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CP-201000930
Log # TXNB-10052

Ref. # 10 CFR 52

July 16, 2010

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555
ATTN: David B. Matthews, Director
Division of New Reactor Licensing

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4
DOCKET NUMBERS 52-034 AND 52-035
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION NO. 4308, 4309, 4310, AND 4311

Dear Sir:

Luminant Generation Company LLC (Luminant) submits herein the response to Request for Additional Information (RAI) No. 4308, 4309, 4310, and 4311 for the Combined License Application (COLA) for Comanche Peak Nuclear Power Plant Units 3 and 4. RAI No. 4309 and 4310 involve flooding, while RAI No. 4308 involves surface hydrology and RAI No. 4311 involves potential dam failures. The attachments and marked-up COLA pages referenced in the response are included on the enclosed CD sorted by RAI number.

Should you have any questions regarding these responses, please contact Don Woodlan (254-897-6887, Donald.Woodlan@luminant.com) or me.

There are no commitments in this letter.

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

Executed on July 16, 2010.

Sincerely,

Luminant Generation Company LLC

Donald R. Woodlan for

Rafael Flores

Attachments:
1. Response to Request for Additional Information No. 4308 (CP RAI #138)
2. Response to Request for Additional Information No. 4309 (CP RAI #139)
3. Response to Request for Additional Information No. 4310 (CP RAI #143)
4. Response to Request for Additional Information No. 4311 (CP RAI #140)
5. Electronic Files Included on the Enclosed CD

D090
NRO

cc: Stephen Monarque w/CD

Electronic distribution w/o CD

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Attachment 1

Response to Request for Additional Information No. 4308 (CP RAI #138)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4308 (CP RAI #138)

SRP SECTION: 02.04.01 - Hydrologic Description

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/18/2010

QUESTION NO.: 02.04.01-6

NUREG-0800, Standard Review Plan (SRP), Section 2.4.1, 'Hydrologic Description,' establishes criteria that Staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

By letter dated October 1, 2009, the NRC staff issued RAI 3663 (RAI 101) Question No. 14240 (02.04.01-1), where the applicant was asked "provide a description of the process followed to determine how the proposed plant interfaces with the hydrosphere, including determinations of the hydrologic causal mechanisms that may require special plant design basis, current and future surface water uses by Comanche Peak Nuclear Power Plant (CPNPP), Units 3 and 4 and other users, conceptual models used to establish bounding hydrologic conditions, and conceptual models used to quantify uncertainty in hydrological processes and conditions at the site. "

The applicant responded in document CP-200901564-Log No TXNB-09067 (ML093230705), dated November 13, 2009. In its response, the applicant stated that it had interpreted the NRC staff's remarks during an October 16, 2009 conference call to mean that the staff was not interested in the applicant's "plan or approach" to the determination of hydrosphere-plant interface or hydrologic causal mechanisms. Additionally, the applicant stated that during this conference call the NRC staff did not request a summary of the applicant's administrative approach or plan.

The NRC staff reviewed the Comanche Peak Updated Tracking Report, Revision 4 of the FSAR, dated September 2, 2009 and referenced in the applicant's response. The NRC staff determined that the applicant has provided additional detail and descriptions of basin hydrology and geomorphology. The staff noted that the quantitative hydrologic data and information are sufficient, but still lack the conceptual and logical linkage necessary to make safety determination. It is the organization of this information and data, with the addition of conceptual model and causal mechanism definitions, into a concise and sequenced scoping discussion that are absent in the FSAR and needed to satisfy the requirements stipulated in this RAI.

In order to make its safety determination, the NRC staff requests a description that provides assurance that the process followed to determine the interaction of the proposed plant with the hydrosphere and hydrologic causal mechanisms was captured in a conceptual and logical analysis, and that the applicant had acquired a clear understanding of the processes involved. This description of process and analysis should include, a hydrologic description for the proposed CPNPP Units 3 and 4, a clear presentation of a conceptual model for Brazos basin hydrology (which incorporates water balance and throughput), the causal mechanisms for water quantity and quality within the basin that may have impact on the performance of the proposed plant, description and analysis of the potential impacts of those causal mechanism on the safety of the proposed units and site, and criteria for limiting the temporal, spatial, and causal mechanism scope of the hydrologic safety analysis.

This is supplemental RAI 2.4.1-00-S.

ANSWER:

FSAR Subsection 2.4.1 provides all data and descriptions required by both RG 1.206 and NUREG-800 regarding the hydrologic description of the surface and groundwater hydrologic settings. The question posed by the NRC is broken down below to provide clarity to the individual portions of this question.

1. "a hydrologic description for the proposed CPNPP Units 3 and 4"

   The hydrologic setting where CPNPP Units 3 and 4 are located in relation to the hydrologic systems is discussed in detail in several places within FSAR Subsection 2.4.1. The watershed basin in which the site (Middle-Brazos Lake Whitney watershed) and its cooling water intake/discharge structures (Middle-Brazos Palo Pinto watershed) are located is included in FSAR Subsection 2.1.4.2 with reservoir details, including reservoir yield and historic operations discussed in FSAR Subsections 2.4.1.2.1 and 2.4.1.2.2.

   Additional clarifications of the individual reservoirs affecting the potential for flooding at the site are discussed below.

2. "a clear presentation of a conceptual model for Brazos basin hydrology (which incorporates water balance and throughput)"

   The Brazos River Basin is an extremely large system (45,700 sq mi) with a large variation of hydrologic conditions throughout its drainage system. The hydrology that could affect, or is affected by, the addition of CPNPP Units 3 and 4, is confined to smaller watersheds within the Brazos River Basin. Therefore, a conceptual model of the entire Brazos River Basin would be extremely complex and of limited usefulness. Discussions of the various watersheds within the Brazos River Basin related to flooding considerations have been added to FSAR Subsection 2.4.1.2.

   With regard to water supply, the location of the site and the cooling water intake/outfall would be considered to be the watersheds that could be affected by, or would have an effect on the site. CPNPP Units 3 and 4 are located on Squaw Creek Reservoir (SCR), which is part of the Middle-Brazos Lake Whitney watershed and discussed in detail in FSAR Subsection 2.4.1.2.2. The cooling water intake and discharge structures are located on Lake Granbury, part of the Middle-Brazos Palo Pinto watershed and discussed in FSAR Subsection 2.4.1.2.1. Details included for SCR and Lake Granbury include reservoir yields for the years 2000 through 2060. The reservoir yields are broken down into both "Firm Yield" and "Safe Yield" amounts as defined in FSAR Subsection 2.4.1.2. These yield amounts are stated in FSAR Subsections 2.4.1.2.1 and 2.4.1.2.2 and would be an equivalent, conservative estimate of basin/watershed throughput in the areas affecting, or affected by, operations of CPNPP Units 3 and 4.

   Using a qualitative analysis approach based on a comparison of distance from the Brazos River and the Paluxy confluence, storage capacity, dam height, and drainage area along with the assumption of transposition of resulting dam failure effects without attenuation, it was determined that the controlling dam failure scenario would include domino-failure of Morris Sheppard Dam and De Cordova Bend Dam. Upstream of Morris Sheppard Dam, the significant dams are located on individual tributaries. Using the qualitative approach, Hubbard Creek Dam was determined to be the controlling dam failure scenario upstream of Morris Sheppard Dam. However, considering future conditions, the domino-failure of Fort Phantom Hill Dam and the proposed Cedar Ridge Reservoir Dam, along with the simultaneous failure of Lake Stamford Dam, was determined to be the controlling dam failure scenario upstream of Morris Sheppard Dam. By quantitative analysis, it was determined that future conditions provide the controlling dam failure scenario. A complete description of the qualitative and quantitative analyses is provided in FSAR Subsection 2.4.4.

3. "the causal mechanisms for water quantity and quality within the basin that may have impact on the performance of the proposed plant"

   Water quantity and quality may have an impact on performance of the proposed plant; however, FSAR Subsection 2.4.1 is concerned with elements of the hydrosphere which have an effect on the safety of the plant and the public. Discussions addressing safety-related flooding at the site have been added to FSAR Subsections 2.4.1.1, 2.4.1.2, and 2.4.1.2.2. Discussions of the various watersheds within the Brazos River Basin related to flooding considerations have been added to FSAR Subsection 2.4.1.2.

   Water quantity descriptions are discussed in FSAR Subsection 2.4.1.2.4 and listed in FSAR Tables 2.4-206 through 2.4-208.

   The causal mechanisms considered for flooding are precipitation, dam failures, ice effects, and flooding generated from the Gulf of Mexico. Precipitation flooding for the watershed above the site is evaluated in FSAR Subsection 2.4.4. Dam failure flooding is also considered in the evaluation for existing and future conditions. Dam failures are considered coincident with probable maximum flooding to maximize the effects of precipitation and dam failures combined. In addition, coincident wind wave activity is included to maximize resulting flood levels. Flooding from ice effects are considered in FSAR Subsection 2.4.7. Ocean surge and tsunami from the Gulf of Mexico are considered in FSAR Subsections 2.4.5 and 2.4.6.

   Surface and groundwater quality is discussed in detail in Environmental Report Subsection 2.3.3. Reference to the overall poor quality of the surface water (slightly saline) in the vicinity of the proposed plant and plant support systems (cooling water) is mentioned in FSAR Subsection 2.4.1.2.4. Additionally, FSAR Subsection 2.4.11.1 states "... there are no safety-related facilities that could be affected by low-flow or drought conditions, since the UHS does not rely on the rivers and streams as a source of water;" therefore, the quantity and quality of water available for plant operations and performance is independent of the safety-related requirements of the proposed plant.

4. "description and analysis of the potential impacts of those causal mechanism on the safety of the proposed units and site"

   No surface water use or mechanism, other than those described in the flooding portions of FSAR, have the potential to adversely affect the safety of the proposed plant. Discussions of causal mechanisms for flooding have been added to FSAR Subsections 2.4.1.1, 2.4.1.2, and 2.4.1.2.2, and are described in detail in FSAR Subsections 2.4.2 through 2.4.10.

   As stated in FSAR Subsection 2.4.1.2.3.2; "There is no safety-related equipment in the Circulating Water System, nor does loss of its normal operating capability adversely affect any safety-related components."

5. "criteria for limiting the temporal, spatial, and causal mechanism scope of the hydrologic safety analysis"

   Discussions addressing the process for limiting the scope of the safety analysis (flooding portions) have been added to FSAR Subsections 2.4.1.1, 2.4.1.2, and 2.4.1.2.2. The only hydrologic mechanism considered to have a potential affect on the safety-related features of the proposed plant is flooding, which is described in the added discussions to FSAR Subsections 2.4.1.1, 2.4.1.2, and 2.4.1.2.2. Groundwater will be discussed in the response to RAI No.4314 (CP RAI #147)

Reference

Brazos River Authority, The Texas Clean Rivers Program 2009 Basin Highlights Report, Website, http://www.brazos.org/crpHistoricalReports.asp, accessed May 26, 2010.

Attachment

TXUT-001-FSAR-2.4.4-CALC-015 Rev 1, Brazos River Dam Failures Analysis for Comanche Peak Nuclear Power Plant Units 3 and 4 (on CD).

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.4-3, 2.4-4, 2.4-5, 2.4-6, 2.4-7, 2.4-12, and 2.4-83 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4308 (CP RAI #138)

SRP SECTION: 02.04.01 - Hydrologic Description

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/18/2010

QUESTION NO.: 02.04.01-7

NUREG-0800, Standard Review Plan (SRP), Section 2.4.1, Hydrologic Description,' establishes criteria that Staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

By letter dated October 1, 2009, the NRC staff issued RAI 3663 (RAI 101) Question Number 14244 (02.04.01-5), where the applicant was asked "Provide a description of all existing and proposed reservoirs within the Brazos River Basin and discuss their significance in terms of the design basis flood analysis."

The applicant responded in document CP-200901564-Log No TXNB-09067 (ML093230705), dated November 13, 2009, indicating that the metric used to classify existing reservoirs for inclusion were the distance from the Brazos-Paluxy confluence and storage volume. The response noted that the proposed South Bend Reservoir would have more than twice the storage of the Hubbard Creek Dam and be closer to the Brazos-Paluxy confluence than existing reservoirs included in the dam break analysis. The applicant, in its response, cited water quality issues, permitting challenges and the omission of the project from Brazos G water planning as reasons for omitting the South Bend project from the dam break analysis.

The NRC staff noted that water needs, permitting challenges, and likelihood of development are all subject to change, given the potential serious impact that development of the South Bend project would have on the flooding scenario.

The NRC staff also noted that the two water storage reservoir metrics (distance form the Brazos-Paluxy confluence and storage volume) are not inherent indicators of the impact of dam failure on the safety of the plant site.

In order to make its safety determination, the NRC staff requests the following information.

1. The applicant revise the dam break analysis to include failure of a dam impounding the South Bend reservoir.

2. The FSAR should include description of how (meaning the physical mechanisms) water storage reservoir metrics impact plant safety from flooding and how the quantitative thresholds for the

metrics (for example, greater than 150 miles upstream or greater than 100,00 acre-feet of storage) establish the analysis as bounding conservative in terms of the design basis flood.

This is supplemental RAI 2.4.1-04-S.

ANSWER:

1. During a public conference call on April 20, 2010, representatives from the Brazos River Authority of Texas described their characterization of the potential source of surface water known as South Bend Reservoir. In the 1940's and 1950's, Texas authorities assessed the potential sources for surface water in the state of Texas, including the Brazos River and the rivers and streams that feed the Brazos. Numerous potential sites were identified, including the potential site referred to as South Bend Reservoir. These potential sites were identified to assess the potential sources for surface water in the Brazos River Basin. While the potential site called the South Bend Reservoir has been identified for over 60 years, no design work has been performed; no budgets have been allotted to start the design, procure the necessary property or execute any type of construction activity; and no other development work has begun. In Texas, plans to develop water projects are updated every five years and the current plan is through the year 2060. The current plans identify no intentions or actions to develop the potential site known as South Bend Reservoir.

   As such, the potential site known as South Bend Reservoir is not a proposed reservoir and per NRC RG 1.206, only actual or proposed features need to be included in the dam break analysis. FSAR Subsections 2.4.1 and 2.4.4 have been revised to clarify this point. The dam break analysis (TXUT-001-FSAR-2.4.4-CALC-015) has been revised to address other issues identified by the NRC, but does not include the potential site known as South Bend Reservoir. The revised analysis was attached to the response to Question 02.04.01-6 above.

2. The qualitative dam failure analysis is performed based on a comparison of the distance from the confluence of the Brazos and the Paluxy Rivers, storage capacity, dam height, and drainage area for the dam in the Brazos River watershed. Domino-type failures and simultaneous failures are postulated when applicable. Dam failures are assumed coincident with the PMF. The qualitative analysis considers both existing and future conditions.

   Because the qualitative analysis compares the metrics for the dams directly to each other to determine a controlling scenario, there are no specific thresholds for the metrics. Under the assumption that dam failure effects are transposed downstream without attenuation, it was determined that the controlling dam failure scenario for existing conditions is the domino-type dam failure of Hubbard Creek Dam, Morris Sheppard Dam, and De Cordova Bend Dam. The controlling dam failure scenario for future conditions was determined to be the domino-type failure of Fort Phantom Hill Dam, the proposed Cedar Ridge Reservoir Dam, Morris Sheppard Dam, and De Cordova Bend Dam. In addition, Lake Stamford Dam was assumed to fail simultaneously with the proposed Cedar Ridge Reservoir Dam. No qualitative distinction could be made between the two potential scenarios. Quantitative analysis was performed for both potential scenarios to determine that the potential dam failure scenario for future conditions is the controlling scenario.

   A detailed description of the qualitative analysis is provided in the response to RAI No. 4311 (CP RAI #140) Question 02.04.04-5. The quantitative dam failure analysis incorporating the outcome from the qualitative analysis has been revised to address inclusion of wind setup and is discussed in the response to CP RAI #140 Question 02.04.04-6. Additionally, the quantitative analysis has been revised to address the antecedent reservoir elevation and is discussed along with the combined effects from upstream dam failures in the response to CP RAI #140 Question 02.04.04-7.

Reference

TXUT-001-FSAR-2.4.4-CALC-015, Brazos River Dam Failures Analysis for Comanche Peak Nuclear Power Plant Units 3 and 4, Revision 1.

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.4-8 and 2.4-9 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

Attachment 2

Response to Request for Additional Information No. 4309 (CP RAI #139)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4309 (CP RAI #139)

SRP SECTION: 02.04.02 - Floods

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/18/2010

QUESTION NO.: 02.04.02-2

NUREG-0800, Standard Review Plan, Section 2.4.2, 'Floods,' establishes criteria that Staff intends to use to evaluate whether an applicant meets the NRC's regulations.

By letter dated October 1, 2009, the NRC staff issued RAI ID 3664 (RAI 102) Question Number 14245 (02.04.02-1), in which the NRC staff asked "In order to determine the safety of structures, systems, and components (SSCs) with respect to floods, Luminant is requested to state explicitly in the COL FSAR the water surface elevation and associated flow rate for the design basis flood (DBF) at the site, and describe all assumptions used in determining the DBF from the flooding scenarios detailed in FSAR Sections 2.4.3 through 2.4.9. Provide a rationale and describe the process used to determine that the stated DBF is bounding conservative, with respect to all permutations of stream, local precipitation, dam failure scenarios, tsunami, surge, seiche, and wind/wave coincidence."

The applicant responded in document CP-200901564-Log No TXNB-09067-(ML093230704) executed on November 13, 2009. the NRC staff has reviewed this response and the revisions included in FSAR Updated Tracking Report No. 4 referenced in the response, and has determined that additional information is needed in order to complete its review.

The NRC staff determined that the applicant has clarified the design basis flood elevations and causal mechanisms for the scenario that the applicant included in the safety analysis. However, the applicant has not explained in its response why this scenario, with its multiple simplifying assumptions, computations, and omission of existing and proposed upstream reservoirs, is bounding conservative with respect to all other scenarios. As an example, the Staff noted that the water elevation below Squaw Creek Dam is computed using an equation for uniform flow at the Brazos-Paluxy confluence, but there is no explanation of why this assumption of uniform flow is bounding and conservative. Other assumptions include the absence of wind setup on reservoirs included in the domino failure scenario, the selection a constant loss rate for infiltration rate in watershed runoff modeling, and dismissal of the possibility of surge and seiche flooding in the analysis. While the likelihood of these factors contributing to a design-basis flood is addressed in other RAIs (and remains unresolved after the NRC staff's review of the RAI responses), the argument for the conservative and bounding nature of the applicant's scenario incorporating all of these assumptions and computations needs to be proffered in FSAR Section 2.4.2.

In order to make its safety determinations, the NRC staff requests the applicant provide a clear description and justification of the conservatism and incorporation of the unaccounted for parameters and factors in the analysis for the determination of design basis flood.

This is supplemental RAI 2.4.2-00-S.

ANSWER:

The argument for the conservative and bounding nature of the probable maximum flood (PMF) analysis has been added to FSAR Subsections 2.4.2.2 and 2.4.2.3. The conservative nature of the approach to the analyses of the effects of local intense precipitation, Squaw Creek Reservoir (SCR) flooding, Brazos River flooding, and coincident wind wave activity are discussed.

The analysis of the effects of local intense precipitation has been revised to account for the increased PMF elevation at SCR as described in the response to RAI No. 4310 (CP RAI #143) Question 02.04.03-5. In addition, the weir discharge coefficient used in the analysis has been reduced to reflect a more conservative approach.

Attachment

TXUT-001-FSAR-2.4.2-CALC-020, Rev 3, Analysis of the Effects of Local Intense Precipitation at the Comanche Peak Nuclear Power Plant Units 3 and 4 (on CD)

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.0-10, 2.4-15, 2.4-16, 2.4-17, 2.4-19, 2.4-20, 2.4-21, and 2.4-111 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

Attachment 3

Response to Request for Additional Information No. 4310 (CP RAI #143)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-5

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that the NRC staff intends to use to evaluate whether an applicant meets the NRC's regulations.

On October 1, 2009, the NRC staff issued RAI ID 3665 (RAI Number 105) Question Number 14246 (02.04.03-1), in which the NRC staff asked "Provide a description of the process used to determine that the probable maximum flood (PMF) analysis for streams and rivers is the most conservative of all plausible conceptual models. This description needs to consider the parameter selections and assumptions made in watershed probable maximum precipitation (PMP) estimation, watershed runoff modeling, channel routing and runoff accumulation modeling, and local site drainage and runoff modeling."

The applicant responded in document CP-200901564-Log No TXNB-09067-(ML093230704) executed on November 13, 2009. The NRC staff has reviewed the response the combined license application (COL) FSAR changes documented in FSAR Updated Tracking Report (UTR) No. 4 and referenced in the applicant's response, and has determined that additional information is needed to complete the NRC staff's review.

The applicant asserts, without explanation, that the conceptual models used to determine the design basis flood comply with Regulatory Guides 1.206 and 1.59. The response also asserts, without explanation, that the river and stream flooding computational methodology is consistent with American National Standards Institute / American Nuclear Society ANSI/ANS-2.8-1992. The staff noted that claims of compliance and consistency with these guidance documents alone do not ensure that the parameter selections or application of the method to specific sites produce a bounding conservative estimate of the design basis flood.

The NRC staff notes that the applicant's response that widespread use of Snyder's method or the availability of Snyder's method in HEC-HMS modeling software ensures that the use of Snyder's method produces a bounding conservative estimate of runoff is not acceptable. The applicant's response also included assertions that the chosen parameterization yielded a conservative estimate; however, this is not sufficient to show that the chosen parameterization is bounding conservative with respect to all other parameterizations.

In order to make its safety determination, the NRC staff requests the applicant revise the response and provide the technical justifications. The response should focus on the basis used to accept as bounding conservative the chain of models that translates PMP estimates to runoff estimates to Squaw Creek Reservoir spillage to design basis flood elevation. That basis should include detailed deductive statements that establish the chosen parameterizations (e.g., Snyder's unit hydrograph; a constant rather than variable loss coefficient) and the choice of parameter values (e.g., values of peaking and lag coefficients; a loss coefficient of 0.10 inch per hour rather than 0.05 inch//hour) as yielding a bounding conservative estimate for the design basis flood elevation.

This is supplemental RAI 2.4.3-00-S.

ANSWER:

The elevations provided below are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29), unless noted otherwise. The plant site grading plan is referenced to the North American Vertical Datum of 1988 (NAVD 88). According to the National Geodetic Survey, the datum shift of NAVD 88 minus NGVD 29 is equal to between 0 and +20 cm for the site. Therefore, it is conservative to account for a maximum conversion of +20 cm (0.66 ft) when comparing water surface elevations determined using NGVD 29 to elevations at the site in NAVD 88. Considering conversion, SCR water surface elevation of 793.66 ft NAVD 88 is well below the CPNPP Units 3 and 4 safety-related structures elevation of 822 ft NAVD 88.

The PMP analysis has been revised to maximize the effects of flooding for the sub basin watershed above Squaw Creek Dam. With reference to FSAR Figure 2.4.3-202, the PMP for Basin 1 has been revised using HMR 52 software to determine the maximum rainfall considering only the area of Basin 1. This is conservative because considering the smaller watershed of the basin results in higher PMP and runoff estimates to the reservoir. The critical storm center is found to be near the centroid of the Squaw Creek watershed. The critical 72-hour storm PMP rainfall total is 42.53 in. The critical storm area is 100 sq mi and the orientation is 145 degrees. The critical temporal distribution is determined to be a two-thirds peaking arrangement.

For the portion of the Squaw Creek watershed below the Squaw Creek Dam, Basin 2, the PMP has not changed. For the Paluxy River watershed, Basin 3 and Basin 4, the PMP has not changed. However, the critical temporal distribution of the 72-hour rainfall has been revised to be a center peaking arrangement. It is conservative to include additional flooding for the Squaw Creek watershed below the Squaw Creek Dam and for the Paluxy River, because maximized PMP for the Squaw Creek watershed above Squaw Creek Dam would not occur coincidentally with maximized PMP for the overall Squaw Creek and Paluxy River watershed. The inclusion of downstream flooding maximizes the potential for effects of a high tailwater at the Squaw Creek Dam.

The PMP storm is preceded with an antecedent storm equal to 40 percent of the PMP and a three-day dry period. The PMF analysis using HEC-HMS software has been revised to assume no precipitation losses occur. In addition to the assumption of no initial losses, the PMF analysis has been revised to assume no losses occur for the duration of the modeled events. This includes both the antecedent storm and the PMP storm. This is a conservative assumption in that all rainfall is transformed to runoff.

The Snyder's unit hydrograph method, based on the guidance provided in Hydrology and Flood Plain Analysis, remains the chosen method for the PMF analysis to transform rainfall to runoff.

$Q_p = 640C_p\, A/t_p$

where:

Q_p = peak discharge of the unit hydrograph (cfs)
C_p = Peaking coefficient ranging from 0.4 to 0.8.
A = Drainage area (sq mi)
t_p = Basin Lag (hr)

The lag time for Snyder's method is defined as $t_p = C_t\, (LL_{ca})^{0.3}$

where:

C_t = coefficient usually ranging from 1.8 to 2.2 (C_t has found to vary from 0.4 in mountainous areas to 8.0 along the Gulf of Mexico)
L = Length of the main stream from the outlet to divide (mi)
L_{ca} = Length along the main stream to a point nearest the watershed centroid (mi)

However, to provide a conservative estimate of the watershed unit hydrographs, the effects of nonlinear basin response are considered by increasing the peak of the unit hydrograph by 20 percent, based on guidance in the Handbook of Hydrology.

The physically measureable parameters of the Snyder's unit hydrograph are based on the existing study. The basin areas are confirmed using USGS quadrangle topography. The length of the main stream and length along the stream to a point nearest the watershed centroid are calculated and compared to the parameters from the existing study. The smaller value is used for the PMF analysis. Using a shorter length is conservative, because it maximizes the unit hydrograph peak runoff.

The largest peaking coefficient, C_p = 0.8, and the smallest lag time coefficient, C_t = 0.4, are used to generated the unit hydrograph. The largest peaking coefficient and the smallest lag time coefficient are conservative because they maximize the unit hydrograph peak runoff.

The shape of the unit hydrograph for each sub basin is determined using the methods in Hydrology and Flood Plain Analysis and the calculated or selected conservative parameters. The peak of each unit hydrograph is increased by 20 percent. The ordinates of each unit hydrograph are then adjusted to maintain the unit hydrograph characteristic of 1 in of runoff.

Base flow has been revised as discussed in the response to Question 02.04.03-10 below to account for the highest average monthly flow of 46 cfs. Based on the guidance of ANSI/ANS-2.8-1992, it is appropriate to use the average monthly flow. The estimate is conservative because the largest average monthly flow is selected.

The revised stage-storage-discharge relationship for SCR is discussed and presented in the response to Question 02.04.03-6 below. The revised stage-storage-discharge relationship utilizes conservative coefficients and assumes the water surface elevation on the downstream face of the Squaw Creek Dam submerges the service spillway crest by 1 ft. This is a conservative assumption because the revised backwater analysis indicates the tailwater would be below the crest of the service spillway.

The backwater analysis is revised incorporating the water surface elevation at the confluence of the Brazos River and Paluxy River. As discussed in the response to RAI No. 4311 (CP RAI #140) Question 02.04.04-7, the water surface elevation at the confluence is 760.05 ft, and is based on the inclusion of the transposed dam failure analysis flow and the peak flows from the flow hydrographs for each basin in the

HEC-HMS model. This is a conservative approach by assuming multiple PMF events occur coincidentally with all peak flows combined.

The backwater analysis is performed using unsteady state conditions and the complete flow hydrographs for each basin in the HEC-HMS model along with a constant elevation hydrograph for the confluence at the Brazos River. The maximum tailwater on the downstream face of the dam is determined to be 760.39 ft. The tailwater elevation is well below the service spillway crest elevation of 775 ft. and the emergency spillway crest elevation of 783 ft.

The PMF analysis using HEC-HMS software is revised to account for the revised precipitation, the revised precipitation loss characteristics, the revised unit hydrographs, the revised baseflow, and the revised stage-storage-discharge relationship, as previously discussed. The resulting peak inflow to SCR is 319,000 cfs. The routed peak discharge from SCR is 206,000 cfs. The resulting water surface elevation is 793.00 ft.

The maximum backwater flow from the HEC-RAS unsteady state model at the downstream face of Squaw Creek Dam is 100,440 cfs. As previously discussed, the downstream conditions do not affect SCR water surface elevation.

Revisions to the coincident wind wave activity analysis are discussed in the response to Question 02.04.03-11 below.

<u>References</u>

U.S. Army Corps of Engineers, Hydrologic Engineering Center, Generalized Computer Program, HMR52, Probable Maximum Storm, Revised April 1991.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, Hydrologic Modeling System, HEC-HMS computer software, Version 3.4.

Bedient P.B., Huber W.C., "Hydrology and Flood Plain Analysis, Third Edition", Prentice Hall Upper Saddle River, NJ07458, 2002.

Maidment, D.R., "Handbook of Hydrology," McGraw-Hill, 1993.

Texas Utilities Services Inc., Comanche Peak Stream Electric Station CPSES 1980-1982, Units 1 and 2, "Safe Shutdown Impoundment Dam, Design Calculations and Calculations Check", Volume 1, by Freese and Nichols.

Texas Utilities Services Inc., Comanche Peak Stream Electric Station CPSES 1980-1982, Units 1 and 2, "Safe Shutdown Impoundment Dam, Design Calculations and Calculations Check", Volume 2, by Freese and Nichols.

U.S. Geological Survey, Geospatial Data Gateway Website, http://datagateway.nrcs.usda.gov/gatewayhome.html, accessed December 27, 2007.

American Nuclear Society, "American National Standard for Determining Design Basis Flooding at Power Reactor Sites," ANSI/ANS-2.8-1992, July 28, 1992.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, River Analysis System, HEC-RAS computer software, Version 3.1.3.

Chow, V.T., "Open Channel Hydraulics", McGraw-Hill Inc., New York, 1959.

National Geodetic Survey, Website, http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html, accessed May 2010.

Attachments

TXUT-001-FSAR-2.4.3-CALC-011 Rev 2, Probable Maximum Precipitation Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 Using HMR 51 & MNR 52 (on CD).

TXUT-001-FSAR-2.4.3-CALC-012 Rev 2, Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS) (on CD).

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.0-10, 2.4-25, 2.4-26, 2.4-27, 2.4-28, 2.4-29, 2.4-30, 2.4-31, 2.4-32, 2.4-107, 2.4-137, 2.4-138, 2.4-139, 2.4-141, 2.4-142, 2.4-143, 2.4-144, 2.4-145, 2.4-146, 2.4-147, 2.4-148, and Figures 2.4.3-203, 2.4.3-204, 2.4.3-206, 2.4.3-207, 2.4.8-208, 2.4.3-211, 2.4.3-212, 2.4.3-213, 2.4.8-214, 2.4.3-215, 2.4.3-216, 2.4.8-217, and 2.4.3-218 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-6

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that the NRC staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

By letter dated October 1, 2009, the NRC staff issued RAI ID 3665 (RAI Number 105) Question Number 14248 (02.04.03-3), in which the NRC staff asked "Provide a rationale for assumptions made in the modeling of instream flooding and drainage for computation of the PMF on rivers and streams affecting the site. Provide documentation and electronic versions of input files for all computer models used to compute the river and stream flooding."

The applicant responded in document CP-200901564-Log No TXNB-09067- (ML093230704) executed on November 13, 2009. The applicant directed the NRC staff to the applicant's response to RAI ID 3665 (RAI Number 105). The NRC staff has reviewed this RAI response and has determined that additional information is needed for the staff to complete its review. The applicant's response to this RAI also referred the staff to Calculation "MITS004 - Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)", Revision 1 and the input and output (I/O) files (FlowMaster) that were submitted previously, as part of July 2009 Hydrology Safety Site Audit Information Need HYDSV-07, via Luminant letter TXNB-09037, dated September 2, 2009. Refer to NRC staff's 'Hydrology Site Safety Audit Report of the Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application,' dated December 3, 2009. This supplemental RAI question results from the staff's examination of that calculation package and from examination of calculation package TXUT-001-FSAR 2.4.3-CALC-012.

The staff noted that the Squaw Creek Dam discharge rating relationships referenced in the FSAR and in TXUT-001-FSAR 2.4.3-CALC-012 are important determinants of the design basis flood elevation reported by the applicant because they model the ability of Squaw Creek Dam to pass PMF flows from Squaw Creek watershed.

Accordingly, the NRC staff requests that the applicant provide:

1. A description of how the Squaw Creek Dam discharge ratings (Tables 7-8 and 7-9 of TXUT-001-FSAR 2.4.3-CALC-012) were developed.

2. References 13 and 14 of TXUT-001-FSAR 2.4.3-CALC-012 for NRC staff review, as well as detailed as-built specifications of dam and spillway geometry for confirmatory analysis by Staff.

This is supplemental RAI 2.4.3-03-S-a.

ANSWER:

The Squaw Creek Dam discharge ratings (Tables 7-8 and 7-9 of TXUT-001-FSAR-2.4.3-CALC-012) were developed using the data supplied by the volumetric survey conducted in 1997 and the Operation and Maintenance Procedures to establish the stage storage relationship. The volumetric survey was utilized for data up to and including elevation 775 ft. The Operation and Maintenance Procedures were utilized for data above elevation 775 ft. The stage discharge relationships from the service spillway and emergency spillway were determined using the Operation and Maintenance Procedures up to and including elevation 790 ft. The corresponding storage at each stage elevation was then used to develop a storage discharge relationship.

The volumetric survey indicates a hydrographic survey was performed using GPS for horizontal location and a depth sounder for vertical information. Volumes were then computer solved at one-tenth foot intervals using digital terrain modeling and a triangulated irregular network model. The Operation and Maintenance Procedures indicate the volume is based on sedimentation survey ranges established pursuant to the requirements of the Texas Water Rights Commission, May 1977.

Supplemental hydraulic design notes for the spillways indicate the service spillway rating curve was developed using the physical and hydraulic properties of the ogee crest in accordance with the guidance of the U.S. Army Corps of Engineers publication EM 1110-2-1603. The emergency spillway rating curve was developed using a backwater computer program and accounted for the downstream channel characteristics.

The calculation has been revised to reflect the most recent available volumetric survey conducted in 2007. Therefore, the revised calculation utilizes the 2008 Volumetric Survey for the stage storage relationship up to and including elevation 775 ft. The Operation and Maintenance Procedures are utilized for data above elevation 775 ft. The 2008 Volumetric Survey utilized the same methodology as the previous volumetric survey to perform the updated hydrographic survey. The revised stage storage relationship is tabulated below.

Revised SCR Stage Storage Relationship

Elevation (ft)	Storage (ac-ft)
775	151,273
776	154,243
777	157,562
778	160,903
779	164,270
780	167,665
781	171,093
782	174,560
783	178,072
784	181,628
785	185,229
786	188,877
787	192,574
788	196,321
789	200,119
790	203,967
791	207,867
792	211,818
793	215,821
794	219,875
795	223,980

In addition, the calculation has been revised to reflect new spillway discharge rating curves utilizing the methods of the U.S. Bureau of Reclamation Design of Small Dams for the service spillway with an ogee crest and the methods of the Federal Highway Administration Hydraulic Design Series Number 5 for the emergency spillway. The reconstituted spillway discharge rating curves are more conservative than those previously used and account for submergence due to assumed tailwater effects.

For the 100-ft wide service spillway with an ogee crest elevation of 775 ft, a design head of 25 ft, or elevation 800 ft, was selected. This is more conservative than the recorded design head of approximately 15 ft. Based on the record drawing approach height for the spillway of 12 ft, the ogee crest discharge coefficient is determined to be 3.78. Accounting for the depth of overtopping flow up to elevation 795 ft, the ogee crest discharge coefficient is reduced to range from 3.02 to 3.67 for an overtopping depth from 1 ft to 20 ft. Because the ogee crest has a 45 degree sloping upstream face, the ogee crest discharge coefficient is increased to range from 3.06 to 3.71.

It is assumed that the ogee crest is submerged 1 ft by the tailwater flooding up to elevation 776 ft. Therefore, the ogee crest discharge coefficient is reduced to account for submergence. The ogee crest discharge coefficient is reduced to range from 0 to 3.71 for an overtopping depth from 1 ft to 20 ft. Submergence effects cease as the depth of overtopping flow approaches 4 ft. The resulting service spillway ogee crest stage discharge relationship and discharge coefficient are tabulated below.

Revised Service Spillway Stage Discharge Relationship

Elevation (ft)	Overtopping Depth (ft)	Discharge Coefficient	Discharge (cfs)
775	0	0	0
776	1	0	0
777	2	3.12	883
778	3	3.16	1,640
779	4	3.22	2,574
780	5	3.27	3,661
781	6	3.31	4,868
782	7	3.35	6,206
783	8	3.37	7,625
784	9	3.41	9,202
785	10	3.45	10,898
786	11	3.48	12,713
787	12	3.52	14,613
788	13	3.54	16,602
789	14	3.56	18,655
790	15	3.60	20,911
791	16	3.63	23,233
792	17	3.66	25,632
793	18	3.67	28,044
794	19	3.70	30,603
795	20	3.71	33,222

The revised backwater analysis as discussed in the response to Question 02.04.03-5 above determined that the water surface elevation on the downstream face of the Squaw Creek Dam would reach elevation 760.39 ft. This elevation is below the ogee crest spillway, indicating no submergence due to tailwater effects would occur. However, the conservative assumption that the spillway crest is submerged is retained for the PMF analysis.

The record drawings identify the emergency spillway is 2,200 ft long, 50 ft wide, and has a concrete cap on the crest at elevation 783 ft. Although the emergency spillway crest is not affected by the tailwater at elevation, submergence is accounted for based on the effects of flow in the channel immediately downstream from the spillway. Up to and including elevation 790 ft, the discharge coefficient is determined to range from 2.91 to 2.92.

According to supplemental hydraulic design notes for the spillways, the downstream channel depth of flow varies from 100 percent to 90 percent of the overtopping headwater depth. Using these ratios, submergence factors reduce the discharge coefficient to range from 1.46 to 2.60. However, using this range of discharge coefficients exceeds the published flows at the higher elevations. Therefore, the submergence factors were recalculated to generate flows that are more conservative than those presented in the Operations and Maintenance Procedures. The resulting discharge coefficients range from 1.46 to 2.54.

Above elevation 790 ft to elevation 795 ft, it is feasible that the discharge coefficient could be up to 3.09, before adjustment using the submergence factor. However, a more conservative approach is used that results in a discharge coefficient up to 2.93. Applying the submergence factor used at elevation 790 ft results in discharge coefficients up to 2.55. This is conservative because the submergence factor would be expected to increase as the headwater increases, which would yield a greater discharge coefficient than selected. The resulting emergency spillway stage discharge relationship, submergence factor, and discharge coefficient are tabulated below.

Revised Emergency Spillway Stage Discharge Relationship

Elevation (ft)	Overtopping Depth (ft)	Submergence Factor	Discharge Coefficient	Discharge (cfs)
783	0	0	0.00	0
784	1	0.50	1.46	3,201
785	2	0.50	1.46	9,054
786	3	0.78	2.27	25,948
787	4	0.80	2.33	40,973
788	5	0.82	2.39	58,895
789	6	0.85	2.48	80,252
790	7	0.87	2.54	103,508
791	8	0.87	2.54	126,462
792	9	0.87	2.54	150,900
793	10	0.87	2.55	177,342
794	11	0.87	2.55	204,597
795	12	0.87	2.55	233,122

The combined effects of revision to the spillway rating curves with the additional revisions made to the PMF analysis as identified in the response to RAI 143 Question 02.04.03-5 are provided in that response.

The requested Reference 13 was misidentified in TXUT-001-FSAR-2.4.3-CALC-012. The reference should have been identified as the "Volumetric Survey of Squaw Creek Reservoir," dated March 10, 2003. However, as discussed above, the calculation has been revised to reflect the most recent volumetric survey performed in December 2007 and finalized in the "Volumetric and Sedimentation Survey of Squaw Creek Reservoir," dated August, 2008. Therefore, the following reference from TXUT-001-FSAR-2.4.3-CALC-012 is attached:

> The Texas Water Development Board, "Volumetric and Sedimentation Survey of Squaw Creek Reservoir December 2007 Survey," August, 2008.

Additionally, the Texas Utilities Services, Inc. Squaw Creek Dam Project Number 2323 record drawings for the dam and spillway geometry are attached.

References

The Texas Water Development Board, "Volumetric Survey of Squaw Creek Reservoir," March 10, 2003.

Freese and Nichols, Operation and Maintenance Procedures, Squaw Creek Dam, Fort Worth, Texas, 1977 (ML100750051)

Bureau of Reclamation, "Design of Small Dams," 1987.

Federal Highway Administration, "Hydraulic Design Series Number 5, Hydraulic Design of Highway Culverts," FHWA-NHI-01-020 HDS No. 5, Second Edition, May 2005

TXUT-001-FSAR-2.4.3-CALC-012 Rev 2, Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)

Attachments

The Texas Water Development Board, "Volumetric and Sedimentation Survey of Squaw Creek Reservoir December 2007 Survey," August, 2008 (on CD)

Layout of Dam, Drawing Number FN-SCR-3, Record Drawing Date February 1978.

Centerline Profile, Drawing Number FN-SCR-4, Record Drawing Date February 1978.

Emergency Spillway Layout and Details, Drawing Number FN-SCR-5, Record Drawing Date February 1978.

Embankment Section & Details, Drawing Number FN-SCR-6, Record Drawing Date February 1978.

Spillway Plan & Profile, Drawing Number FN-SCR-14, Record Drawing Date February 1978.

Geometry, Plan & Sections Crest, Drawing Number FN-SCR-17, Record Drawing Date February 1978.

Impact on R-COLA

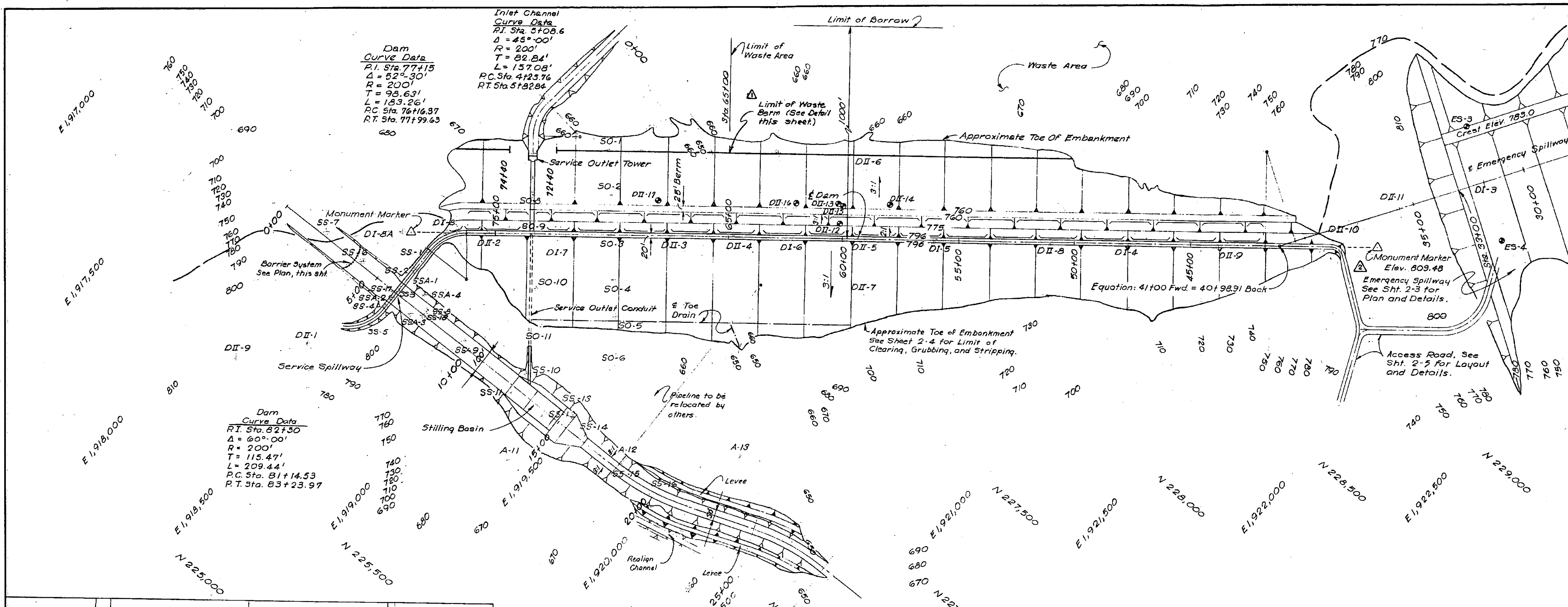
None.

Impact on S-COLA

None.

Impact on DCD

None.



Spillway Channel Curve Data No. 1
P.I. Sta. 20+00
Δ = 20°-00'
R = 1000'
T = 176.33
L = 349.07
P.C. Sta. 18+23.67
P.T. Sta. 21+72.74

Spillway Channel Curve Data No. 2
P.I. Sta. 26+50
Δ = 20°-00'
R = 1000'
T = 176.33'
L = 349.07'
P.C. Sta. 24+73.67
P.T. Sta. 28+22.74

LAYOUT OF DAM

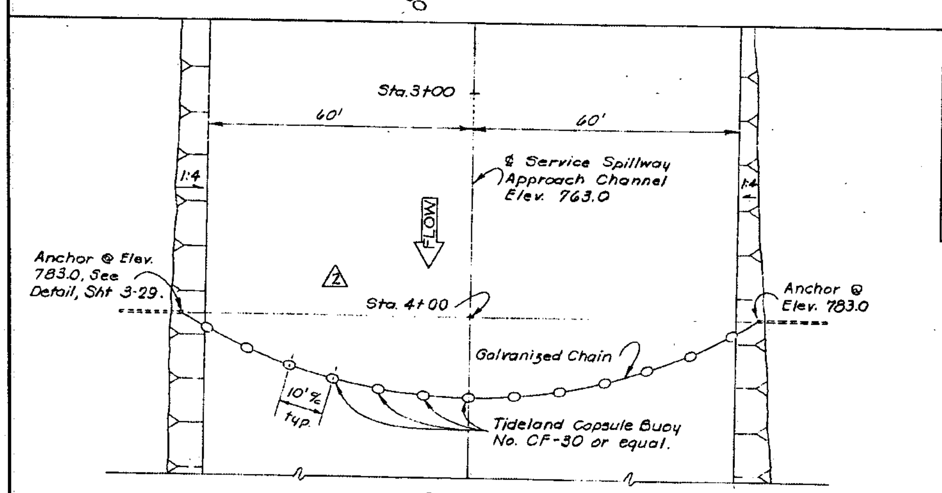
Scale: 1" = 200'

GENERAL NOTES

1. Logs of Borings are located in Section 6 of these plans.
2. Locations of Borings are indicated on each applicable sheet.
3. Source of Map Topography: Photogrammetry in December 1972 by Limbaugh Engineers, Inc., and Surveys by SEMPCO, Inc.
4. Coordinates are Lambert Grid Coordinates.
5. Stationing is along curves.
6. All curves are Arc Definition.

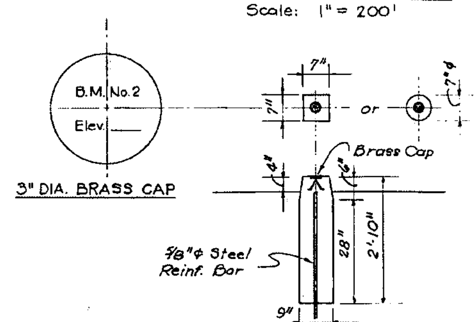
LEGEND

- Cut
- Fill
- Boring Location
- Limit of Riprap and Blanket
- Section Number
- Sheet No. Section Cut On
- Sheet No. Section Shown On (— — if shown on same sheet as cut)



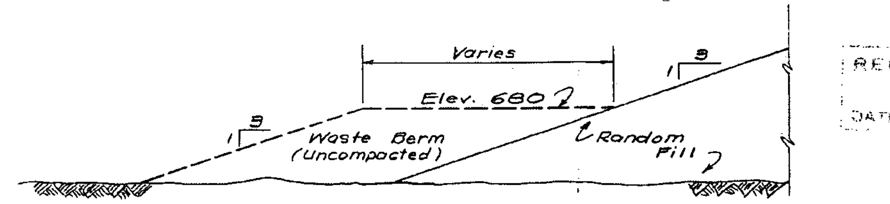
PLAN
BARRIER SYSTEM

Scale: 1" = 20'



TYPICAL CONCRETE MONUMENT MARKER

Scale: 1/2" = 1'-0"



SECTION - WASTE BERM

No Scale

RECORD DRAWING
DATE Feb. 1978

DWG. NO. FN-SCR-3

DATE	REVISION	BY
1-28-75	Limits of Waste Berm and Section.	R.A.T.
7-7-77	Record Drawing Revisions	R.A.T.

DESIGNED W.R.B. | DRAWN J.W.R. | TRACED D.B. | CHECKED

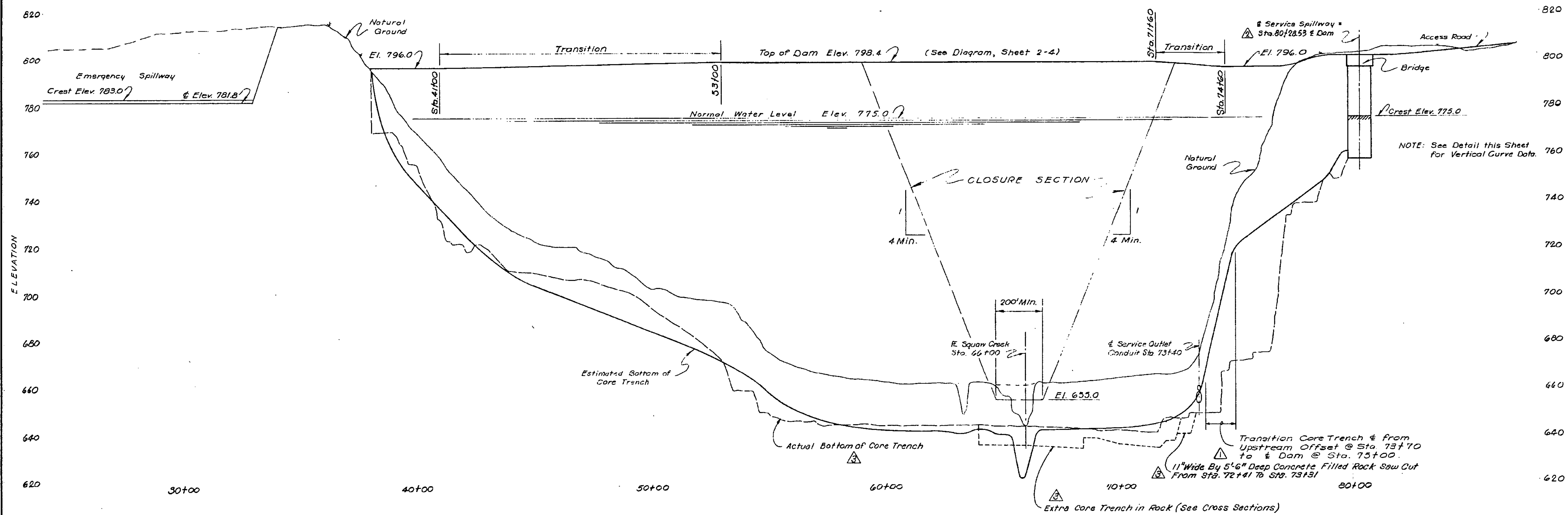
JOB NO. TEU-72120 | DATE APRIL 1974 | SCALE AS NOTED

Freese and Nichols CONSULTING ENGINEERS

TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

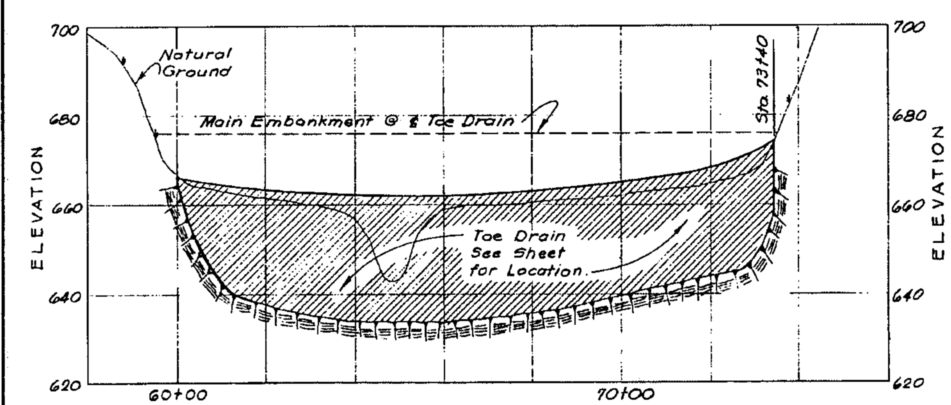
EARTH WORK
LAYOUT OF DAM

SEQ. NO. 3 | SHEET NO. 2-1 | OF SHEETS 5



CENTERLINE PROFILE

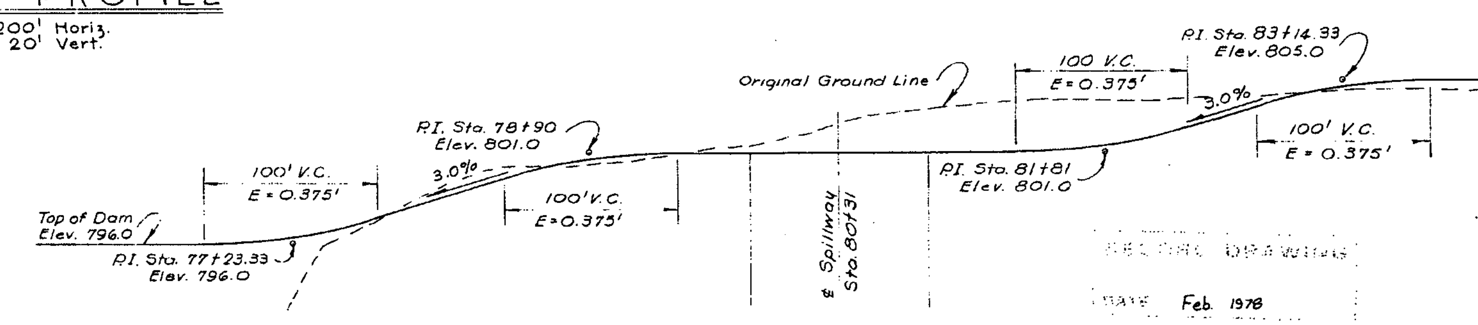
Scale: 1" = 200' Horiz. 1" = 20' Vert.



PROFILE ALONG ℄ TOE DRAIN

Scale: 1" = 200' Horiz. 1" = 20' Vert.

⚠1 Drainage Filter Limits:
1. Core Trench - Sta. 51+00 to 74+00.
2. Horizontal and Toe - 60+00 to 73+35.



VERTICAL CURVE DATA

Scale: 1" = 50' Horiz. 1" = 5' Vert.

RECORD DRAWING
DATE Feb. 1978

DWG. NO. FN - SCR - 4

DATE	REVISION	BY
1-28-75	⚠1 Note on Filter Limits and Core Trench Transition.	R.A.T.
11-20-75	⚠2 C.O. #5, Spillway Sta. Change	R.A.T.
7-7-77	⚠3 Record Drawing Revisions	R.A.T.

DESIGNED W.R.B.
DRAWN W.R.B.
TRACED J.W.R.
CHECKED

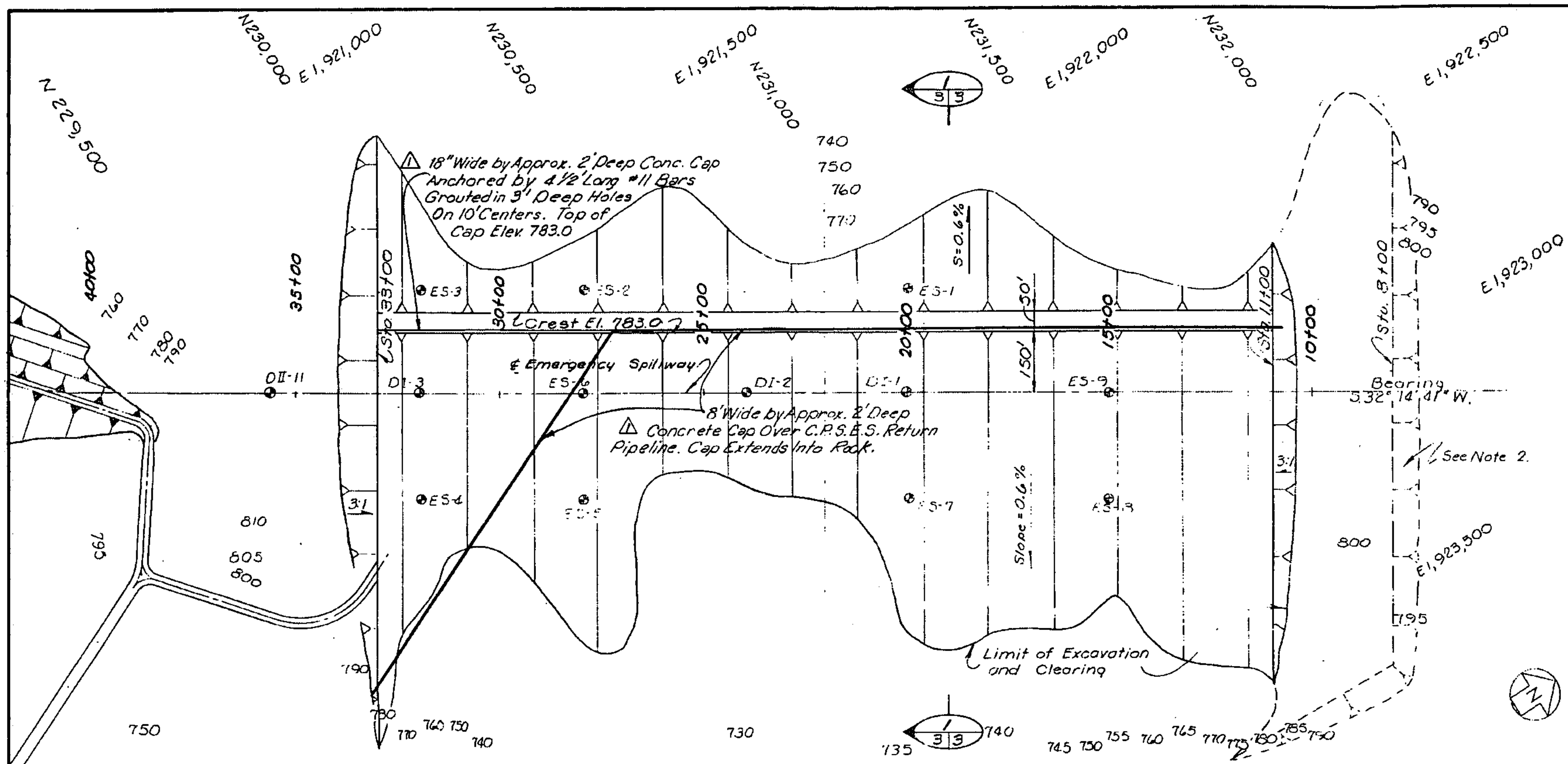
JOB NO. TEU72120
DATE APRIL 1974
SCALE AS NOTED

Freese AND Nichols CONSULTING ENGINEERS

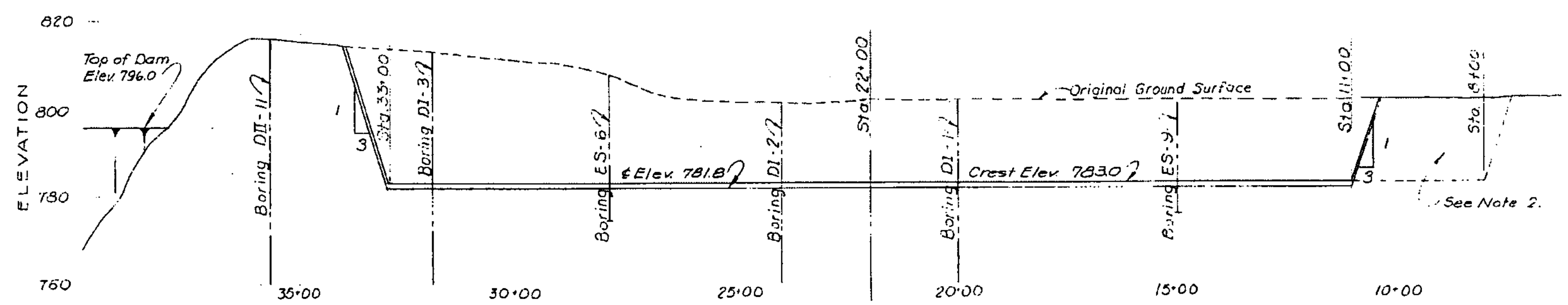
TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

EARTH WORK
CENTERLINE PROFILE

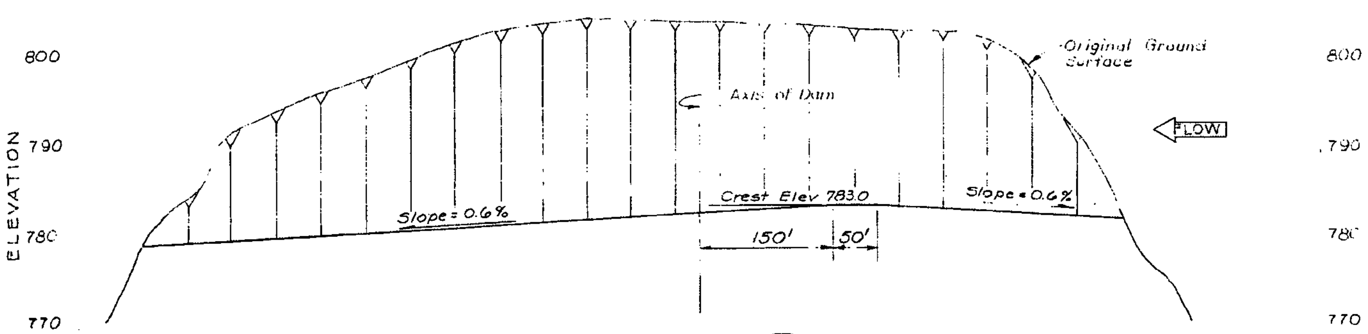
SEQ. NO. 4
SHEET NO. 2-2
OF SHEETS 5



PLAN
Scale 1" = 200'



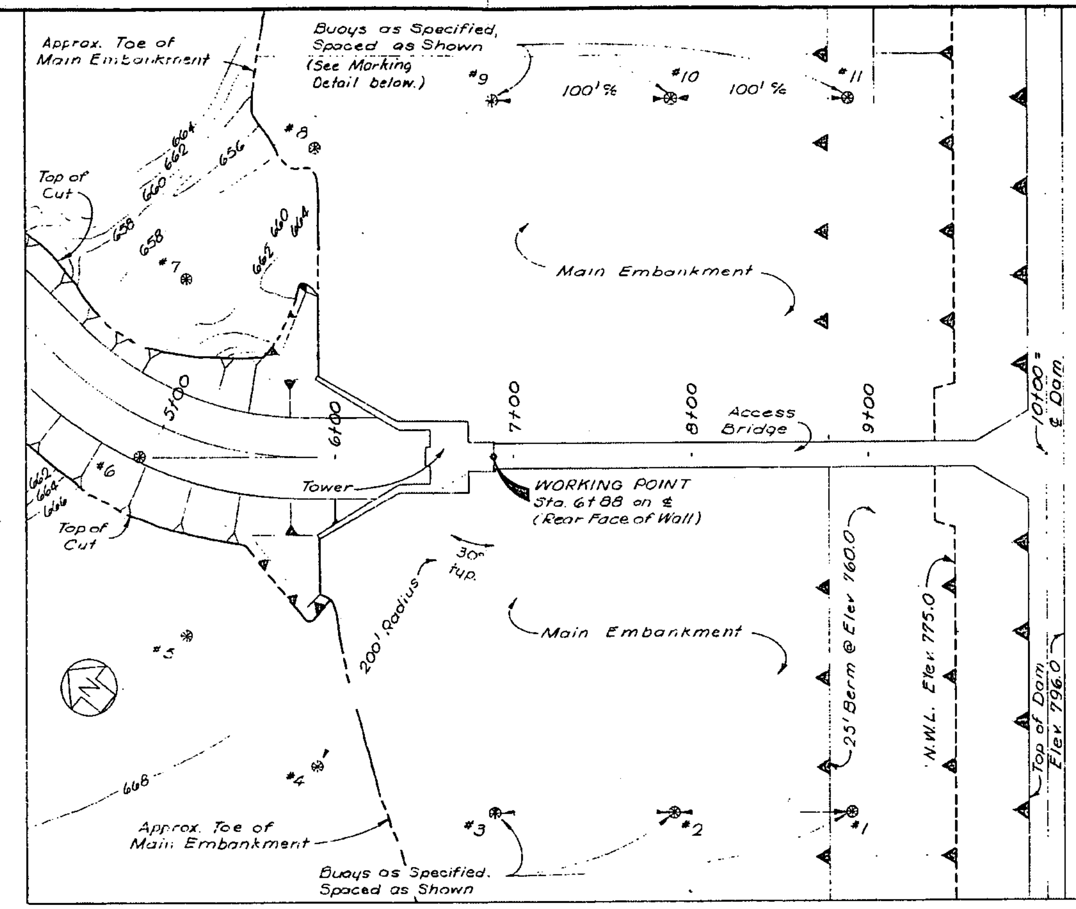
CENTERLINE PROFILE
Scale 1" = 200' Horz., 1" = 20' Vert.



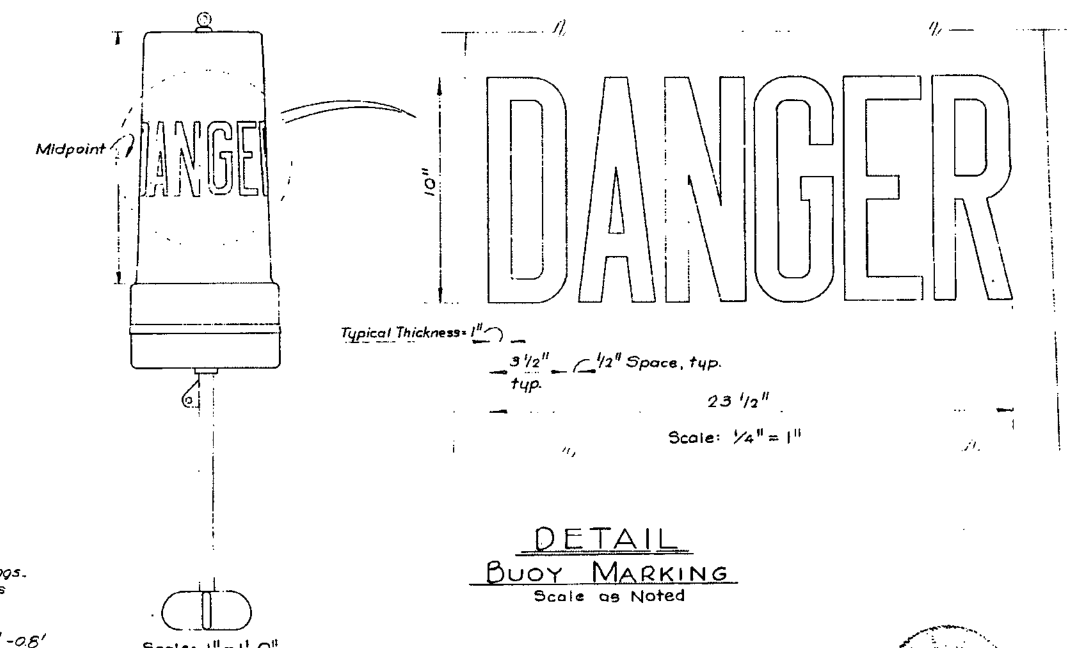
SECTION 1/3-3
Scale 1" = 100' Horz., 1" = 10' Vert.

GENERAL NOTES

1. See Section 6 for Logs of Borings.
2. Excavation shall be extended as necessary to meet rock fill requirements. (Not Extended)
3. Finish Grade Tolerance: +0.3' -0.8' from grade.



PLAN
BUOY LINE AROUND SERVICE OUTLET
Scale: 1" = 50'



DETAIL
BUOY MARKING
Scale as Noted

Feb. 1978

DWG. NO. FN-SCR-5

DATE	REVISION	BY
2-21-78	1 Record Drawing Revisions	R.A.T.

DESIGNED	W.R.B.
DRAWN	W.R.B.
TRACED	D.D.
CHECKED	
JOB NO.	TEU 72120
DATE	APRIL 1974
SCALE	AS NOTED

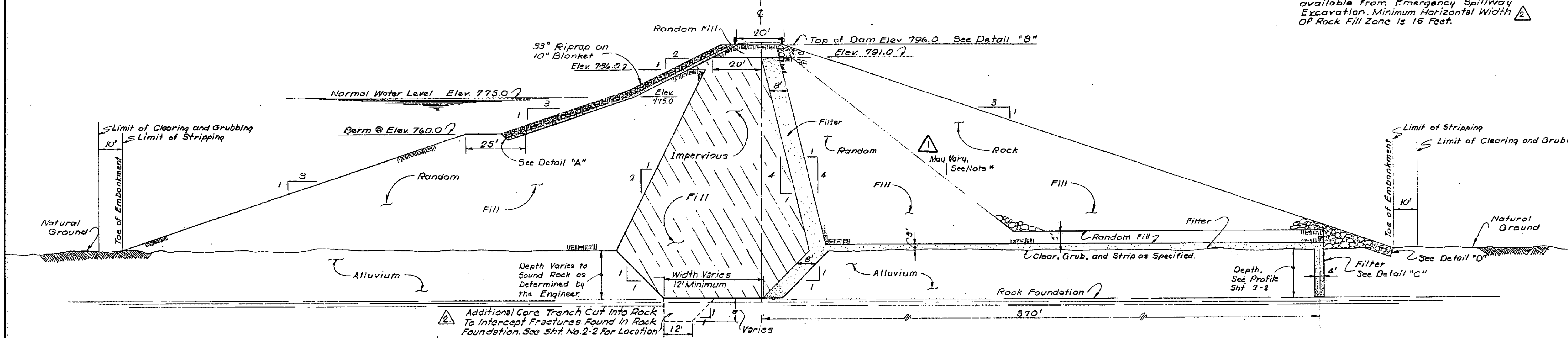
Freese and Nichols CONSULTING ENGINEERS

TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

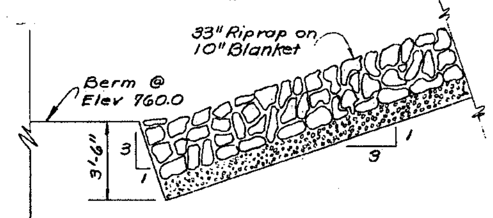
EARTH WORK
EMERGENCY SPILLWAY LAYOUT AND DETAILS

SEQ. NO. 5 — SHEET NO. 2-3 — OF SHEETS 5

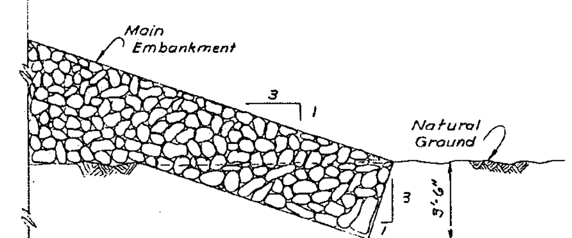
⚠1 *Note: Adjust Slope to suit quantity of Rock available from Emergency Spillway Excavation. Minimum Horizontal Width ⚠2 Of Rock Fill Zone Is 16 Feet.



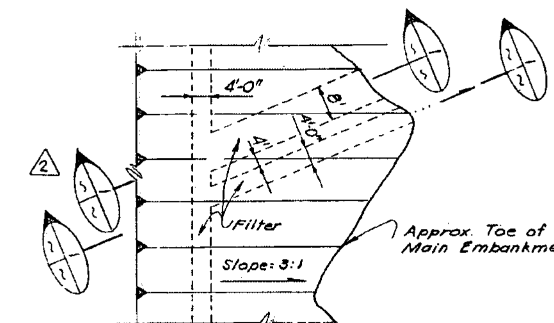
TYPICAL EMBANKMENT SECTION
Scale: 1" = 20'



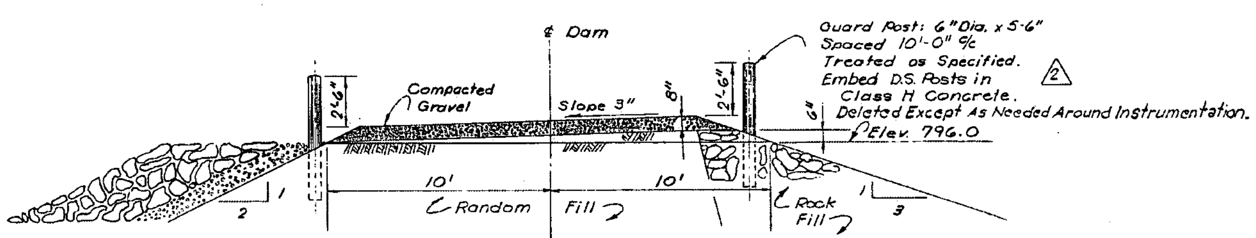
DETAIL "A"
TOE OF RIPRAP EMBEDMENT
Scale: 1/4" = 1'-0"



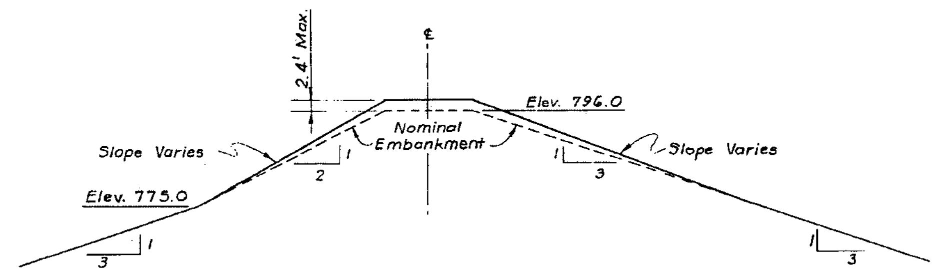
DETAIL "D"
TOE OF MAIN EMBANKMENT
Scale: 1/4" = 1'-0"



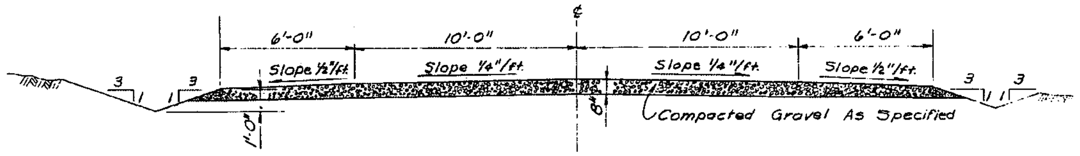
DETAIL "C"
PART PLAN OF TOE DRAIN OUTLET
Scale: 1" = 20'



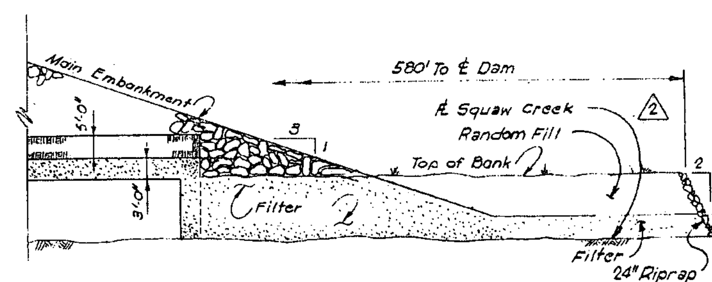
DETAIL "B"
CROWN DETAIL
Scale: 1/4" = 1'-0"



OVERBUILD DIAGRAM
Scale: 1" = 20'



SECTION 1/2-4
TYPICAL ROADWAY SECTION
Scale: 1/4" = 1'-0"



SECTION 1
Scale: 1" = 20'

RECORD DRAWING
Feb. 1976

DWG. NO. FN-SCR-6

DATE	REVISION	BY
5-1-75	⚠1 CO # 3: Note added to adjust Slope	R.A.T.
7-7-77	⚠2 Record Drawing Revisions	R.A.T.

DESIGNED W.R.B.
DRAWN J.W.R.
TRACED J.W.R.
CHECKED

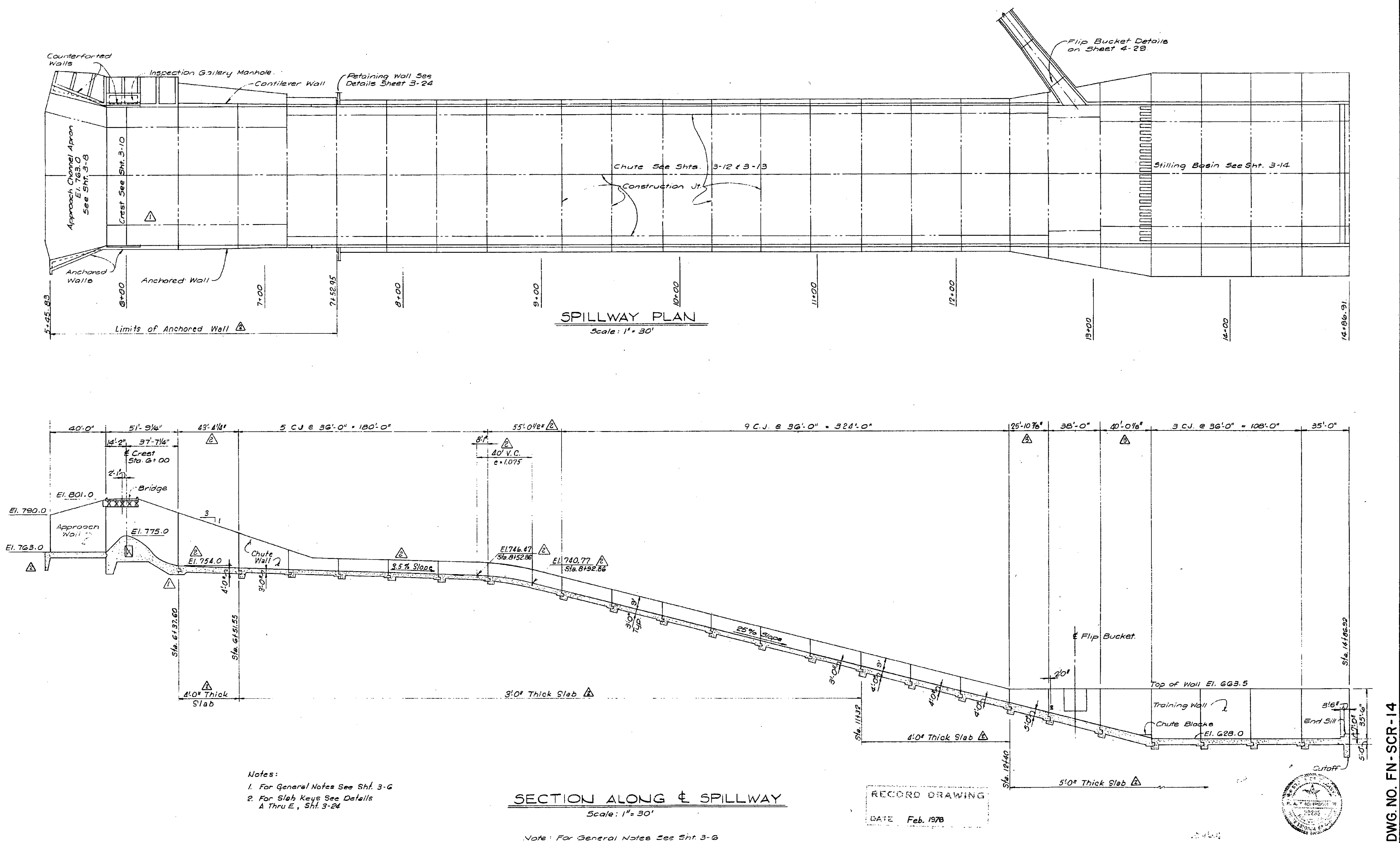
JOB NO. TEU 72120
DATE APRIL 1974
SCALE AS NOTED

Freese AND Nichols CONSULTING ENGINEERS

TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

EARTH WORK
EMBANKMENT SECTION & DETAILS

SEQ. NO. 6
SHEET NO. 2-4
OF SHEETS 5



Note: For General Notes See Sht. 3-6

DATE	REVISION	BY
5-1-75	1 C.O.#3: Reversed Key; changed C.J.	R.A.T.
10-20-75	2 C.O.#4: Changes due to overexcavation.	R.A.T.
11-20-75	3 C.O.#5 - Service Outlet Correction	R.A.T.
7-6-77	4 Record Drawing	R.A.T.

DESIGNED R.M.L.
DRAWN M.R.
TRACED M.R.
CHECKED

JOB NO. TEU 72120
DATE APRIL 1974
SCALE AS NOTED

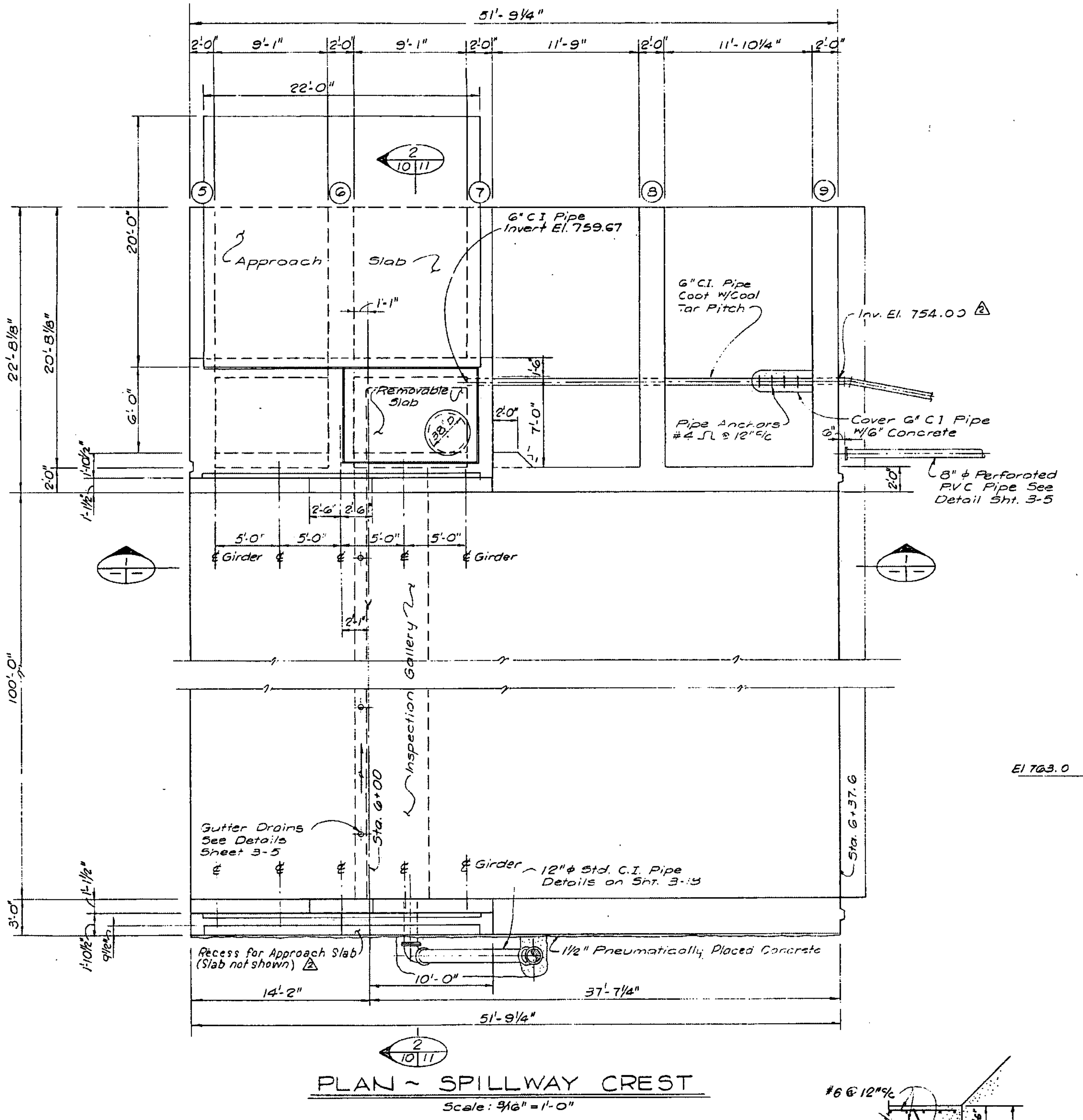
Freese and Nichols CONSULTING ENGINEERS

TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

SERVICE SPILLWAY
SPILLWAY PLAN & PROFILE

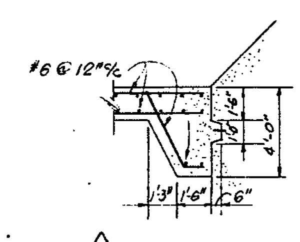
SEQ. NO. 13
SHEET NO. 3-7
OF SHEETS 29

DWG. NO. FN-SCR-14



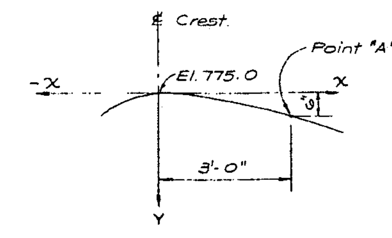
PLAN ~ SPILLWAY CREST

Scale: 3/16" = 1'-0"



DETAIL

Scale: ¼" = 1'-0"

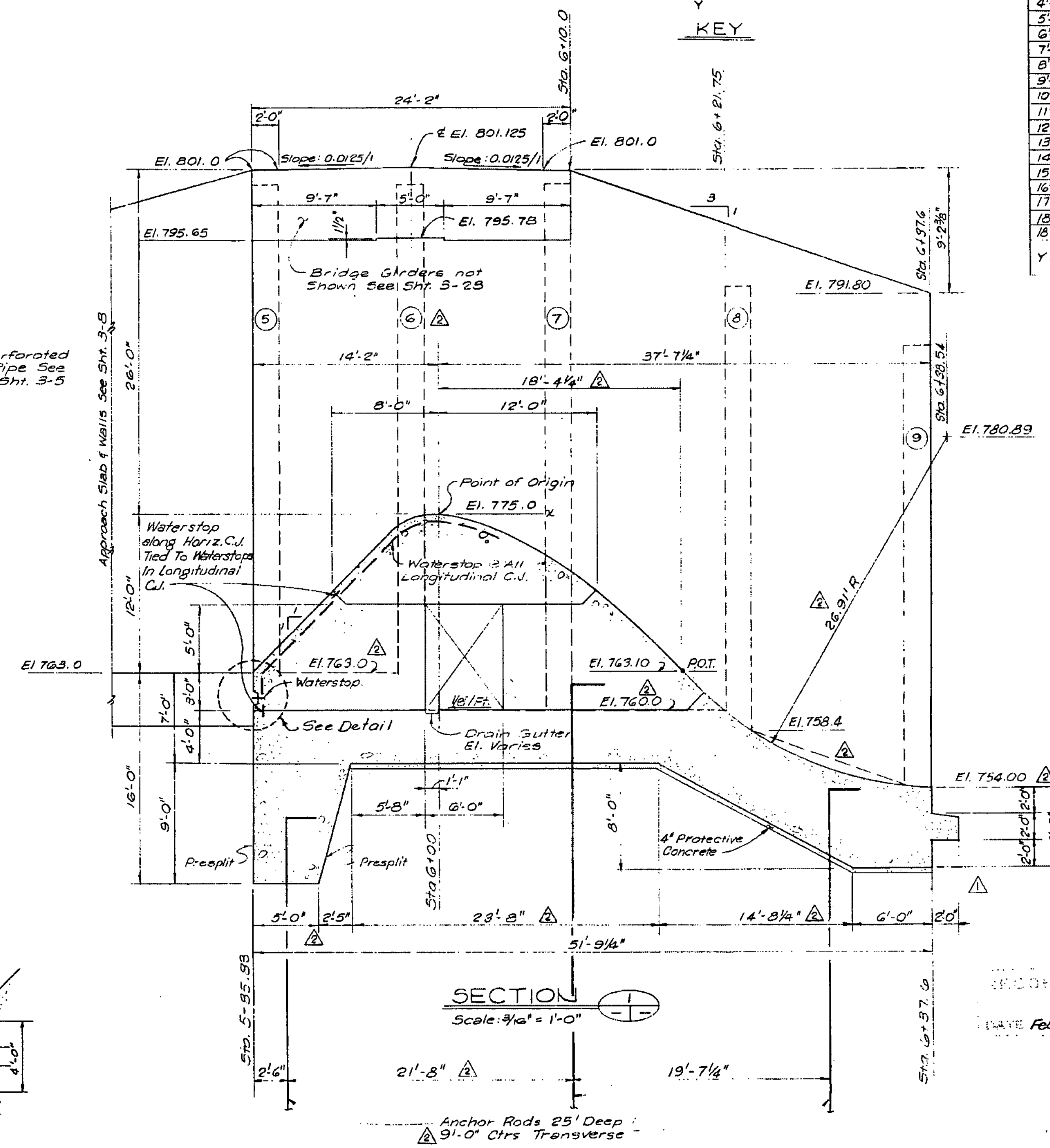


KEY

COORDINATES			
UPSTREAM CREST		DOWNSTREAM CREST	
X	Y	X	Y
-0'-6⅞"	0'-⅛"	0'-6"	0'-¼"
-1'-1⅝"	0'-1⅛"	1'-0"	0'-⅞"
-1'-6¾"	0'-2⅛"	1'-6"	0'-1¾"
-1'-11⅞"	0'-3½"	2'-0"	0'-3"
-2'-3¼"	0'-4⅝"	2'-6"	0'-4⅜"
-2'-5⅞"	0'-5⅝"	3'-0"	0'-6"
-2'-9¼"	0'-7⅛"	3'-6"	0'-7⅞"
		4'-0"	0'-9⅞"
		5'-0"	1'-2⅝"
		6'-0"	1'-8⅛"
		7'-0"	2'-2½"
		8'-0"	2'-9⅜"
		9'-0"	3'-5"
		10'-0"	4'-1⅜"
		11'-0"	4'-10⅜"
		12'-0"	5'-7⅞"
		13'-0"	6'-6⅛"
		14'-0"	7'-4⅞"
		15'-0"	8'-4⅜"
		16'-0"	9'-4⅜"
		17'-0"	10'-4⅞"
		18'-0"	11'-6"
		18'-4¼"	11'-10¾"

$Y = \frac{X^{1.75}}{13.672}$

← Point "A"



SECTION

Scale: 3/16" = 1'-0"

Note: For General Notes See Sht 3-5

RECORD DRAWING

DATE Feb. 1978

DWG. NO. FN-SCR-17

DATE	REVISION	BY
5-1-75	1 C.O. #3: Reversed Key: Detail for Approach key	R.A.T.
10-20-75	2 C.O. #4 Changes due to overexcavation.	R.A.T.
7-8-77	3 Record Drawing	R.A.T.

DESIGNED R.M.L.
DRAWN M.R.
TRACED M.R.
CHECKED

JOB NO. TEU 72120
DATE APRIL 1974
SCALE AS NOTED

Freese AND Nichols CONSULTING ENGINEERS

TEXAS UTILITIES SERVICES INC.
SQUAW CREEK DAM
PROJECT NUMBER 2323

SERVICE SPILLWAY
GEOMETRY, PLAN & SECTIONS CREST

SEQ. NO. 16
SHEET NO. 3-10
OF SHEETS 29

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-7

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that the NRC staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

By letter dated October 1, 2009, the NRC staff issued RAI ID 3665 (RAI 105) Question Number 14248, in which the NRC staff asked "Provide a rationale for assumptions made in the modeling of instream flooding and drainage for computation of the PMF on rivers and streams affecting the site. Provide documentation and electronic versions of input files for all computer models used to compute the river and stream flooding."

The applicant responded in document CP-200901564-Log No TXNB-09067- (ML093230704) executed on November 13, 2009. The applicant directed the staff to the applicant's response to RAI 3665 (RAI Number 105). The applicant's response to this RAI also referred to Calculation "MITS004 - Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)", Revision 1 and the input and output (I/O) files (FlowMaster) that were submitted previously as part of July 2009 Hydrology Safety Site Audit Information Need HYDSV-07 via Luminant letter TXNB-09037, dated September 2, 2009. Refer to the NRC staff's 'Hydrology Site Safety Audit Report of the Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application,' dated December 3, 2009.

This supplemental RAI question results from staff's examination of that calculation package and from examination of calculation package TXUT-001-FSAR 2.4.3-CALC-012.

The NRC staff noted that the Squaw Creek Dam discharge rating relationships referenced in the COL FSAR and in TXUT-001-FSAR 2.4.3-CALC-012 are important determinants of the design basis flood elevation reported by the applicant because they model the ability of Squaw Creek Dam to pass PMF flows from Squaw Creek watershed.

The staff's synthesis of data from multiple tables in the FSAR and TXUT-001-FSAR 2.4.3-CALC-012 are provided in Table A to this supplemental RAI. Table A indicates that the crest of the service spillway is at about 775 ft, and the crest of the emergency spillway is at about 783 ft. The storage, stage, discharge relationship displayed in Table A is used in the applicant's implementation of HEC-HMS for calculating the PMF at Comanche Peak, Units 3 & 4. However, the dam break analysis has maximum backwater elevation on the downstream side of the Squaw Creek Reservoir dam at 775 ft, essentially the elevation of the service spillway crest and just eight feet below the crest of the emergency spillway. This above normal or "flooded tailwater" condition was not discussed by the applicant in the FSAR. If the normal discharge relationships for the emergency and service spillways are not adjusted to account for this flooded condition, then the applicant's computations would indicate passage of more flow than is actually possible in the PMF condition, and the resulting design basis flood elevation would be erroneously low and not conservative.

Accordingly, the Staff requests that the Applicant provide a description of how the above normal tailwater condition was modeled in computations of Squaw Creek Dam and spillway discharge during the PMF scenario described in the FSAR.

This is supplemental RAI 2.4.3-03-S-b.

The applicant's analysis of flooding in Squaw Creek Reservoir used discharge rating data presented in Tables 7-8 and 7-9 of TXUT-001-FSAR 2.4.3-CALC-012 and the extrapolation described on page 18 for evaluation of the probable maximum flood. The two tables combined provide the stage-discharge relationship used in the Applicant's implementation of HEC-HMS to calculate PMF levels. Table A, below, compiles the storage, stage and discharge relationships presented by the Applicant's contractor. The left side of the Table A is from Table 7-8. Except for the last three rows, the right side of Table A is from Table 7-9. The bottom three entries in the rightmost column are the results of the extrapolation presented by the Applicant's contactor. The values summarized by Table A are critical to evaluation of PMF at the proposed Comanche Peak Nuclear Power Plant, Units 3 and 4.

Table A. Stage, storage and discharge relationship for Squaw Creek Reservoir from TXUT-001-FSAR 2.4.3-CALC-012.

From Table 7-8		From Table 7-9			
Stage (ft)	Storage (acre-ft)	Storage (acre-ft)	Service spillway (cfs)	Emergency spillway (cfs)	Total discharge (cfs)
770	135,752				0
775	151,418	151,418	0	-	0
776	154,243	154,243	300	-	300
777	157,562	157,562	900	-	900
778	160,903	160,903	1,700	-	1,700
779	164,270	164,270	2,700	-	2,700
780	167,665	167,665	3,800	-	3,800
781	171,093	171,093	5,100	-	5,100
782	174,560	174,560	6,400	-	6,400
783	178,072	178,072	8,000	-	8,000
784	181,628	181,628	9,600	3,500	13,100
785	185,229	185,229	11,400	13,000	24,400
786	188,877	188,877	13,300	26,000	39,300
787	192,574	192,574	15,300	41,500	56,800
788	196,321	196,321	17,400	59,500	76,900
789	200,119	200,119	19,600	81,000	100,600
790	203,967	203,967	21,900	104,500	126,400
791	207,867				*151,964*
793	215,821				*203,143*
795	223,980				*255,964*

ANSWER:

As discussed in the response to Question 02.04.03-5 above, the revised backwater analysis determined that the water surface elevation on the downstream face of the Squaw Creek Dam would reach elevation 760.39 ft. This elevation is below the ogee crest spillway, indicating no submergence due to tailwater effects would occur. However, as discussed in the response to Question 02.04.03-6 above, the conservative assumption that the spillway crest is submerged by 1 ft is incorporated into the revised service spillway rating curve. Also, the emergency spillway rating curve accounts for tailwater flow in the channel immediately downstream from the spillway. The combined effects of revision to the spillway rating curves with the additional revisions made to the PMF analysis are provided in the response to Question 02.04.03-5.

Reference

TXUT-001-FSAR-2.4.3-CALC-012 Rev 2, Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)

Impact on R-COLA

None.

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-8

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that staff intends to use to evaluate whether an applicant meets the NRC's regulations.

The staff issued RAI ID 3665 (RAI number 105) Question Number 14248 (02.04.03-3), in which the NRC staff asked "Provide a rationale for assumptions made in the modeling of instream flooding and drainage for computation of the PMF on rivers and streams affecting the site. Provide documentation and electronic versions of input files for all computer models used to compute the river and stream flooding."

The applicant responded in document CP-200901564-Log No TXNB-09067-(ML093230704) executed on November 13, 2009. The applicant directed the staff to the applicant's response to RAI ID 3665 (RAI Number 105). The staff has generated a supplemental RAI to address its need for additional information. The applicant's response to this RAI also referred to Calculation "MITS004 - Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant, Units 3 and 4 (HEC-HMS & HEC-RAS)", Revision 1 and the input and output (I/O) files (FlowMaster) that were submitted previously, as part of July 2009 Hydrology Safety Site Audit Information Need HYDSV-07 via Luminant letter TXNB-09037, dated September 2, 2009. This supplemental RAI question results from the staff's examination of that calculation package and from examination of calculation package TXUT-001-FSAR 2.4.3-CALC-012. Refer to the NRC staff's 'Hydrology Site Safety Audit Report of the Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application,' dated December 3, 2009.

The staff noted that the Squaw Creek Reservoir storage-elevation and discharge-elevation relationships referenced in the FSAR and in TXUT-001-FSAR 2.4.3-CALC-012 are important determinants of the design basis flood elevation reported by the applicant because they determine how much flood rise is produced when Squaw Creek Reservoir is surcharged by the PMF.

Page 18 of 28 of TXUT-001-FSAR 2.4.3-CALC-012 reports that the discharge-storage relationship available to the applicant was linearly extrapolated to higher storage and discharge flow levels. The NRC staff needs to reproduce this extrapolation in confirmatory analysis and make a safety determination about the design basis flood elevation that depends upon this extrapolation.

In order to ensure that the methods used to perform the analyses used to make its safety determinations technically valid and conservative, the staff requests that the applicant provide in the COL FSAR, deductive statements proving that the linear extrapolation is bounding conservative. The analysis should demonstrate that the linear extrapolation to extreme storage values conservatively underestimates Squaw Creek Dam discharge and overestimates Squaw Creek Reservoir elevation during PMF conditions, and that the resulting design basis flood elevation is bounding conservative.

This is supplemental RAI 2.4.3-03-S-c.

ANSWER:

As discussed in the response to Question 02.04.03-6 above, the stage storage relationship has been revised to reflect the most recent available volumetric survey. The revised analysis utilizes the 2008 Volumetric Survey for the stage storage relationship up to and including elevation 775 ft. The Operation and Maintenance Procedures are utilized for data above elevation 775 ft. The stage storage relationship has not been extrapolated.

Also, the spillway stage discharge relationship has been revised using more conservative application of the defined methods and is no longer extrapolated. The service spillway discharge rating curve has been reconstituted utilizing the methods of the U.S. Bureau of Reclamation Design of Small Dams for an ogee crest. The emergency spillway discharge rating curve has been reconstituted utilizing the methods of the Federal Highway Administration Hydraulic Design Series Number 5. The same conservative approaches using the defined methods are used to determine the discharge at elevations above those identified by the Operations and Maintenance Procedures. The combined effects of revision to the spillway rating curves with the additional revisions made to the PMF analysis are provided in the response to Question 02.04.03-5 above.

<u>References</u>

The Texas Water Development Board, "Volumetric and Sedimentation Survey of Squaw Creek Reservoir December 2007 Survey," August, 2008.

Freese and Nichols, Operation and Maintenance Procedures, Squaw Creek Dam, Fort Worth, Texas, 1977 (ML100750051).

Bureau of Reclamation, "Design of Small Dams," 1987.

Federal Highway Administration, "Hydraulic Design Series Number 5, Hydraulic Design of Highway Culverts," FHWA-NHI-01-020 HDS No. 5, Second Edition, May 2005.

TXUT-001-FSAR-2.4.3-CALC-012 Rev 2, Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS).

<u>Impact on R-COLA</u>

None.

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-10

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that the staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

The NRC staff issued RAI ID 3665 (RAI Number 105) Question Number 14248, in which the NRC staff asked "Provide a rationale for assumptions made in the modeling of instream flooding and drainage for computation of the PMF on rivers and streams affecting the site. Provide documentation and electronic versions of input files for all computer models used to compute the river and stream flooding."

The applicant responded in document CP-200901564-Log No TXNB-09067- (ML093230704) executed on November 13, 2009. The applicant directed the staff to the applicant's response to RAI ID 3665 (RAI Number 105). The NRC staff has generated a supplemental RAI to address its need for additional information. The applicant's response to this RAI also referred to Calculation "MITS004 - Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)", Revision 1 and the input and output (I/O) files (FlowMaster) that were submitted previously, as part of July 2009 Hydrology Safety Site Audit Information Need HYDSV-07 via Luminant letter TXNB-09037, dated September 2, 2009. This supplemental RAI question results from the NRC staff's examination of that calculation package and from examination of calculation package TXUT-001-FSAR 2.4.3-CALC-012. Refer to the NRC staff's 'Hydrology Site Safety Audit Report of the Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application,' dated December 3, 2009.

Pages 12 and 13 of TXUT-001-FSAR 2.4.3-CALC-012 report selection of a base flow rate. The applicant used a 1977-present average of July baseflows—the lowest of all months for the 1977-present period of record.

In order to make its safety determinations based on appropriate consideration of conservative estimates, the staff requests that the applicant justify why the average of July baseflows is bounding conservative as compared to the use of a greater baseflow statistic.

This is supplemental RAI 2.4.3-03-S-e.

ANSWER:

In accordance with ANSI/ANS-2.8-1992 guidance, the PMF analysis has been revised to incorporate the effects of the highest average monthly flow of 46 cfs determined using U.S. Geological Survey gage 08091750 data. The highest monthly flow is adjusted based on the ratio of the modeled basin drainage area to the gage area. The baseflow is applied to the model as a constant rate. The combined effects of revision to the baseflow with the additional revisions made to the PMF analysis are provided in the response to Question 02.04.03-5 above.

References

American Nuclear Society, "American National Standard for Determining Design Basis Flooding at Power Reactor Sites," ANSI/ANS-2.8-1992, July 28, 1992

United States Geological Survey USGS, Website http://nwis.waterdata.usgs.gov/, (Monthly Statistics for USGS Gages) Data extracted February 7, 2008

TXUT-001-FSAR-2.4.3-CALC-012 Rev 2, Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)

Impact on R-COLA

None.

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4310 (CP RAI #143)

SRP SECTION: 02.04.03 - Probable Maximum Flood (PMF) on Streams and Rivers

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/24/2010

QUESTION NO.: 02.04.03-11

NUREG-0800, Standard Review Plan (SRP), Section 2.4.3, 'Probable Maximum Flood (PMF) on Streams and Rivers,' establishes criteria that staff intends to use to evaluate whether an applicant meets the NRC's regulations.

The NRC staff issued RAI ID 3665 (RAI Number 105) Question Number 14248, in which the NRC staff asked "Provide a rationale for assumptions made in the modeling of instream flooding and drainage for computation of the PMF on rivers and streams affecting the site. Provide documentation and electronic versions of input files for all computer models used to compute the river and stream flooding."

The applicant responded in document CP-200901564-Log No TXNB-09067- (ML093230704) executed on November 13, 2009. The applicant directed the staff to the applicant's response to RAI ID 3665 (RAI Number 105). The NRC staff has generated a supplemental RAI to address its need for additional information. The applicant's response to this RAI also referred to Calculation "MITS004 - Probable Maximum Flood Calculation for Comanche Peak Nuclear Power Plant Units 3 and 4 (HEC-HMS & HEC-RAS)", Revision 1 and the input and output (I/O) files (FlowMaster) that were submitted previously, as part of July 2009 Hydrology Safety Site Audit Information Need HYDSV-07 via Luminant letter TXNB-09037, dated September 2, 2009. This supplemental RAI question results from the staff's examination of that calculation package and from examination of calculation package TXUT-001-FSAR 2.4.3-CALC-012. Refer to the NRC staff's 'Hydrology Site Safety Audit Report of the Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application,' dated December 3, 2009.

The NRC staff noted that the applicant does not specify the reservoir elevation corresponding to the Squaw Creek Reservoir surface used to compute critical fetch length for wind and wave height computation.

In order to make safety determinations based on adequate consideration of appropriate mechanisms that result in a conservative estimate, the staff requests that the applicant include a figure in the COL FSAR detailing the location of the critical fetch length. The NRC staff also requests that the applicant describe any dependence of the critical fetch length on reservoir elevation, which would require that the fetch length be computed for the reservoir at the PMF (rather than normal) elevation of Squaw Creek Reservoir to yield a conservative estimate of wind and wave height.

This is supplemental RAI 2.4.3-03-S-f.

ANSWER:

The coincident wind wave activity is determined for the longest fetch length, which is based on the maximum water surface elevation achieved during the PMF for the Squaw Creek Reservoir. Coincident wind wave activity has been recalculated based on the increased PMF elevation at Squaw Creek Reservoir as identified in the response to Question 02.04.03-5 above. Figure 2.4.3-209 has also been revised to reflect the increased PMF elevation and identify the critical fetch length determined.

<u>Attachment</u>

TXUT-001-FSAR-2.4.3-CALC-013 Rev 3, Coincident Wind Wave Analysis for Comanche Peak Nuclear Power Plant Units 3 and 4 (on CD).

<u>Impact on R-COLA</u>

See attached marked-up FSAR Revision 1 pages 2.4-32, 2.4-33, 2.4-55, 2.4-58, and Figure 2.4.3-209 (on CD).

<u>Impact on S-COLA</u>

None.

<u>Impact on DCD</u>

None.

Attachment 4

Response to Request for Additional Information No. 4311 (CP RAI #140)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4311 (CP RAI #140)

SRP SECTION: 02.04.04 - Potential Dam Failures

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/21/2010

QUESTION NO.: 02.04.04-5

NUREG-0800, Standard Review Plan (SRP), Section 2.4.4, 'Potential Dam Failures,' establishes criteria that Staff intends to use to evaluate whether an Applicant meets the NRC's regulations.

By letter dated October 2, 2009, the NRC staff issued RAI ID 3666 (RAI No. 111) Question Number 14250 (02.04.04-1), in which the NRC staff asked "Provide a description of the process used to determine that the multiple dam failure analysis and resulting flood elevations are based on the most conservative of all plausible conceptual models, including consideration of multiple scenarios of domino failures of existing and proposed dam development within the Brazos River Basin and coincident wind and wave activity on each failed dam."

The applicant responded in document CP-200901564-Log No TXNB-09067 (ML093230704) executed on November 13, 2009. The NRC staff has reviewed the response, including the cited changes reflected in Updated Tracking Report No. 4, FSAR.

The NRC staff refers to the portion of the applicant's response that reads "Because the site is located off-channel on a tributary of the Brazos River, the most conservative approach for the critical dam failure event would be for this reach of the Brazos River to flood by way of domino-type dam failure of upstream dams, and for flood waters to back-up from the Brazos River and Paluxy River confluence onto the site by way of the Squaw Creek catchment." The applicant has provided much of the necessary information about how the applicant identified a bounding conservative approach to the dam break problem.

In order to make its safety determination based on the use of appropriate quantitative and technical analyses, the NRC staff requests that the applicant provide clear justification for the assertion of bounding conservatism of the resulting flood elevation at the proposed Comanche Peak Nuclear Power Plant, Units 3 and 4 site by providing a physical basis and hydraulic basis for including or excluding each existing or proposed dam and reservoir from the domino dam failure analysis presented in the FSAR.

This is supplemental RAI 2.4.4-00-S-a.

ANSWER:

Detailed discussion of the qualitative assessment has been added to FSAR Subsection 2.4.4.1. The quantitative assessment has been revised to include assessment of future conditions and to address Questions 02.04.04-6 and -7 below.

Impact on R-COLA

See attached marked-up FSAR Revision 1pages 2.4-34, 2.4-35, 2.4-36, 2.4-37, 2.4-38, 2.4-39, 2.4-40, 2.4-51, 2.4-52, 2.4-106, 2.4-107, 2.4-149, 2.4-150, 2.4-151, 2.4-152, 2.4-153, 2.4-154, 2.4-155, 2.4-156, 2.4-157, 2.4-158, 2.4-159, and new Figure 2.4.4-204 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4311 (CP RAI #140)

SRP SECTION: 02.04.04 - Potential Dam Failures

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/21/2010

QUESTION NO.: 02.04.04-6

NUREG-0800, Standard Review Plan (SRP), Section 2.4.4, 'Potential Dam Failures,' establishes criteria that NRC staff intends to use to evaluate whether an applicant meets the NRC's regulations.

The NRC staff issued RAI ID 3666 (RAI No. 111) Question Number 14250 (02.04.04-1), in which the NRC staff asked "Provide a description of the process used to determine that the multiple dam failure analysis and resulting flood elevations are based on the most conservative of all plausible conceptual models, including consideration of multiple scenarios of domino failures of existing and proposed dam development within the Brazos River Basin and coincident wind and wave activity on each failed dam."

The applicant responded in document CP-200901564-Log No TXNB-09067-ML093230704 executed on November 13, 2009. The NRC staff has reviewed the response, including the cited changes reflected in FSAR Updated Tracking Report No. 4.

The NRC staff disagrees with the last portion of the applicant's response that states "The total dam failure flow is the sum of the spillway flow, the breach flow, the remainder of the overtopping flow not affected by the breach width combined with the coincident PMF flow for the respective dams. The dam failure flows represent the dam storage for the respective dams. The coincident wind wave activity on each failed upstream dam will be limited to an instantaneous wave height and will not increase the dam failure flows. Hence, coincident wind wave activity on each of the failed upstream dam was considered not applicable for the dam failures."

The NRC staff notes that wind setup on a reservoir is not an instantaneous phenomenon. Rather it can be a persistent mechanism for increasing the energy head on a dam about to fail. The equations used by the applicant to compute dam break flows in FSAR Section 2.4.4.1 do exhibit dependence on energy head at the time of failure. The NRC staff concludes that wind setup on a reservoir would increase dam break flows in the applicant's dam break scenario.

In order to make its safety determination based on adequate consideration of appropriate mechanisms that result in a conservative estimate, the NRC staff requests that the applicant add wind setup computations for all reservoirs included in the dam break analysis.

This is supplemental RAI 2.4.4-00-S-b.

ANSWER:

The quantitative dam failure analysis for existing and future conditions has been revised to include wind setup in accordance with the guidance of U.S. Army Corps of Engineers publication EM 1110-2-1420. Discussion of wind setup has been added to FSAR Subsection 2.4.4.1.

Wind speed is based on the guidance provided in ANSI/ANS-2.8-1992. In lieu of site specific wind speed studies the maximum wind speed is determined using the guidance chart for the annual extreme-mile, 2-year mean recurrence interval. For the Brazos River watershed, the wind speed varies from 50 mph to 60 mph. The maximum 60 mph wind speed is selected for the input parameter. This is conservative and bounding for the expected range of 2-year wind speeds for the region.

The fetch distance is determined based on the reservoir surface area at the overtopping or otherwise maximum water surface elevation. U.S. Geological Survey 7.5 minute quadrangles for each reservoir are used to identify the longest fetch length. The longest straight line fetch distance is used to define the wind setup and is more conservative than using an effective fetch. Because the topographic maps depict elevation contours at 10-foot intervals, the maximum water surface elevation is rounded up to the nearest estimated 5-ft or 10-ft contour. Therefore, the fetch distance is based on a more conservative elevation than the maximum water surface elevation.

The average depth of water is determined from the hydraulic depth using U.S. Geological Survey contours and supplemented with bathymetry maps from individual reservoir volumetric survey reports developed by the Texas Water Development Board as appropriate. However, the maximum water surface elevation is used as the basis for the average depth and not the higher rounded up contour used to derive the fetch distance. This is conservative because it results in a smaller average depth. A smaller average depth results in a higher wind setup.

The overtopping or otherwise maximum water surface elevation at each reservoir is based on the resulting PMF elevation combined with the effects from upstream dam failures and transposed to the dam without attenuation. The antecedent reservoir elevation prior to the arrival of the PMF and combined effects from upstream dam failures are discussed in the response to Question 02.04.04-7 below.

<u>References</u>

U.S. Army Corps of Engineers, "Engineering and Design Hydrologic Engineering Requirements for Reservoirs," EM 1110-2-1420, October 31, 1997.

American Nuclear Society, "American National Standard for Determining Design Basis Flooding at Power Reactor Sites," ANSI/ANS-2.8-1992, July 28, 1992.

U.S. Geological Survey, Quadrangles, Website, http://www.usgs.gov, accessed April 2010.

Texas Water Development Board, Volumetric Survey of Fort Phantom Hill Reservoir, March 10, 2003.

Texas Water Development Board, Volumetric Survey of Lake Stamford, January 24, 2000.

Texas Water Development Board, Volumetric Survey Report of Possum Kingdom Lake December 2004-January 2005 Survey, May 2006.

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.4-40, and 2.4-43 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Comanche Peak, Units 3 and 4

Luminant Generation Company LLC

Docket Nos. 52-034 and 52-035

RAI NO.: 4311 (CP RAI #140)

SRP SECTION: 02.04.04 - Potential Dam Failures

QUESTIONS for Hydrologic Engineering Branch (RHEB)

DATE OF RAI ISSUE: 2/21/2010

QUESTION NO.: 02.04.04-7

NUREG-0800, Standard Review Plan (SRP), Section 2.4.4, 'Potential Dam Failures,' establishes criteria that Staff intends to use to evaluate whether an applicant meets the NRC's regulations.

The NRC staff issued RAI ID 3666 (RAI No. 111) Question Number 14253 (02.04.04-4), in which the NRC staff asked "Provide a rationale for assuming normal water surface elevations for reservoirs included in the domino-type dam failure scenario. Explain why the analysis should not include maximum reservoir elevations as reported in operating histories or in reservoir operating guides maintained by operating authorities."

The applicant responded in document CP-200901564-Log No TXNB-09067-(ML093230704) executed on November 13, 2009. Staff has reviewed the response, including the cited changes reflected in FSAR Updated Tracking Report No 4.

The applicant's response states that "reservoirs are assumed to be at normal water surface elevation for antecedent conditions at the onset of the PMF" and that "the peak water surface elevation for the corresponding dam failure is equal to the height of the dam plus the height of the overtopping flows, which will exceed the maximum reservoir elevation and hence, was considered to be conservative." This response does not address the dependence of breach and overtopping flows on initial height (reservoir elevation), nor does it address the increased volume impounded by the reservoir at maximum storage, which would worsen downstream flooding.

In order to make its safety determination based on the use of appropriate quantitative and technical analyses, the NRC staff requests that the applicant provide justifications based on the hydraulic equations cited in Section 2.4.4.1 of the FSAR, that the assumption of normal water surface elevation for failed reservoirs is as conservative as an assumption of reservoirs at maximum elevation. Otherwise, the applicant should revise the analysis to model reservoirs at maximum water surface elevation prior to failure.

This is supplemental RAI 2.4.4-03-S.

ANSWER:

The quantitative dam failure analysis for existing and future conditions has been revised to include conservative antecedent reservoir elevations greater than or equal to maximum recorded water surface elevations. The elevations provided below are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29), unless noted otherwise. The plant site grading plan is referenced to the North American Vertical Datum of 1988 (NAVD 88).

The maximum recorded water surface elevation at Hubbard Creek Reservoir is 1190.22 ft. The dam failure analysis assumes an antecedent water surface elevation at the emergency spillway elevation of 1194.0 ft.

The maximum recorded water surface elevation at Lake Stamford is 1426.18 ft. The dam failure analysis assumes an antecedent water surface elevation at the dam crest elevation of 1,436.8 ft.

The maximum recorded water surface elevation at Fort Phantom Hill Reservoir is 1639.50 ft. The dam failure analysis assumes an antecedent water surface elevation at the levee elevation of 1643.0 ft.

The maximum recorded water surface elevation at Possum Kingdom Lake is 1003.60 ft. The dam failure analysis assumes an antecedent water surface elevation at the maximum historical water surface elevation.

The maximum recorded water surface elevation at Lake Granbury is 693.60 ft. For the upstream breach flow evaluation, the dam failure analysis assumes an antecedent water surface elevation at the dam crest elevation of 706.5 ft. For the upstream breach wave height evaluation, the dam failure analysis assumes an antecedent water surface elevation at the maximum historical water surface elevation.

Design details for the proposed Cedar Ridge Reservoir Dam are unavailable. However, according to the 2011 Brazos G Regional Water Plan, the normal full pool elevation is 1489.0 ft. The dam failure analysis assumes a dam crest elevation of 1510.0 ft. The dam failure analysis assumes an antecedent water surface elevation at the dam crest elevation.

The revisions to the dam failure analysis discussed in the responses to Questions 02.04.04-5 and 02.04.04-6 above, combined with the revisions to account for antecedent reservoir water surface elevations, result in a total flow of 6,730,000 cfs from De Cordova Bend Dam. The upstream dam failure flow is transposed to the confluence with the Paluxy River to determine the water surface elevation at the confluence.

The HEC-RAS stream course model discussed in FSAR Subsection 2.4.3 has been revised to incorporate the Brazos River. Brazos River cross sections upstream and downstream of the confluence with the Paluxy River are estimated using USGS quadrangle topography. The Manning's roughness coefficient of 0.15 is used for the channel and overbanks. This is a conservative estimate based on the published tables by Chow. The dam failure analysis flow is used as input for the Brazos River. Additionally, the peak flows from the flow hydrographs for each basin in the HEC-HMS model, discussed in the response to RAI No. 4310 (CP RAI #143) Question 02.04.03-5, are used as input to the Brazos River tributaries. This is a conservative approach by assuming multiple PMF events occur coincidentally with all peak flows combined. The analysis is performed using steady state conditions to determine a water surface elevation of 760.05 ft at the confluence of the Brazos River and the Paluxy River.

The elevations above are provided with reference to the National Geodetic Vertical Datum of 1929 (NGVD 29). The plant site grading plan is referenced to the North American Vertical Datum of 1988 (NAVD 88). According to the National Geodetic Survey, the datum shift of NAVD 88 minus NGVD 29 is equal to between 0 and +20 cm for the site. Therefore, it is conservative to account for a maximum conversion of +20 cm (0.66 ft) when comparing water surface elevations determined using NGVD 29 to elevations at the site in NAVD 88. Considering conversion, the confluence water surface elevation of 760.71 ft NAVD 88 is well below the CPNPP Units 3 and 4 safety-related structures elevation of 822 ft NAVD 88.

References

U.S. Geological Survey, Water-Data Report 2009, 08086400 Hubbard Creek Reservoir nr Breckenridge, TX, Website, http://wdr.water.usgs.gov/, accessed May 2010.

U.S. Geological Survey, Water-Data Report 2009, 08084500 Lake Stamford near Haskell, TX, Website, http://wdr.water.usgs.gov/, accessed May 2010.

U.S. Geological Survey, Water-Data Report 2009, 08083500 Fort Phantom Hill Reservoir near Nugent, TX, Website, http://wdr.water.usgs.gov/, accessed May 2010.

U.S. Geological Survey, Water-Data Report 2008, 08088500 Possum Kingdom Lake near Graford, TX, Website, http://wdr.water.usgs.gov/, accessed May 2010.

U.S. Geological Survey, Water-Data Report 2008, 08090900 Lake Granbury near Granbury, TX, Website, http://wdr.water.usgs.gov/, accessed May 2010.

Brazos G Regional Water Planning Group, Brazos G Regional Water Planning Area, Initially Prepared 2011 Brazos G Regional Water Plan, March 2010.

National Geodetic Survey, Website, http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html, accessed May 2010.

Impact on R-COLA

See attached marked-up FSAR Revision 1 pages 2.4-40, 2.4-41, 2.4-42, 2.4-43, 2.4-44, 2.4-45, 2.4-46, 2.4-47, 2.4-48, 2.4-49, 2.4-50, 2.4-51, 2.4-53, 2.4-54, 2.4-106, 2.4-107, and Figures 2.4-202 and 2.4-203 (on CD).

Impact on S-COLA

None.

Impact on DCD

None.

Attachment 5

Electronic Files Included on the Enclosed CD

RAI 4308-138

- FSAR pages for RAI 138.pdf
- TXUT-001-FSAR-2.4.4-CALC-015 Rev 1 Part 1 of 2.pdf
- TXUT-001-FSAR-2.4.4-CALC-015 Rev 1 Part 2 of 2.pdf

RAI 4309-139

- FSAR pages for RAI 139.pdf
- TXUT-001-FSAR-2.4.2-CALC-020 Rev 3.pdf

RAI 4310-143

- FSAR pages for RAI 143.pdf
- Squaw Creek 2007 Survey.pdf
- TXUT-001-FSAR 2.4.3-CALC-011 Rev 2 Part 1 of 4.pdf
- TXUT-001-FSAR 2.4.3-CALC-011 Rev 2 Part 2 of 4.pdf
- TXUT-001-FSAR 2.4.3-CALC-011 Rev 2 Part 3 of 4.pdf
- TXUT-001-FSAR 2.4.3-CALC-011 Rev 2 Part 4 of 4.pdf
- TXUT-001-FSAR 2.4.3-CALC-012 Rev 2.pdf
- TXUT-001-FSAR 2.4.3-CALC-013 Rev 3.pdf

RAI 4311-140

- FSAR pages for RAI 140.pdf