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

August 26, 2009
U7-C-STP-NRC-090102

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 Request for Additional Information

Attached are the responses to NRC staff questions in Request for Additional Information (RAI) letter number 184, related to Combined License Application (COLA) Part 2, Tier 2, Sections 2.4S.3, "Probable Maximum Flood (PMF) on Streams and Rivers," 2.4S.4, "Potential Dam Failures," and 2.4S.10, "Flooding Protection Requirements." Attachments 1 through 5 provide a complete response to RAI letter number 184, and include responses to the following questions:

02.04.03-9	02.04.04-11	02.04.10-2
	02.04.04-12	
	02.04.04-13	

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

There are no commitments in this letter.

If you have any questions regarding these responses, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

D091
NRO

STI 32518859

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

Executed on 8/26/09

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

rhb

Attachments:
1. RAI 02.04.03-9
2. RAI 02.04.04-11
3. RAI 02.04.04-12
4. RAI 02.04.04-13
5. RAI 02.04.10-2

cc: w/o attachments and enclosure except*
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RAI 02.04.03-9

Question:

Describe which of the HEC-HMS model parameter values used in the Halff study were changed for the STP Units 3 and 4 FSAR PMF analysis. Include a table of these parameters with corresponding values used in the two studies. Describe the process used to arrive at the parameter values used in the STP Units 3 and 4 FSAR.

Response:

The following input parameters to the Halff HEC-HMS model (Reference 2.4S.3-8) were changed for the STP Units 3 and 4 FSAR PMF analysis:

- Initial Rainfall Loss (in)
- Constant Rainfall Loss Rate(in/hr)
- Snyder Lag Time (hours)

Table 1 below shows the value of each of parameters listed above as extracted from the HEC-HMS model obtained from Halff Associates and the modified value as used in the FSAR PMF analysis.

Table 1, Halff HEC-HMS Parameters and Values Changed for FSAR PMF Analysis

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Sub-basin Name	Halff HEC-HMS 100-yr Initial Rainfall Loss (in)	PMF Initial Rainfall Loss (in)	Halff HEC-HMS 100-yr Constant Rainfall Loss Rate (in/hr)	PMF Constant Rainfall Loss Rate (in/hr)	Halff HEC-HMS Snyder Lag Parameter (hours)	PMF Snyder Lag Parameter (hours)
AL-16	0.39	0	0.06	0.05	1.62	1.22
AL-17	0.6	0	0.22	0.05	2.89	2.17
AL-18	0.48	0	0.2	0.05	0.94	0.71
AL-19	0.53	0	0.12	0.05	2.31	1.73
AL-20	0.61	0	0.23	0.05	1.38	1.04
AL-21	0.45	0	0.2	0.05	1.34	1.01
AL-22	0.42	0	0.19	0.05	1.38	1.04
AL-23	0.69	0	0.22	0.05	6.76	5.07
AL-24	2.04	0	0.25	0.05	3.45	2.59
AL-25	1.39	0	0.25	0.05	2.62	1.97
AL-26	0.47	0	0.2	0.05	1.3	0.98
AL-27	0.29	0	0.17	0.05	2.14	1.61
AL-28	0.47	0	0.2	0.05	1.07	0.80
AL-29	0.99	0	0.07	0.05	5.19	3.89
AL-30	1.42	0	0.1	0.05	4.25	3.19
AL-31	1.16	0	0.09	0.05	4.75	3.56

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Sub-basin Name	Halff HEC-HMS 100-yr Initial Rainfall Loss (in)	PMF Initial Rainfall Loss (in)	Halff HEC-HMS 100-yr Constant Rainfall Loss Rate (in/hr)	PMF Constant Rainfall Loss Rate (in/hr)	Halff HEC-HMS Snyder Lag Parameter (hours)	PMF Snyder Lag Parameter (hours)
AL-32	1.24	0	0.08	0.05	5.15	3.86
AL-33	1.28	0	0.09	0.05	5.53	4.15
AL-34	0.69	0	0.07	0.05	4.83	3.62
AL-35	0.72	0	0.06	0.05	3.01	2.26
AL-36	1.61	0	0.09	0.05	4.93	3.70
AL-37	1.63	0	0.09	0.05	5.33	4.00
AL-38	1.52	0	0.06	0.05	6.19	4.64
AL-39	1.23	0	0.08	0.05	6.23	4.67
CC-01	1.48	0	0.08	0.05	4.95	3.71
CC-02	0.53	0	0.04	0.05	4.69	3.52
CC-03	1.17	0	0.06	0.05	6	4.50
CC-04	1.47	0	0.08	0.05	6.21	4.66
CC-05	1.1	0	0.05	0.05	7.37	5.53
CC-06	1.38	0	0.08	0.05	6.65	4.99
CC-07	0.76	0	0.03	0.05	10.34	7.76
CC-08	1.49	0	0.08	0.05	5.63	4.22
CC-09	1.53	0	0.09	0.05	4.74	3.56
CC-10	1.31	0	0.04	0.05	6.43	4.82
CC-11	1.42	0	0.08	0.05	6.87	5.15
CC-12	1.77	0	0.08	0.05	6.34	4.76
CC-13	0.98	0	0.11	0.05	7.23	5.42
CC-14	0.57	0	0.07	0.05	8.88	6.66
CC-15	0.58	0	0.07	0.05	7.67	5.75
CC-16	0.59	0	0.07	0.05	6.96	5.22
CC-17	0.75	0	0.08	0.05	6.69	5.02
CC-18	0.63	0	0.08	0.05	9.44	7.08
CC-19	1.42	0	0.16	0.05	7.77	5.83
CC-20	1.08	0	0.11	0.05	6.21	4.66
CC-21	1.45	0	0.16	0.05	8.27	6.20
CC-22	0.87	0	0.11	0.05	6.2	4.65
CC-23	0.73	0	0.09	0.05	6.82	5.12
CC-24	0.56	0	0.08	0.05	5.91	4.43
CC-25	0.71	0	0.1	0.05	7.87	5.90
CC-26	0.67	0	0.1	0.05	6.37	4.78
CC-27	0.47	0	0.07	0.05	8.32	6.24
CC-28	0.61	0	0.1	0.05	5.8	4.35
CC-29	0.59	0	0.05	0.05	1.55	1.16
CC-30	0.62	0	0.06	0.05	14.8	11.10
CC-31	0.61	0	0.06	0.05	9.41	7.06
CC-32	0.69	0	0.07	0.05	7.35	5.51
CC-33	0.78	0	0.09	0.05	8.11	6.08

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Sub-basin Name	Halff HEC-HMS 100-yr Initial Rainfall Loss (in)	PMF Initial Rainfall Loss (in)	Halff HEC-HMS 100-yr Constant Rainfall Loss Rate (in/hr)	PMF Constant Rainfall Loss Rate (in/hr)	Halff HEC-HMS Snyder Lag Parameter (hours)	PMF Snyder Lag Parameter (hours)
CC-34	0.72	0	0.08	0.05	8.66	6.50
CC-35	0.58	0	0.05	0.05	5.3	3.98
CC-36	2	0	0.07	0.05	5.77	4.33
CC-37	2.7	0	0.1	0.05	5.82	4.37
CC-38	0.79	0	0.09	0.05	7.9	5.93
LC-01	0.75	0	0.2	0.05	8.58	6.44
LC-02	0.83	0	0.21	0.05	8.76	6.57
LC-03	0.46	0	0.08	0.05	11.93	8.95
LC-04	0.49	0	0.08	0.05	8.66	6.50
LC-05	0.5	0	0.09	0.05	10.05	7.54
LC-06	0.47	0	0.08	0.05	7.63	5.72
LC-07	0.5	0	0.09	0.05	7.36	5.52
LC-08	0.51	0	0.09	0.05	7.51	5.63
LC-09	0.49	0	0.09	0.05	6.24	4.68
LC-10	0.47	0	0.08	0.05	7.02	5.27
LC-11	0.52	0	0.09	0.05	4.47	3.35
LC-12	0.49	0	0.08	0.05	5.7	4.28
LC-13	0.48	0	0.08	0.05	4.56	3.42
LC-14	0.51	0	0.09	0.05	4.66	3.50
LC-15	0.55	0	0.1	0.05	3.11	2.33
LC-16	0.55	0	0.1	0.05	2.58	1.94
LC-17	0.42	0	0.07	0.05	3.13	2.35
LC-18	0.46	0	0.08	0.05	1.45	1.09

The values for the initial rainfall loss and the constant (or uniform) loss rate from the Halff HEC-HMS model are based on the calibrated results that Halff Associates obtained for the 100-year storm (Reference 2.4S.3-8)

Process:

Initial Rainfall Loss
To be conservative, the initial rainfall loss for each of the sub-basins in the HEC-HMS FSAR PMF analysis was set equal to zero as based on recommendations in Reference 2.4S.3-12 as stated in the STP 3 & 4 COLA, FSAR Subsection 2.4S.3.4.2.1 under Rainfall Losses. The values of the initial rainfall loss contained in the original Halff model as listed in Column 2 of Table 1 were all changed to zero as shown in Column 3 of Table 1.

Constant Rainfall Loss Rate
A minimum constant (uniform) loss rate of 0.05 in/hr was selected for each of the sub-basins based on values in Table 8-8.1 of Reference 2.4S.3-12 as stated in FSAR Subsection 2.4S.3.4.2.1

under Rainfall Losses. The values of the constant rainfall loss rate contained in the original Halff model as listed in Column 4 of Table 1 were all changed to 0.05 in/hr as shown in Column 5 of Table 1.

Snyder Lag Time

The calibrated values of the Snyder Lag Time, Tp, as contained in the Halff Associates HEC-HMS model are shown in Column 6 of Table 1 for all of the basins used in the FSAR PMF study. The Lag Times were reduced in the FSAR PMF analysis in accordance with recommendations contained in the United States Army Corps of Engineers manual, EM 1110-2-1417 (Reference 2.4S.3-24), as stated in FSAR Section 2.4S.3.3. A 25% reduction in the calibrated Halff HEC-HMS model's Snyder Lag time for each sub-basin was used in the FSAR PMF analysis. The values used in the FSAR PMF analysis are shown in Column 7 of Table 1, and were obtained by multiplying the values in Column 6 by 0.75.

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

References:

2.4S.3-8 "Colorado River Flood Damage Evaluation Project – Phase I," Volume I and Volume II, prepared for the Lower Colorado River Authority and Fort Worth District Corps of Engineers, Halff Associates, Inc, July 2002.

2.4S.3-12 "Engineering Guidelines for the Evaluation of Hydropower Projects, Determination of the Probable Maximum Flood," Federal Energy Regulation Commission (FERC), September 2001.

2.4S.3-24 "Flood-Runoff Analysis," Engineering Manual 1110-2-1417, United States Army Corps of Engineers, August 1994.

RAI 02.04.04-11

Question:

In response to RAI 02.04.04-9 and 02.04.04-10 (U7-C-STP-NRC-090012, February 23, 2009; Attachment 1), the applicant proposed changes to the FSAR. The proposed text for FSAR Subsection 2.4S.4.2.2.3.1 mentions that a hypothetical sump was modeled at East, West, and North boundaries. Is this configuration simply a deepening of the topography along these boundaries when the water surface elevation is held constant? How were the sumps added to the model and how were they incorporated with the specified boundary conditions? RMA2 model description suggests that these sumps were needed to improve model stability. What is the nature of the instability that is being addressed? Provide citations to publicly-available references that describe this approach while using the RMA2 model.

Response:

A common reason for a dynamic numerical model to become unstable is having boundary nodes rapidly oscillate between wet and dry conditions. An artificial sump can address this problem. This can be implemented by setting the topographic elevations of the boundary nodes of a 2D grid low enough to ensure that these boundary nodes stayed wet throughout the entire simulation. Most modeling guides advise keeping the boundary conditions simple and sufficiently far away so as to not impact the results of the target areas. In actuality, all physical hydraulic models also use this approach, because they are actually pumping water into a constructed domain, and the "sump" is the area to which the model receives inflow or discharges.

For the STP Units 3 and 4 dynamic RMA2 modeling, the initial 2D model experienced instability, exhibiting non-convergence and execution termination before the end of the entire hydrograph simulation. The instability was associated with dry nodes along the boundaries of the 2D grid. To address this issue, artificial sumps were developed to ensure all nodes stayed wet throughout the entire simulation period. To verify that the boundaries are sufficiently far away so that they would not influence the target areas, a sensitivity analysis was conducted with different boundary conditions (water surface elevations). The results of the sensitivity analysis indicated that changing boundary conditions along the artificial sumps did not impact the modeling results in and near the target areas.

List of publications involving the description or use of artificial sump concept:

Ettema, R. Hydraulic Modeling: Concepts and Practice. Environmental and Water Resources Institute (U.S.). ASCE Publications. 390 pp., 2000.

Description of the use of sumps in physical models to control (and vary) the boundary conditions for calibration.

Hughes, S.A. Physical Models And Laboratory Techniques In Coastal Engineering. USACE, ERDC. 568 pp., 1993.

Kamphius, J.W. Introduction to coastal engineering and management. World Scientific Publishing Company. 600 pp., 2000.

Su, Y.C. (PBS&J); E. Lehotsky and D. Fuller (Cheniere LNG, Inc.). "The Sabine Pass LNG Terminal, Challenges for a new LNG Terminal in Louisiana", Caring for the Coast: Texas Coastal Conference 2009, Galveston, Texas, June 4-5, 2009.

Su, Y.C. (PBS&J) and J. Mahmoud (Cheniere LNG, Inc.). "Beneficial Use of Dredged Materials at Louisiana Shoreline Near Sabine Pass", EC 07, International Erosion Control Association's Annual Conference & Expo, Reno, Nevada, 2007.

Su, Y.C., J. Koutny, J. Benoliel, J. Mahmoud, and M. Heaney (PBS&J); D. Granger (Cheniere LNG, Inc.). "Sediment Transport Modeling of Dredged Disposal Materials Near Sabine Pass." Coastal Texas 2020 Technical Erosion Conference 2005, Houston, Texas, September 14-16, 2005.

Su, Y.C., C. Woodward, J. Koutny, and J. Benoliel (PBS&J); W. Crull (Harris County Flood Control District) "Modeling of Flood Control Channels Using SMS/RMA2." TFMA 17th Annual Texas Flood Conference, Fort Worth, Texas, 2004.

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

RAI 02.04.04-12

Question:

In response to RAI 02.04.04-9 and 02.04.04-10 (U7-C-STP-NRC-090012, February 23, 2009; Attachment 1), the applicant proposed changes to the FSAR. The proposed text for FSAR Subsection 2.4S.4.2.2.3.2 discussed the impact of treating buildings in the MCR breach analysis as "hard" or "soft." The response states that considering the buildings as "soft" results in a conservative estimate of flood inundation. It is not clear if this is general statement or finding from this particular model analysis. The conclusion made in the RAI response (applicant's response to RAI 02.04.04-3, in U7-C-STP-NRC-090022, Attachment 4, Page 1 of 4) is not clear to staff because removal of obstructions ("soft" buildings) may increase the cross-sectional area of the discharge even though the roughness in those areas may have been increased. Provide a discussion why removal of "soft" buildings would result in higher flood water surface elevations and greater velocities.

Response:

The MCR breach analysis assumed that not all buildings, particularly the light metal structures near the levee, would be able to withstand the relatively high velocity flow resulting from an MCR breach. Engineering judgment was used to identify "soft buildings" which were assumed not to be able to withstand the MCR breach flow. These buildings would no longer obstruct the flow and therefore they were removed from the 2D grid. However, the remaining building frames and any debris were assumed to increase the roughness of the surface and the roughness coefficients were adjusted accordingly.

The removal of soft buildings directly between the power block and the MCR would remove obstacles in the path of the MCR breach flow, thus allowing a larger flow with higher flow velocity to reach the downstream Units 3 and 4. By removing the soft buildings directly upstream of Units 3 and 4, the increased MCR breach flow reaches the plant buildings practically unimpeded and would cause greater flood inundation.

The 2D RMA2 modeling effort was conducted based on best available data and engineering evaluation of the buildings. Classifying buildings as hard and soft and assuming that soft buildings would not withstand high velocity flood water associated with an MCR breach makes the analysis assumptions and results more realistic.

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

RAI 02.04.04-13

Question:

In response to RAI 02.04.04-9 and 02.04.04-10 (U7-C-STP-NRC-090012, February 23, 2009; Attachment 1), the applicant proposed changes to the FSAR. The applicant stated in the proposed text for FSAR Subsection 2.4S.4.2.2.4.2: "The flood flow from the MCR embankment breach would not erode the STP 3 and 4 plant site area because surfacing in this area is mostly concrete or asphalt pavement or compacted gravel and grass. The maximum velocity of 4.72 ft/s would not cause severe erosion of these surfaces, and any minor erosion around corners of the buildings would not impact the safety-related facilities of Units 3 and 4." The applicant did not describe if a threshold maximum velocity would be considered to cause erosion that would be severe. Provide a description of the amount of erosion that would be considered severe and a flow velocity that may lead to such an erosion. Include publicly available references in support.

Response:

In the literature regarding erosion and sediment control, the threshold of erosion is in general represented by either flow velocity or shear stress (References 1, 2 and 3). The following is a discussion related to threshold velocities for erosion of different types of surfacing.

The design criteria in Reference 1 include a table showing permissible shear stresses for various lining materials against flow velocity. As shown in Table 1, surfaces with well-established vegetation (e.g., grass) can be expected to resist from 0.35 to 3.70 pounds per square foot of shear stress. Areas covered with gravels having D50 = 1 to 2 inches have permissible shear stress of 0.40 to 0.80 pounds per square foot, and over 20 pounds per square foot if covered with concrete blocks. These shear stress values are compared against the shear stresses and corresponding flow velocities listed in Reference 2.

An evaluation of critical conditions for various protection measures is reported in Reference 2. As shown in Table 2, the critical condition for areas covered with grass was found to be 5.9 feet per second with a corresponding shear stress of 0.4 pounds per square foot. This value falls within the 0.35 to 3.70 pounds per square foot range for grass-lined surface presented in Reference 1. It also indicates the ability of grass-lined area to resist flow velocity of 5.9 feet per second or higher.

Reference 2 includes a table showing maximum permissible velocities for various gravel materials. As shown in Table 3, the permissible shear stress for coarse gravel ranges from 0.30 to 0.67 pounds per square foot, corresponding to a permissible flow velocity range of 4.0 to 6.0 feet per second. Additionally, these permissible shear stresses are consistent with the permissible shear stress range of 0.40 to 0.80 pounds per square foot presented in Reference 1.

Information similar to that presented in References 1 and 2 regarding permissible velocity or shear stress values can be found in textbooks related to the subject. Reference 3 includes a table containing 1926 research findings by Fortier and Scobey. As shown in Table 4, the permissible velocity for coarse gravel was found to range from 4.0 to 6.5 feet per second. This range is consistent with the permissible velocity values in Reference 2. This textbook also indicates that the permissible velocity and shear stress values have been widely researched, reported, and used for almost a century.

In conclusion, a simulated maximum velocity of 4.72 feet per second for the proposed STP Units 3 and 4 area is not expected to result in significant erosion because the area will be covered with gravel, grass, concrete, or asphalt. In order for erosion of these surfaces to occur, a sustained velocity greater than the threshold velocity range of 4.0 to 6.0 feet per second would be necessary. Even with velocities slightly exceeding the threshold velocity for a short duration (less than two hours), any resulting erosion would not be severe enough to affect the deep foundations of the safety-related SSCs.

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

References:

1. Texas Department of Transportation (TxDOT). Hydraulic Design Manual. April 2002.
2. U.S. Department of Transportation (USDOT). Development of a Methodology for Estimating Embankment Damage Due to Flood Overtopping. Report No. FHWA/RD-86/126. 204 pp. March 1987.
3. Yang, C.T. Sediment Transport Theory and Practice. The McGraw-Hill Companies, Inc. 396 pp., 1996.

Table 1. Design Criteria in TxDOT Hydraulic Design Manual (Reference 1)

Permissible Shear Stresses for Various Linings

Protective Cover	(lb./sq.ft.)	τ_p(N/m^2)
Retardance Class A Vegetation (See the "Retardation Class for Lining Materials" table above)	3.70	177
Retardance Class B Vegetation (See the "Retardation Class for Lining Materials" table above)	2.10	101
Retardance Class C Vegetation (See the "Retardation Class for Lining Materials" table above)	1.00	48
Retardance Class D Vegetation (See the "Retardation Class for Lining Materials" table above)	0.60	29
Retardance Class E Vegetation (See the "Retardation Class for Lining Materials" table above)	0.35	17
Woven Paper	0.15	7
Jute Net	0.45	22
Single Fiberglass	0.60	29
Double Fiberglass	0.85	41
Straw W/Net	1.45	69
Curled Wood Mat	1.55	74
Synthetic Mat	2.00	96
Gravel, D_{50} = 1 in. or 25 mm	0.40	19
Gravel, D_{50} = 2 in. or 50 mm	0.80	38
Rock, D_{50} = 6 in. or 150 mm	2.50	120
Rock, D_{50} = 12 in. or 300 mm	5.00	239
6-in. or 50-mm Gabions	35.00	1675
4-in. or 100-mm Geoweb	10.00	479
Soil Cement (8% cement)	>45	>2154
Dycel w/out Grass	>7	>335
Petraflex w/out Grass	>32	>1532
Armorflex w/out Grass	12-20	574-957
Erikamat w/3-in or 75-mm Asphalt	13-16	622-766
Erikamat w/1-in. or 25 mm Asphalt	<5	<239
Armorflex Class 30 with longitudinal and lateral cables, no grass	>34	>1628
Dycel 100, longitudinal cables, cells filled with mortar	<12	<574
Concrete construction blocks, granular filter underlayer	>20	>957
Wedge-shaped blocks with drainage slot	>25	>1197

Table 2. USDOT's Evaluation of Critical Conditions (Reference 2)

Evaluation of critical conditions for the protection measures.

Protection Measure	Overtopping Depth (ft)	Discharge (ft^3/s-ft)	Average Flow Depth (ft)	Average Velocity (ft/s)	Maximum Velocity (ft/s)	Energy Slope	Manning's n	Shear* Stress (lb^2/ft^2)	Remarks
Geoweb	1.0	3.0	0.38	7.9	8.3	0.27	0.051	1.0	Significant toe erosion occurred after 9 hours of test.
Gabion	1.0	3.0	0.42	7.1	7.9	0.34	0.068	1.0	Stable
Gabion	2.0	8.4	0.82	10.2	10.9	0.27	0.066	2.0	Stable
Gabion	4.0	25.0	1.59	15.7	17.2	0.22	0.060	5.0	Some rock migrated, but gabion remained stable.
Soil Cement	1.0	3.0	0.32	9.4	11.5	0.21	0.034	0.6	Stable
Soil Cement	2.0	8.4	0.55	15.3	18.0	0.11	0.022	1.6	Stable
Soil Cement	4.0	25.0	1.48	16.9	20.0	0.022	0.017	1.9	Stable
Enkamat	1.0	3.0	0.38	7.9	8.0	0.28	0.051	1.0	Stable
Enkamat	2.0	8.4	0.80	10.5	12.0	0.15	0.047	2.5	Some erosion
Grass	0.5	3.0	0.17	5.9	6.1	0.33	0.044	0.4	Stable

Table 3. USDOT's Permissible Velocities (Reference 2)

Table 9. Maximum permissible velocities recommended by Fortier and Scobey and the corresponding unit-tractive-force values converted by the U.S. Bureau of Reclamation (for straight channels of small slope, after aging).

Material	Clear Water		Water Transporting colloidal silts	
	V_c ft/s	τ_c lb/ft²	V_c ft/s	τ_c lb/ft²
Fine sand, colloidal	1.50	0.027	2.50	0.075
Sandy loam, noncolloidal	1.75	0.037	2.50	0.075
Silt loam, noncolloidal	2.00	0.048	3.00	0.11
Alluvial silts, noncolloidal	2.00	0.048	3.50	0.15
Ordinary firm loam	2.50	0.075	3.50	0.15
Volcanic ash	2.50	0.075	3.50	0.15
Stiff clay, very colloidal	3.75	0.26	5.00	0.46
Alluvial silts, colloidal	3.75	0.26	5.00	0.46
Shales and hardpans	6.0	0.67	6.00	0.67
Fine gravel	2.50	0.075	5.00	0.32
Graded loam to cobbles when noncolloidal	3.75	0.38	5.00	0.66
Graded silts to cobbles when colloidal	4.00	0.43	5.50	0.80
Coarse gravel, noncolloidal	4.00	0.30	6.00	0.67
Cobbles and shingles	5.00	0.91	5.50	1.10

Table 4. Permissible Velocities in Yang's Textbook (Reference 3)

Permissible canal velocities (Fortier and Scobey, 1926)

	Velocity† (ft/s)		
Original material excavated for canal (1)	**Clear water, no detritus (2)**	**Water-transporting colloidal silts (3)**	**Water-transporting noncolloidal silts, sands, gravels, or rock fragments (4)**
Fine sand (noncolloidal)	1.50	2.50	1.50
Sandy loam (noncolloidal)	1.75	2.50	2.00
Silt loam (noncolloidal)	2.00	3.00	2.00
Alluvial silts when noncolloidal	2.00	3.50	2.00
Ordinary firm loam	2.50	3.50	2.25
Volcanic ash	2.50	3.50	2.00
Fine gravel	2.50	5.00	3.75
Stiff clay (very colloidal)	3.75	5.00	3.00
Graded, loam to cobbles, when noncolloidal	3.75	5.00	5.00
Alluvial silts when colloidal	3.75	5.00	3.00
Graded, silt to cobbles, when colloidal	4.00	5.50	5.00
Coarse gravel (noncolloidal)	4.00	6.00	6.50
Cobbles and shingles	5.00	5.50	6.50
Shales and hard pans	6.00	6.00	5.00

† For channels with depth of 3 ft or less after aging.

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Question:

10 CFR 52.1(a) states "[s]ite characteristics are the actual physical, environmental and demographic features of a site. Site characteristics are specified in an early site permit or in a final safety analysis report for a combined license." 10 CFR 50.2 states: "Design bases means that information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges or values chosen for controlling parameters as reference bounds for design. These values may be...requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals." Table 2.0-2 of FSAR Rev 0 lists site characteristics including those related to surface and ground water events. Provide the following site characteristics (if a site characteristic listed below is not relevant to the site, a description should be included as justification why it was excluded) and indicate which of these would be used in design of or verification of the designs of various safety-related SSCs:

1. The grade elevations of all safety-related SSCs and the corresponding site grade elevations
2. The local intense precipitation
3. The maximum water surface elevation from the most severe of the combined-effects floods
4. The most severe hydrodynamic (drag) forces
5. The most severe rate-of-rise of flood water surface
6. The minimum low water surface elevation
7. Ice conditions and forces (precursors for frazil ice formation; maximum historical ice sheet thickness; most severe combination of crushing, bending, buckling, and splitting forces form ice on safety-related SSCs)
8. The maximum post-construction groundwater elevation
9. The point-of-compliance for 10 CFR Part 20, Appendix B, Table 2, Column 2 dose limits to the public from accidental release of liquid radioactive effluents by the operating plant of plants in surface and ground water pathways.

Response:

The site characteristics, and their location in the COLA Sections, are provided in the following table. COLA Sections refer to Revision 2, unless otherwise noted.

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

	Site Characteristic	COLA Section Referenced	Site Characteristic Value (Answer)	SSC design / verification
1	The grade elevations of all safety-related SSCs and the corresponding site grade elevations	2.4S.1.1, paragraph	Building Floor El. of Safety-related SSCs = 35 ft Nominal Plant Site Grade El = 34 ft	The site grade elevation is used to establish the building floor elevations of the safety-related SSCs.
2	The local intense precipitation	Table 2.4S.2-4	Table provides rainfall depths	Used to establish the Design Basis Flood Level for the safety-related SSCs.
3	The maximum water surface elevation from the most severe of the combined-effects floods	2.4S.2.2, paragraph **(See Note)**	Design Basis Flood Level (DBF) = 40.0 ft (Based on the most severe external flood level (MCR Dike Breach) which is less than the DBF.)	To establish the design basis flood level for the safety-related SSCs.
4	The most severe hydrodynamic (drag) forces	2.4S.4.2.2.4.3 **(See Note)**	Drag Force (Fd) is 44 pounds/square foot	Used in the structural design of the safety-related SSCs.
5	The most severe rate-of-rise of flood water surface	Figures 2.4S.4-20 and 2.4S.4-21 **(See Note)**	Figures provide rate of rise at the Plant SSCs	Used in the structural design of the safety-related SSCs.
6	The minimum low water surface elevation	2.4S.11.5 and 9.2.5.3.4	No low water surface elevation is established for safety-related water supply. The makeup water to the UHS is provided by site wells with backup from MCR.	N/A
7	Ice conditions and forces (precursors for frazil ice formation; maximum historical ice sheet thickness; most severe combination of crushing, bending, buckling, and splitting forces from ice on safety-related SSCs)	2.4S.7	This subsection states that ice formation is unlikely, and there are no historical ice events near the site.	N/A
8	The maximum post-construction groundwater elevation	Table 3.4-1	Estimated Post Construction Groundwater Elevation = 28 ft Design groundwater elevation for all SSCs is 32 ft	Both are used in the structural design of the safety-related site-specific SSCs.

	Site Characteristic	COLA Section Referenced	Site Characteristic Value (Answer)	SSC design / verification
9	The point-of-compliance for 10 CFR Part 20, Appendix B, Table 2, Column 2 dose limits to the public from accidental release of liquid radioactive effluents by the operating plant or plants in surface and groundwater pathways.	2.4S.13	Point of Compliance for groundwater pathway is hypothetical well along the eastern site property boundary. Point of compliance for surface water pathway is not applicable.	Used for Compliance with 10 CFR Part 20, Appendix B.

Note: COLA Markup in RAI 02.04.04-9, Attachment 1 to letter from Scott Head to Document Control Desk, "Supplemental Responses to Requests for Additional Information," dated February 23, 2009, U7-C-STP-NRC-090012, ML090710301, ML090710302