.e., d85 of 0.1 mm to 0.5 mm) the existing filter criterion D15/d85 <5 is conservative and reasonable where:

  D15 = Particle size of the filter soil (i.e., the drainage sand), for which 15 percent by dry weight of particles are smaller, and

  d85 = Particle size of the base soil, for which 85 percent by dry weight of particles are smaller

Table 2.5.5-3 shows the compatibility of the two drainage sand materials with the above criteria.

Filter criteria proposed in Reference 2.5.5-~~11~~22 are as follows:

- Select the base soil material that requires the smallest D15 size (e.g., Stratum Clay 1 [Top]).
- Place the base soil in a category based on the percent passing the No. 200 sieve in accordance with Table D-1 of the reference (e.g., Category 2 for Stratum Clay 1 [Top]).
- Determine the maximum D15 for the filter in accordance with Table D-2 of the reference (e.g., for Category 2, D15 of the proposed drainage material less than or equal to 0.7 mm). D15 size of the proposed drain material is 0.26 mm which satisfies the criteria.

As noted above, the D15 size of both drainage sand materials is 0.26 mm (which is 0.7 mm), satisfies the above criteria.

The criteria proposed for filter design (References 2.5.5-10 and 2.5.5-22) would permit water to pass freely without loss of fines to the drain systems. Use of a filter on the discharge side of the embankment is also a preventive measure to mitigate the adverse effects of dispersive soils (References 2.5.5-23 and 2.5.5-24). The subsurface investigations performed for the embankment zone did not include tests to identify the dispersive behavior of those soils. However, if found to be warranted, supplemental investigations, conducted at the COL stage or early construction, would provide the means to further analyze the potential of dispersive behavior of foundation soils and embankment fill in more detail. As indicated by Reference 2.5.5-24, the addition of 2 to 3 percent hydrated lime during construction could be another method to convert dispersive soils to a non-dispersive form, if encountered. If warranted by the above-referenced COL stage evaluation of the potential for dispersive behavior, practicable measures will be determined to mitigate the potential adverse effects of dispersive soils.

SSAR Subsection 2.5.5.2.2.7 will be updated in a future revision to the ESP, as indicated:

2.5.5.2.2.7 Design Criteria

The following design criteria apply to cooling basin embankment dams:

- Embankments built with clayey material (representative materials are Composite "A"/Sand, having USCS classification of SC; and Composite "B"/Clay, having USCS classification of CL) taken from site excavations, and compacted to a minimum of 95 percent of modified Proctor (Reference 2.5.4-19) maximum dry density at approximately 4 percent above optimum moisture content. Refer to Subsections 2.5.4.5.3 and 2.5.5.4, and Table 2.5.4-45.
- Geotechnical properties of the embankment fill materials used in the design of the embankments are selected based on laboratory test results from recompacted soils. Refer to Subsections 2.5.4.5.3 and 2.5.5.4, and Table 2.5.4-45.
- Embankments are designed with slopes 3H:1V, or flatter.
- Horizontal acceleration at the base of the embankments: 0.10g.
- Minimum slope stability static FOS are as follows (References 2.5.5-1, 2.5.5-9, and 2.5.5-11):
    - End of Construction: 1.30
    - Steady-State Seepage: 1.50
    - Rapid Drawdown: 1.30
    - Pseudo-static: 1.15
- Post-earthquake residual strength: 0.80 x static value.
- Seismic slope deformation: Less than 3 feet.
- Filters: Designed in accordance with References 2.5.5-9 and 2.5.5-~~11~~22.
- Inboard slope protection: Soil-cement, approximately 2.5 feet

SSAR References:

2.5.5-10 Sherard, J.L., Dunnigan L.P., and Talbot, J.R., *Filters for Silts and Clays*, Geotechnical Special Publication No 32, *Embankment Dams: James L. Sherard Contributions*, S. Singh, Editor, (Nonproprietary), American Society of Civil Engineers, 1992.

2.5.5-11 US Army Corps of Engineers, *Engineering and Design Slope Stability* ~~*Analysis Manual*~~, EM 1110-2-1902, (Nonproprietary), October 31, 2003.

2.5.5-22 US Army Corps of Engineers, *Engineering and Design Seepage Analysis and Controls for Dams*, EM 1110-2-1901, (Nonproprietary), April 30, 1993.

2.5.5-23 Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw-Hill Book Co., (Nonproprietary), 1984

2.5.5-24 Mitchell, J.K., and Soga, K., Fundamentals of Soil Behavior, Third Edition, John Wiley & Sons. Inc., (Nonproprietary), 2005.

RAI 02.05.05-17:

Question:

From SSAR Figure 2.5.1-41 and 2.5.1-49 the staff infer that growth faults D and E potentially underlying the cooling basin. In accordance with 10 CFR 100.23(d)(4), discuss the consideration of the growth faults D and E in the slope stabilization analysis for the cooling basin and the potential for embankment failure.

Response:

Potential growth fault lineaments from LiDAR associated with growth faults D and E are mapped underlying the cooling basin. The surficial expression of these lineaments is discussed in SSAR Subsections 2.5.1.2.4.2.3 and 2.5.1.2.4.2.4 and the characterization of growth fault D is further discussed in responses to RAIs 02.05.01-6 and RAI 02.05.01-8 through -13. The SSAR and RAI responses indicate that the topographic lineaments potentially associated with growth faults D and E are visible on LiDAR data and manifest on the ground surface by a distributed southeast-down tilting or folding of the ground surface. As discussed in SSAR Subsection 2.5.1.2.4.2.3.2 and Figure 1b and 1d of the response to RAI 02.05.01-2, the envelope of the interpreted potential zone of deformation associated with Growth Fault D is located 509 ft (155 m) outside of the power block area, which contains all structures, systems, and components important to safety. Deformation associated with growth faults D and E is related to broad folding distributed over several hundred feet and movement on these faults does not appear to have produced discrete faulting at the surface. These considerations, the information in SSAR Subsection 2.5.1.2.4.2.3.2, and responses to NRC's RAIs provide the basis for concluding that future potential movement on these growth faults will not produce deformation of the embankment. Thus, these faults were not specifically considered in the slope stability analyses of the embankments for the non-safety related cooling basin. Notwithstanding, a non-mechanistic breach of the cooling basin embankment was assumed in order to evaluate the potential impacts of flooding on the power block area. The results of that evaluation, presented in SSAR Subsection 2.4.4.3.2, are that the predicted maximum water level is 91.0 ft NAVD88 and is below the minimum power block finished site grade of 95 ft NAVD88.

Due to the uncertainties in estimating the rates of slip on growth faults in the site vicinity, Exelon has committed to implementing a VCS growth fault displacement monitoring program at the COL stage (See the response to RAI 02.05.03-3).

Associated ESPA Revision:

No ESPA revision is required as a result of this response.

ATTACHMENT 12

SUMMARY OF REGULATORY COMMITMENTS

(Exelon Letter to USNRC, NP-11-0034, dated July 25, 2011)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Exelon will revise the VCS ESPA SSAR Section 2.5.4 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.04-5 (Attachment 1)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No
Exelon will revise the VCS ESPA SSAR Section 2.5.4 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.04-17 (Attachment 4)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No
Exelon will revise the VCS ESPA SSAR Section 2.5.5 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.05-6 (Attachment 6)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No
Exelon will revise the VCS ESPA SSAR Section 2.5.5 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.05-9 (Attachment 7)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Exelon will revise the VCS ESPA SSAR Section 2.5.5 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.05-15 (Attachment 9)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No
Exelon will revise the VCS ESPA SSAR Section 2.5.5 to incorporate the change shown in the enclosed response to the following NRC RAI: 02.05.05-16 (Attachment 10)	Revision 1 of the ESPA SSAR and ER planned for no later than March 31, 2012	Yes	No

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 52-042-ESP
EXELON NUCLEAR TEXAS HOLDINGS, LLC	)	
	)	
(Early Site Permit for Victoria County Station Site)	)	July 26, 2011

CERTIFICATE OF SERVICE

I certify that on July 26, 2011 a copy of the "Notification of Filing Related to Admitted Contentions" was served by the Electronic Information Exchange on the following recipients:

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