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Docket Nos. 50-498/499

MEMORANDUM FOR: George Lear, Chief
Hydrologic and Geotechnical Engineering Branch, DE

THRU: Lyman Heller, Leader, Geotechnical Engineering Section
Hydrologic and Geotechnical Engineering Branch, DE

FROM: Dinesh Gupta, Geotechnical Engineering Section
Hydrologic and Geotechnical Engineering Branch, DE

SUBJECT: REPORT ON SITE VISIT TO SOUTH TEXAS PROJECT (MARCH 30, 1982)
AND MEETING WITH APPLICANT (MARCH 31 AND APRIL 1, 1982)

- REFERENCES:
1. IE Investigation Report 79-10, April 28, 1980.
 2. Letter from G. W. Oprea, Jr., IL&P to K. Seyfrit, NRC, Subject: Expert Committee's Final Report Concerning Show Cause Item 2, Structural Backfill Investigation, dated February 27, 1981.
 3. Memorandum from E. J. Gallagher, NRC to H. A. Wilber, Subject: Summary of April 26-27, 1980 Meeting on Structural Backfill at South Texas Project Units 1 & 2 (Docket No. 50-498; 50-499), dated May 29, 1981.
 4. Letter from C. S. Hedges, Woodward Clyde Consultants, to J. L. Hawks, Brown & Root, Subject: Relative Density of Structural Backfill - South Texas Project Electric Generating Station, MCC Foreign Document No. WCR-6000-09-1, dated May 28, 1980.
 5. Letter from C. S. Hedges, Woodward Clyde Consultants, to J. L. Hawks, Brown & Root, Subject: Relative Density of Structural Backfill, South Texas Project Electric Generating Station, MCC Foreign Document No. WCR-6000-11-1 Dated May 28, 1980.
 6. Task Interface Agreement (IF & IRR), Task No. 7, Subject: Liquefaction Potential of Loose Backfill Material Identified at South Texas Project, Units 1 & 2, as a Result of Field Borings, dated May 14, 1981.

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A. BACKGROUND

At South Texas Project, all Category I foundations are supported on structural backfill overlying natural subgrade. The thickness of the compacted backfill under and around the foundations ranges from a few feet to 68.5 feet. Most of the excavation and backfilling work was completed in 1976 - 1977.

In December, 1979 and January, 1980, the Office of Inspection and Enforcement conducted an investigation to establish that the plant backfill was placed according to the Final Safety Analysis Report (FSAR) specifications and that the fill meets the design criteria consistent with these commitments. Several open items were identified as a result of this investigation. (Reference 1).

In January/February, 1980, the applicant drilled a series of investigation borings around the Category I foundations to identify any deficiencies in the plant backfill. Additional borings were performed in March/April 1980 to better define the extent of the areas with backfill densities potentially less than the FSAR criteria. The applicant also conducted a test fill study in 1980 to determine the backfill densities attained by the compaction procedures used during placement of the fill. Based on these investigations, the applicant identified four areas around the Category I foundations where the backfill did not meet the specified densities. In February 1981, the applicant submitted a report to the I&E offices of the NRC on the adequacy of the Structural Backfill. This report (Reference 2) was prepared for the applicant by a committee of geotechnical engineers, consisting of A. J. Hendron, Jr., H. D. Seed and S. D. Wilson, which concluded that the condition of the structural backfill, as placed, is entirely adequate for the design requirements of the project.

In May, 1981, as a result of the review of various IE inspection reports and the applicant's submittals to the NRC, the Office of Inspection and Enforcement concluded that the structural backfill generally meets project design requirements (Reference 3). However, this review identified the following two topics, in which additional technical review was considered necessary:

1. Results of 1980 field investigation borings (Ref. 4 and 5).
2. Liquefaction analysis of areas which have loose fill material (Ref. 2).

Under a task interface agreement between IE and NRR dated May 14, 1981, the technical review of the above mentioned items was assigned to NRR/DE/INGEN staff (Ref. 6). After a preliminary review of References 2,

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4 and 5, the NRC staff decided that it was necessary to make a site visit and to audit all the field density and boring records available. A meeting with the applicant to discuss open issues was also planned.

Although the staff and the applicant wanted an earlier meeting, a schedule for site visit and meeting was postponed because of unavailability of a key Brown & Root technical contact person during the last three months of 1981. Also, in early 1982, the staff could not make the visit because of a lack of NRC travel funds. The trip reported herein was finally made in March/April 1982.

B. PURPOSE OF VISIT

The purpose of the subject site visit to South Texas Project on March 30, 1982 and the meeting with the applicant on March 31 and April 1, 1982 was to inspect the plant fill area around the Category I foundations and to discuss with applicant the information necessary to a technical review of the two items identified by I&E. To inform the applicant of the scope of review, the staff provided the applicant, in the first week of March 1982, a suggested agenda (attachment 1) for the proposed discussion.

C. PEOPLE CONTACTED

On March 30, at the site, the staff met with the NRC resident inspector, Bill Hill. The following persons from NRC, Houston Lighting and Power (HL&P), and Brown & Root (B&R) were also present at the time of the site visit:

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|----------------|--------------------|----------------|
| L. Heller, NRC | M. McBurnett, HL&P | T. Mullin, B&R |
| D. Gupta, NRC | G. Steinkamp, HL&P | |
| J. Tapia, NRC | | |

On March 31 at the Brown & Root (B&R) offices in Houston, Rob L. Engen of HL&P provided several documents for staff review and audit. A list of the documents reviewed by Staff is given in Attachment 2.

During the discussion on April 1, also at B&R offices, the following persons from NRC, HL&P, B&R, Bechtel and Woodward Clyde Consultants (WCC) were present:

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|-------------------|--------------------|---------------------|
| L. Heller, NRC | R. Engen, HL&P | B. Pettersson, B&R |
| D. Gupta, NRC | M. McBurnett, HL&P | R. Woodward, WCC |
| J. Tapia, NRC RTV | M. Powell, HL&P | C. Hedges, WCC |
| D. Sells, NRC PM | | M. Power, WCC |
| | | S. Feroz, Bechtel |
| | | R. Talmage, Bechtel |
| | | J. Young, Bechtel |

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D. SITE VISIT ACTIVITIES

The plant construction work at the time of the site visit was at a standstill. It is proposed to resume non-safety related construction in June, 1982 and safety related construction in September 1982.

The staff activities at the site consisted of an inspection of the plant fill around the Category I structures of the two units. We observed the location stakes of the applicants' 1980 investigation and verification borings and inspected some of the settlement monuments installed on the outside of the structures, Sandex extensometers and piezometers. We also noticed that the Mechanical Electrical Auxiliary Building (MEAB) for Unit 2 is only partially complete. This building had a total recorded settlement of 4.29 inches, and an across-the-foundation tilt of 0.95 inches in June 1981. The allowable design tilt for this building is 1 inch.

Near Unit 1, the staff inspected the open trenches in which Essential Cooling Water (ECW) pipelines were lying. The sides of these trenches clearly showed the individual lifts in the structural backfill. The backfill we saw appeared to be compacted adequately. It was also clear that the backfill material is excellent from the point of view of quality of material and gradation and should be capable of being compacted adequately with proper compactive effort.

The staff walked along portions of the Category I ECW pipeline routes, the soil-cement lined cooling pond and near the intake and discharge structures. We also viewed the area of the proposed large cooling lake. The lake has not been filled yet because any water in the lake might interfere with the continuous pumping of the ground water at the site.

F. OFFICE DISCUSSION

At the time of the visit, the transfer of records from Brown & Root (previous A/E) to Bechtel (new A/E) was still in a transition phase, and had not been completed.

The discussion at the B&R office on April 1, 1982 closely followed the outline suggested by staff (Attachment 1). However, the applicant told the staff that it was not prepared to discuss items 9 and 10 of the agenda because any discussion on these subjects would have to involve expert committee members, none of whom was present at the meeting.

At the conclusion of the meeting, the following salient points of discussion were reiterated.

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1. The settlement data provided to the staff on March 31, 1982 (day before meeting) was up to June 1981 only. The staff suggested that applicant should provide up-to-date settlement data for all Category I structures for NRC review.
2. The applicant has provided a boring location plan for borings along the route of ECW pipeline; however, a profile along this line is not available for review. The staff requested the applicant to provide a soil profile along the pipeline, with the depiction of the pipeline, bedding details and cover clearly identified on the profile.
3. Based on the audit on March 31, 1982 the staff mentioned that the records indicate that some of the in-place relative density values for structural backfill underneath the intake and discharge structures are less than the FSAR specified requirements. The staff suggested that the applicant evaluate the impact of these relative densities on these safety related structures.
4. The applicant explained that the estimate of the extent of the four non-conforming areas identified in the expert committee report (Ref. 2) is based on later verification borings around the first of January 1980 investigation borings that showed non-conforming relative density zones. The applicant also mentioned that some inferences regarding the limits of these areas were drawn from the boundaries of the excavation slopes. Staff commented that the number of borings does not seem to be adequate to define the extent of the non-conforming zones, and the applicant's verbal reasons for isolating the non-conforming areas needs to be further documented for present staff review purposes and for the OL review.
5. For the liquefaction potential evaluation, the applicant has assumed that surface layer underneath the mat foundations may have low relative densities. However, any non-conformance, such as that found in four areas around the Category I buildings has not been investigated for areas underneath the buildings. The staff mentioned that the reason for the assumption that only the surface layer underneath the mat foundations may have non-conforming density is not clear to the staff. By prior agreement with the staff the applicant was not prepared to discuss the liquefaction potential evaluation analysis contained in the expert committee report at this meeting. If such a discussion is necessary, it will be scheduled at a later date.

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- 6. The staff mentioned that the immediate task before the staff is to determine whether there is sufficient evidence to:
 - a. justify the adequacy of the boring program in reaching the conclusion that the non-conforming areas under and around the category I structural foundations have been sufficiently identified, and/or their existence or non-existence has been properly extrapolated, and
 - b. conclude that the liquefaction potential of the non-conforming areas has been conservatively evaluated.

F. SUMMARY

Although the site visit, audit and the meeting with R&R have been very useful to the staff in understanding the applicant's viewpoint and reasoning on the above issues, the staff concerns were not completely resolved at the meeting. The staff informed the applicant that we will send formal questions to the applicant to seek further clarifications of these topics. The schedule for completion of the subject I&E Intersagency Task Assistance will be contingent on the satisfactory resolution of forthcoming staff questions.

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 Dinesh Gupta
 Geotechnical Engineering Section
 Hydrologic and Geotechnical
 Engineering Branch
 Division of Engineering

Attachments:

- 1. Agenda for meeting
- 2. Audit documents

cc: J. Knight
 L. Heller
 D. Gupta
 D. Sells, LPM
 E. Gallagher, IE
 J. Tapia, Rg IV
 R. Landsman, Rg III
 W. Hill

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Docket Nos.: 50-492/499

South Texas Project

Subject: Suggested Outline for Presentation by WCC to HRC on 4/1/82
(9:00 am to 12:00 noon)

Plant Backfill Evaluation
South Texas Project

1. ORIGINAL SUBSURFACE CONDITIONS AT SITE 5 minutes
2. DETAILS OF EXCAVATION, BACKFILLING, BORROW AREAS,
BORROW MATERIALS 5 minutes
3. PLANT LAYOUT 5 min.
 - i) Bldg Dimensions
 - ii) Static & Dynamic Load Intensity/All Cat I Structures
 - iii) Thickness of Backfill/All Cat I Structures
Underneath the Structures
 - iv) Design Groundwater Table
 - v) SSE & OBE
 - vi) Plant Profile of Cat. I Buried Pipes & Conduits
(Bedding and Backfill Procedures and Specifications)
4. CHRONOLOGICAL HISTORY OF PROBLEM (PLANT BACKFILL ONLY) 15 minutes
 - i) IE Show Cause Order
 - ii) Task Force Activities
 - iii) Independent Review Committee Activities
 - iv) Resolution of Items
 - v) Open Item Details (Liquefaction Potential Evaluation
of Identified Deficient Areas and Underneath
Mat Foundations)
5. SOIL DENSITY DISTRIBUTION WITHIN BACKFILL 10 minutes
 - i) Placement Specifications
 - ii) Details of In-Place Density Measurements
During Placement. (Method, locations, Depth, Freq.
Results)
 - iii) Statistical Analyses of Field Data
 - iv) I&E's Concerns
 - v) Resolution of Concerns

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| 6. BORING INVESTIGATIONS (1980) | 25 minutes |
| i) Details of Boring Program (No., Location, Depth, Procedure) | |
| ii) Details of SPT Program, I&E Concern for Nonconformance, Resolution of Concern. | |
| iii) Justification for Adequacy of the Extent of Boring Program | (10 minutes) |
| iv) Boring and SPT Data and its Discussion | |
| 7. DEFICIENT AREAS | 15 minutes |
| i) Discussion of Areas | |
| ii) Location of Areas with Respect to Cat. I Structures, Pipes and Conduits. | |
| iii) Extent of Deficiency | |
| iv) Possible Consequences of Deficiency | |
| v) Basis for Conclusion that all Potentially Deficient Areas Have Been Identified and Their Possible Effects on safety analyzed. | |
| 8. LIQUEFACTION POTENTIAL EVALUATION | 30 minutes |
| i) Description of areas (Around and underneath the mat foundations) analyzed for liquefaction potential | |
| ii) Procedure Used | |
| iii) Modeling | |
| iv) Input Parameters | |
| v) Laboratory Testing and Results | |
| vi) Field Geophysical Testing and Results | |
| vii) Assumptions in Modeling, Input etc. | |
| viii) Details of Computations | |
| ix) Results and Conclusions | |
| x) Possible Consequences of Liquefaction of Deficient Areas. | |
| 9. ANALYSIS OF POTENTIAL DEFICIENCY UNDERNEATH THE MAT FOUNDATIONS | 10 minutes |
| 10. UP-TO-DATE SETTLEMENT EXCAVATION, HEAVE AND RECOMPRESSION DATA/ ALL CAT. I STRUCTURES | 30 minutes |
| - Analysis of allowable and measured differential settlements. | |
| 11. BURIED PIPING AND CONDUITS PROFILE AND RELATIONSHIP TO DEFICIENCY. | 10 minutes |

List of Documents Reviewed on 3/31/82

at Brown & Root Office, Houston

1. Technical Ref Document #SY310SR112, dated 10/10/81 - Geotechnical Monitoring, 2 volumes.
2. TRD # 3A7006P001-B, dated 1/29/81 - Cat I Structural Backfill Placement and Quality Control Data.
3. Evaluation of Liquefaction Potential, South Texas Project Units 1 & 2, WCC, dated July 25, 1975.
4. Expert Committee's Final Report, Jan. 30, 1981.
5. WCC Structural Backfill Investigation, May 28, 1980.
6. Pittsburgh Testing Laboratory Procedure # QC-ST-1, "Soils Inspections and Tests - Field, Feb. 26, 1976.
7. WCC Statistical Analysis Report, Jan. 23, 1981.
8. WCC Report on Standard Penetration and Density Comparison, January 22, 1981.
9. Settlement/Heave Cat I - Differential Settlement Unit I, Brown & Root Cat # 3Y310SC264 - 14F, 9/19/81.
10. Settlement/Heave Cat I Diff Settlement Unit 2, Brown & Root Cate No. 3Y310SC 264-18C, 9/28/81.
11. TRD # Y0605r 159 C dated 3/25/82. Structural Backfill Data Compilation, Placement and Testing Information, 2 Volumes.
12. TRD # 3A7006P002-B/dated 9/24/80 Test Program for Compaction of Cat. I Structural Backfill.