3, 8. 79

BECHTEL INVESTIGATION
INTO CAUSES
OF DIESEL GENERATOR
BUILDING SETTLEMENT

Consumers Power Company
Midland Plant Units 1 and 2

DEVIATION STATEMENT:
"INSUFFICIENTLY COMPACTED BACKFILL"

	Is	Is Not	Distinctions	Changes
WHAT	DG Bldg Admin Bldg Transf FND Cond Tank Area Diesel Tanks	Pond Dikes Plant Area Dikes incl Evap Bldg Cooling Tower Radwaste Bldg Tank Farm Area Pipe Tunnel	Spec /Acceptance Criteria Diff Material	Reliance on Testing Introduced Struct Backfill
WHERE	Plant Fill Area	Glacial Till (Undisturbed) Insitu Natural Sand Backfill under Powerblock N&W Plant Dikes Pond Dikes Undisturbed Plant Fill (? Cond Tank Area)	Smaller Areas Temporary Fill Ramps Q-Listed Process (Inspection)	Small Equipment Nonuniform Compaction Different Contractors Test Frequency

Preliminary 2/15/79

DEVIATION STATEMENT:
"INSUFFICIENTLY COMPACTED BACKFILL" (Cont.)

	Is	Is Not	Distinctions	Changes
WHEN	Sept 77 Admin Mid 78 Other	Prior to 1977	Pond Filled 74-75 Slowdown 76-77 Dry Yrs Late in Schedule	Borrow Area Moisture Personnel Initial Moisture Content More Winters
EXTENT	Area South of Turbine Bldg in the Upper Portion of the Fill Approx EL 615 to EL 628	Elsewhere or Below EL 615	Proximity to Cooling Pond Extensive U/G Installations Reexcavated Area	

Preliminary 2/15/79

G-0476-02

POSSIBLE CAUSES

Test		Cause
SPECIFICATION/ACCEPTANCE CRITERIA	No	Used All over Site
TESTING	✓	Questionable, under Review, Check R/W
DIFFERENT MATERIAL	?	Under Review, Relates to Proctors
STRUCTURAL BACKFILL	No	Used All over Site
REEXCAVATED AND REFILLED AREA (Procedures and Controls)	✓	Investigate Photos, Procedures, Controls
SMALLER AREAS	No	
NONUNIFORM COMPACTION		Subcategory of Reexcavated Area
SMALL EQUIPMENT (Large Lifts)		Used All over Site
TEMPORARY FILL NOT REMOVED?	✓	Review Photos
RAMPS NOT REMOVED?	✓	Review Photos
DIFFERENT CONTRACTORS	No	
TEST FREQUENCY	?	Check R/W

Preliminary 2/15/79

G-0476-04

POSSIBLE CAUSES (Cont.)

Test		Cause
Q-LISTED PROCESS (Inspection Process)	✓	Except for R/W
POND FILLED		Other Areas Have Not Settled Although Pond Filled Now
74-75 SLOWDOWN	?	Impacted Personnel, Procedures, Controls
76-77 Dry Years	?	Involves Moisture Content Questions Below
BORROW AREA (Stockpile)	?	Involves Moisture Content Questions Below
INITIAL MOISTURE CONTENT	?	Under Review with Tests
FINAL MOISTURE CONTENT	?	Under Review with Tests
LATE IN SCHEDULE	No	Other Areas Not Affected
MORE WINTERS	No	Other Areas Not Affected
PERSONNEL	✓	
PROXIMITY TO COOLING POND	?	
EXTENSIVE UNDERGROUND INSTALLATIONS		———

Preliminary 2/15/79

ITEMS TO INVESTIGATE FOR MOST PROBABLE CAUSE(S)

- REEXCAVATION AND BACKFILL
  - Material Selection
  - Inadequate Procedures & Controls
  - Review Photos, Procedures, Controls & Subcontractor Daily Reports
- TEMPORARY FILL AND RAMPS NOT REMOVED
  - Inadequate Procedures & Controls
  - Review Photos, Procedures, Controls & Subcontractor Daily Reports
- Q-LISTED PROCESS-INSPECTION PROCESS
  - Review Surveillance & Inspection Procedures In Relation to Other Findings
  - Audit Procedures Bechtel and Canonie
- TESTING
  - Results are Questionable - Relied on
  - Testing Is under Review
  - Procedure Changed 9/78
- PERSONNEL
  - Minimal Involvement of Technical Support after 74-75 Slowdown
  - Bulk of Earthwork Complete
  - Review Qualifications of Testing, Inspection, & Supervisory Personnel

Preliminary 2/15/79

Bechtel Power Corporation

Midland Units 1 and 2
Bechtel Job 7220

PRELIMINARY

February 16, 1979

PROBLEM of INSUFFICIENTLY COMPACTED BACKFILL

QUESTIONS to be INVESTIGATED to ARRIVE at MOST PROBABLE CAUSE(S)

(1) Re-excavation and backfill process —

  (a) Material mix unacceptable?

  (b) Construction did/did not have adequate procedural control for this type of activity?

(2) Nonremoval of temporary fill and construction ramps?

(3) Was inspection process by Bechtel (QC, Field Engineering and Subcontracts), Canonie QC, and audit process adequate?

(4) Nonrepresentative or invalid test results used as acceptance criteria?

(5) Personnel —

  (a) Insufficient support by technical groups such as Geotech?

  (b) Turnover due to Project delays?

  (c) Turnover in UST personnel?

  (d) Qualification of all parties (Bechtel Field Engineering, QC, Canonie, UST technicians, etc.)?

Bechtel Power Corporation
Midland Units 1 and 2
Bechtel Job 7220

February 16, 1979

TASK FORCE PLAN

INVESTIGATION INTO CAUSE(S) OF INSUFFICIENTLY COMPACTED BACKFILL

QUESTION	Investigate By	Status of Investigation
1) Re-excavation & backfill process--		
a) Material mix unacceptable?	Consultant review	Planned
b) Construction did/did not have adequate procedural control for this type of activity?	Review of records (QCIRs, Subcon. reports, etc.)	Planned
2) Nonremoval of temp. fill & construction ramps?	Review of Construction records, photos, soil test records, Canonie's records.	In process
3) Was inspection process by Bechtel (QC, Field Eng. & Subcontracts), Canonie QC and audit process adequate?	Plot soil test results & review QCIRs, Canonie daily reports, audit reports, NCRs.	In process
4) Nonrepresentative or invalid test results used as acceptance criteria?	Review UST records; plot & review soil test records; select & dig test pits.	In process
5) Personnel		
a) Insufficient support by tech. groups such as Geotech?	Review freq. of visits & trip reports.	Planned
b) Turnover due to Project delays?	Review Project manpower records.	Planned
c) Turnover in UST personnel?	Reviewing UST records.	Planned
d) Qualification of all parties? (Bechtel Field Eng., QC, Canonie, UST technicians, etc.)	Review personnel records & resumes, training records.	Planned

PRELIMINARY DRAFT

MAR 2

P. A. Martinez

MIDLAND PROJECT GWO 7020 - DIESEL GENERATOR FOUNDATION
PRELIMINARY DEVIATION STATEMENT 2/15/79 (Kepler - Tregue Analysis)
File: Serial:

Bernal /
Weidner /

We have some comments on the Bechtel's approach to identify the "most probable causes." Because the analysis could be self serving, CPCo has asked and Bechtel has agreed that CPCo should provide comments. These comments are noted below:

1. Can Bechtel provide information regarding the levels of confidence which can be obtained in arriving at the most probable cause(s).

2. The individual items considered are broad and general rather than specific and narrow. By not being specific, certain basic items are deleted and will be ignored or forgotten in the final analysis. We believe specification/ acceptance is one of the distinctions which is deleted on broad and general analysis while in fact it is very germain to the cause discussion.

3. This method also discards items which are not different and concludes they are not problems. One could argue that this is not valid and use the liner plate bulge as an example. Embedded pipe was used on other projects and even in other areas of this project, yet at Midland it froze, cracked the concrete and bulged the liner plate.

4. We also note that, [illegible] ~~development by~~ CPCo and Bechtel Field were not involved in the development of the K-T Analysis used for this presentation.

Specific comments on analysis items listed by Bechtel:

Page 1:

A. Second column; Radwaste Building and Tank Farm area should be under IS

B. Fifth column; Introduced Struct. Backfill - cite specification C-211.

C. Should also add the difference in Spec C-210, C-211.

D. Method for compacting material for dikes vs. plant area fill (excluding north & west plant area) was different. Should be included under changes.

E. Under Changes; less inspection should be included.

Page 2:

A. Third Column; Elsewhere or below 615' -- Was this material excavated (disturbed)?

B. Column 4 - 74-75 Slowdown - The time during the slow down (1974-75) would have provided more time for natural consolidation which was an early 1900's method of compaction.

C. Column 5 - More winters - The local of the fill affected by "number of winters" is probably below elevation 615. Since this locale is supposedly satisfactorily compacted "winters" in itself should not be considered as an adverse factor. Incorporation of frozen backfill should be considered, however.

D. Column 5 - Opposite "Extent" - The lower part of the Diesel Generator building foundation which lies below elev. 615' has already been subjected to preloading by the 20' of fill above it. Since portions of the lower part of the fill appears to be satisfactory preloading promises good results for the upper 20' of fill this observation may render the distinction of elevation of no consequence. In reviews of your records the differences in the fill between the lower and upper elevations should be documented and analyzed.

Page 3:

A. Column 3 - Distinction - Because buildings were constructed the problem was discovered. This should be added as a distinction.

Is not - Prior to 1977 - Special emphasis has been placed on the work below 615' and prior to 1977. Obviously, the time period should be developed for the fill placed below elev. 615', and the conditions in which placement was executed. It should also be determined whether major re-excavations were made below elevation 615' and whether sand was re-introduced to the fill below elevation 615'. In total Bechtel should scope the extent of the re-excavations in the problem areas.

B. Different Material and different contractors - relates to the capabilities of the individual personnel involved. Both these areas should be checked as a possible cause.

C. Re-excavated and refilled area - More research is required to define whether materials in question were disturbed.

D. Small areas - Small equipment - These two items may contribute to non-uniform and inadequate compaction and should be included as a possible cause.

Page 4:

A. Initial & Final Moisture Content - should be examined from a time and elevation standpoint.

B. Proximity to cooling pond - This item should be answered "no" at this time considering the test item "pond filled".

C. Testing - Inspection - Should also be tied in with elevation and timing.

Listed below are some of the items we feel should be investigated as possible causes:

1. Application of different specification creiteria may have contributed to the problem. Specifications may not have been clear or simple enough to satisfy proper implementation.
2. Backfill sand and clay interfaces may have not been blended correctly. Sand in this regard may have been a problem.
3. The fact that the work under the D/G Building was completed in smaller areas may have contributed to the problem.
4. From borings it woul.d appear that non-uniform compaction may be a site wide problem.

5. The use of smaller equipment and large lifts should be included as a possible cause.

6. Because Bechtel and Canonie both worked extensively in this area we feel that this aspect should be investigated. (This would relate also to inspection effort, controls and space.)

7. Structural backfill and pit run sands may not have been placed in the correct areas.

8. During placement of foundation footings, the underlying soil may have been frozen and subsequently heaved.

9. Frozen soil may have been incorporated in the fill and covered by subsequent lifts.

10. Equipment utilized for small areas may not have been adequate to achieve the required compaction.

11. Material placement and compaction may not have been properly supervised or inspected.

12. Areas of re-excavation may not have been dressed up to blend with materials used for trench backfill.

13. Fill may have been placed during rainy days.

14. Material may have been placed but not compacted, or test frequency required by specifications may have not been adequate for small areas.

15. Bechtel inspection was not as detailed or comprehensive as Canonie (lift checks, time in field).

16. No qualified soils engineer on site during 1975-1977 backfill operations.

17. No plots of tests made to assure uniform coverage. This may be a specification deficiency.

18. Test location incorrectly called out.

19. Areas may have been prepared solely for the purpose of taking a test.

20. Test records were not reviewed in a timely fashion and in the depth necessary to identify testing errors.

21. Investigate the refill vs. the primary process of placing soils. There could be some differences that cause the problem.

22. Look hard at the Bechtel vs. Canonie performance - why was there a difference in performance.

23. Flooding sand in trenches was a common practice to achieve compaction. It may be that surrounding clays were saturated and subsequently softened resulting in weak fill and poorly compacted sands.

24. Bechtel's QC involvement administration and direction of U.S. Testing activities may have resulted in inadequate testing procedures.

The above comments do not necessarily provide guidance or limit the extent of possible concerns or areas of investigation and should not be constructed as such.

To BWMarguglio, JSC-220A

From DEHorn, Midland DEH

Date October 31, 1978

Subject MIDLAND PROJECT - NRC EXIT
INTERVIEW OF OCTOBER 27, 1978
File: 0.4.2 Serial: 280FQA78

Consumers Power Company

INTERNAL CORRESPONDENCE

CC SAfifi, Bechtel - Ann Arbor
WRBird, JSC-216B
RLCastleberry, Bechtel - Ann Arbor
TCCooke, Midland
JLCorley, Midland
GSKeeley, P14-408B
DBMiller, Midland
JFNewgen, Bechtel

The following people were in attendance at the subject exit interview which was conducted at the end of G. J. Gallagher's inspection of October 24-27, 1978:

CPCo	Bechtel	NRC
RCBauman	WLBarclay	RJCook
TCCooke	ABoos	GJGallagher
JLCorley	RLCastleberry	
DEHorn	LADreisbach	
GSKeeley	PAMartinez	
DBMiller		
BHPeck		
RMWheeler		

Mr. Gallagher stated that the visit was a follow-up on 50.55(e) report of the diesel generator settlement and that it was also a fact finding visit. The inspection consisted of a review of past data, activities in progress and planned activities for future work. Inspection was performed by review of the FSAR commitments; Specification C-210; Specification C-211; PQCI/IR C-1.02; Dames and Moore Report of Foundation Investigation and Preliminary Explorations for Borrowed Materials dated June 28, 1968 and supplement to this report dated March 15, 1969; preliminary data on diesel generator settlement problem including boring plan, cross sections of fill, blow count versus the elevation graphs, lab data, settlement data, boring logs, dutch cone logs, weather data and penetrameter readings in test pits; design drawings C-45, C-109, C-117 and C-1001; soil tests taken in the diesel generator building area during construction compiled by B. T. Cheek, Bechtel QC; observation of soil testing at the test lab and in the field; and discussions with Bechtel Geo-Tech, Project Engineering, Field Engineering, Quality Control Engineering, U.S. Testing, Consumers Power Company, PMO and QA personnel. Mr. Gallagher stated that he would not handle the findings as noncompliances, however, they could become items of noncompliance when they are reviewed by his management.

His findings/observations were as follows:

1. The FSAR states that during operation, settlement readings will be taken every 90 days. Because of the diesel generator settlement problem, this frequency should be re-evaluated for adequancy.

   [illegible] make [illegible] at this time.

2. FSAR Table 2.5-14 "Summary of Foundation Supporting Seismic Category I Structures" identifies the supporting soil materials under the diesel generator building as being controlled, compacted cohesive soils. However, construction drawing C-109, Rev. 9 and C-117, Rev. 6 identifies the material in this area as Zone 2 material. Zone 2 material is identified as random fill described as any material free of organic or other deleterious materials. In the field a variety of materials have been used for the diesel generator foundation material, in particular, sands, clay, and lean concrete, silty sands and clayey sands. The apparent conflict is that Table 2.5-14 identifies cohesive soils where, in actuality, cohesionless sands have been utilized. A review of the records indicate that sands have been used between elevation 594'-608', areas of elevation 611'-613' and areas between 616'-622'. This indicates the extent of the variability of the material placed under the diesel generator building foundation. Mr. Gallagher did not feel it was good judgement to use random material under the support of a structure.

3. FSAR Table 2.5-21 "Summary of Compaction Requirements" identify random fill to require a compaction effort of a minimum of 4 passes with the specified equipment in this table. This requirement has not been an imposed requirement of Bechtel Specification C-210 nor an inspection requirement of Bechtel Quality Control Instruction C-1.02 for backfill.

4. FSAR section 3.8.5.5 states that settlements of shallow spread footings founded on compacted fill are estimated to be on the order of ½" or less. Site Survey Program has identified settlements in the diesel generator building foundation on spread footings to range from 0.55 inches to 2.30 inches and in excess of 3.0 inches for the diesel generator pedestal.

5. FSAR figure 2.5-47 indicates the foundation of the diesel generator building to be at elevation 634', according to design drawings C-1001, Rev. 5 it is indicated for the diesel generator spread footings and pedestal foundation to be at 628'.

6. A. Specification C-210, section 13.7.1 requires all cohesive backfill in the plant area to be compacted to not less than 95% maximum density as determined by ASTM D1557 method D which requires an effective compactive effort of 56,000 foot-pounds of energy per cubic foot of soil. However, section 13.4 Testing requires testing of the materials placed in the plant area to be performed in accordance with tests listed in section 12.4. This section, in particular section 12.4.5.1, "Cohesive Soils," requires maximum lab densities to be determined using ASTM D1557 Method D provided a compactive energy equal to 20,000 foot-pounds per cubmic foot is applied (Bechtel Modified Proctor Density). To date, the Bechtel Modified Proctor Density for determining maximum proctor density versus optimum moisture content has been utilized. This conflict results in an unconservative method of determining the maximum proctor density and method of assuring that the required percent compaction is achieved. In particular, the actual in-place compaction would be less using the Bechtel Modified Proctor Density as a reference than using the standard ASTM D1557 method D. This is due to the fact that the compactive energy exerted using the Bechtel Modified Method is less than the effort exerted by the standard method D - example: 20,000 foot-pounds versus 56,000 foot-pounds.

Bechtel Quality Control Instruction C-1.02 section 2.4 testing identifies the applicable inspection criteria and includes Specification C-210, section 13.7 and 12.4 which includes the apparent conflict as described in detail in Part A above.

.. A further review of the original subsurface investigation performed by Dames and Moore and documented in report supplement dated March 15, 1969 page 16 indicates that the recommended minimum compaction criteria for support of structures be 100% of maximum density using a compactive effort of 20,000 foot-pounds (resulting from Bechtel Modified Proctor determination). However, this 100% of Bechtel Modified Proctor corresponds to 95% compaction according to the standard ASTM D1557 method D and not 95% compaction according to Bechtel Modified Proctor method which has been utilized for the entire plant fill area to date. Furthermore, Dames and Moore Report, page 15 states that all fill and backfill material should be placed at or near the optimum moisture content in near horizontal lifts approximately 6-8" in loose thickness. Bechtel specification permits a maximum of 12 inches which affects the compactability of the material.

7. Piping, condensate lines, duct banks, and other utilities under the diesel generator building may also be affected and must be evaluated.

8. Mr. Gallagher stated he was leaving not having seen design calculations and will be discussing design calculations, assumptions made, and conflicts with the FSAR with Licensing.

9. The inspector observed the structural concrete crack that has developed in the east exterior wall. The crack was observed with members from Bechtel Geo-Tech and Consumers Power Company. The crack extended full height of the wall and continued down through the spread footing as seen from the inside of the building. The crack is expected to have been induced flexurally caused by differential settlement. Discussion with Bechtel design staff has indicated that this crack is under study and is currently being evaluated. ACI-318-71 in the commentary section 10.6.4 limits flexural crack exposed to the outside to 0.013". Corrective action may be required if this limit is exceeded.

10. The following tests were observed to be performed in accordance with the applicable tests standards by U.S. Testing:

    A. Lab Test ASTM D1557-70

    B. ,Field Test ASTM D/1556-64

11. Calculations should be evaluated on the increase and the rate of increase of the pond fill and the effects of the water in other areas.

12. Mr. Gallagher stated that the NRC does not view preloading of the structure to be a fix or resolution of the problem at this time.

13. Seismic loading calculations should be determined for the type of material existing in its present condition.

Bob Wheeler has looked at [illegible] spec 7C-501 & FSAR & PSAR & C-210 & 211 & compared

10/11/78

RWW

INCONSISTENCIES DISCOVERED TO DATE

9

Is having an Engineering list.

Bob [illegible] memo asking [illegible] predict [illegible]

1) References:

a. Dames & Moore Report (Page 15)

b. Standard No. 7220-C-501, "Civil & Structural Design Criteria" (Page 8)

"Filling operations shall be performed under the technical supervision of a qualified Soils Engineer who will perform in-place density tests in compacted fill to verify that all materials are placed and compacted in accordance with recommended criteria."

Bob [illegible] could be [illegible] we have the problem

Bechtel Field did not have a Soils Engineer on site.

Take sample of material to be used for fill & run test. This gives optimum [illegible] it & as you place it [illegible] & its too [illegible] & density [illegible] 500 [illegible]

2) References:

a. Dames & Moore Report (Page 14)

b. Bechtel Specs C-210 and C-211

[illegible] 10, [illegible]

Dames & Moore - "All fill and backfill materials should be placed at or near the optimum moisture content in nearly horizontal lifts approximately six to eight inches in loose thickness."

Bechtel Specs - C-211, Section 5.2.2 - "However, in no case shall the uncompacted lift thickness exceed 12 inches."

Obviously, these two requirements conflict.

CPCo. has noted areas where 12" exceeded [illegible] Bechtel [illegible] may not have had a good [illegible] like a concrete [illegible] involved.

Random fill is permitted [illegible] may have not compacted adequately [illegible] type [illegible] for [illegible] Bechtel Modified [illegible] assigning Bechtel Modified Proctor Tests [illegible]

3) References:

a. Dames & Moore Report (Page 15)

b. Bechtel Specification C-211

Dames & Moore - "In addition, no compacted soils should be allowed to freeze. If fill or backfilling operations are discontinued during periods of cold weather, it is recommended that all frozen soils be removed or recompacted prior to resumption of operations."

Bechtel Spec - "No backfill shall be placed upon frozen surface nor shall any frozen material be incorporated in backfill."

This does not address the question of removal or recompaction upon resumption of work.

[illegible] is being [illegible] less dense

compared to criteria [illegible] group [illegible]

Bob was told [illegible] to use [illegible]

4) References:

a. Bechtel Design Standard C-501

b. Bechtel Spec C-211

AA Bechtel Design Standard - Table of Minimum Compaction Criteria

Purpose of fill - On site
support of structure Sand soil
Percent relative density —
85% (D2049-69)

Could be significant under bldg.

Spec C-211, Section 5.5.1 - "Cohesionless (sand) material shall be compacted to not less than 80% relative density.... by ASTM D. 2049"

Spec and Design Standard conflict.

5) References:

a. Dames & Moore Report (Page 14)

b. FSAR Page 2-7

c. Drawing C-44

Sand lens — Diesel

Dames & Moore - "It is recommended that all areas in which the final grade will be raised by placement of fill be stripped of all topsoil and other unsuitable soil if any and be thoroughly proof rolled."

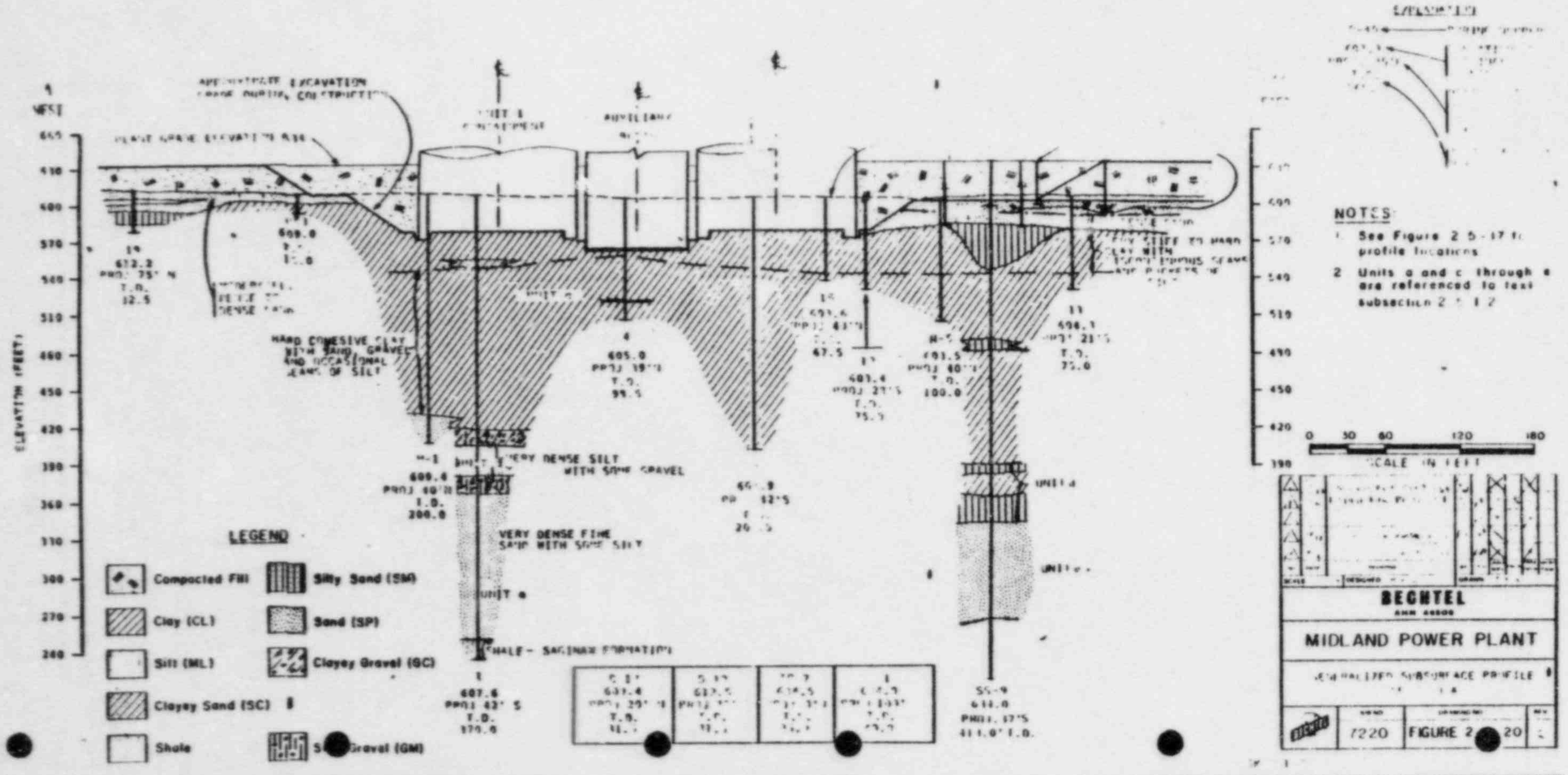
FSAR - "All loose in-site sands, soft or compressible clay soils, and organic soils will be excavated in the Turbine Building area."

Bechtel Drawing C-44, Note #4 - "Within the excavation area shown all loose surficial sands with relative density less than 75% shall be removed."

Added to this drawing 8/23/75. — work was done year before this

Boring logs show us that the soil was not removed, however, it may be greater than 75%.

Vibration + water



NOTES:

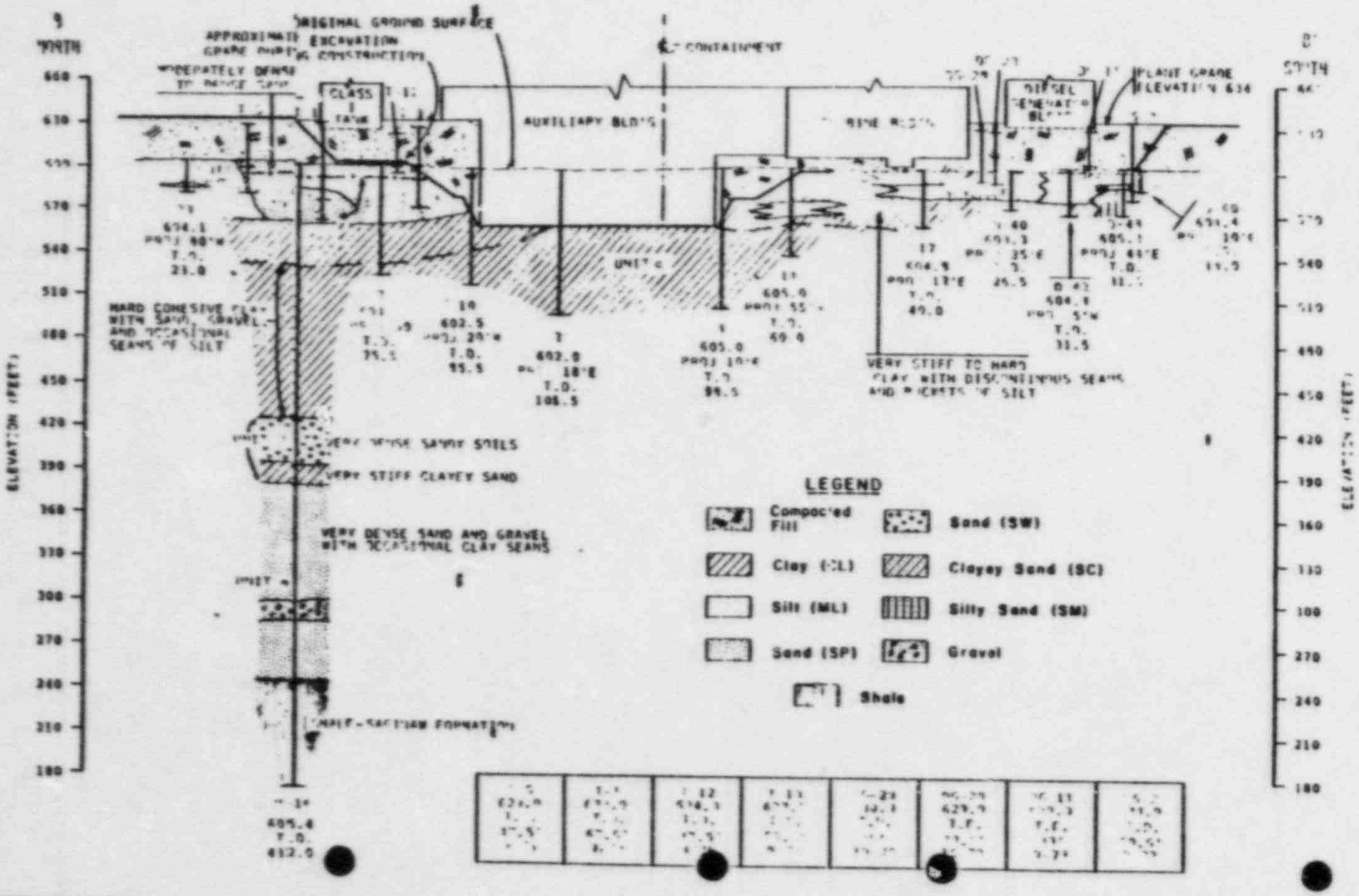
1. See Figure 2.5-17 for profile locations
2. Units a and c through e are referenced to text subsection 2.5.1.2

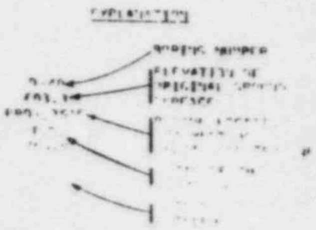
BECHTEL

MIDLAND POWER PLANT

GENERALIZED SUBSURFACE PROFILE

7220 FIGURE 2.5-20





NOTES:

1 See Figure 2 5-17 for profile locations

2 Units a, and c through e are referenced to text subsection 2 5 1 2

0 30 60 120 180

SCALE IN FEET

BECHTEL

ANN ARBOR

MIDLAND POWER PLANT

FIGURE 2 21

92

[illegible]

Consumers
Power
Company

80EP10.1.3
General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • (517) 788-0550

January 23, 1980

Mr Tom Newell
Acting District Engineer
PO Box 30028
Lansing, MI 48909

MIDLAND PLANT - SITE DEWATERING

As part of the engineering design to control groundwater elevation in the area North of the cooling pond, dewatering wells have been installed by Loughney Dewatering, Inc, Certificate of Registration under Act 294 attached. Approximately 138 temporary wells (1-1/2") have been installed since August 1, 1979. Identification of individual wells, well depth and estimated pumping rate of each 'series' of wells is provided in the attached data sheets. Well locations are identified in the attached drawing entitled "Midland Power Plant, Temporary Dewatering Well Locations".

The dewatering discharge of all wells will be directed to the cooling pond. As you can see from the data sheets, the flow to the pond will be about 320 gpm. Data derived from the temporary dewatering operation will aid in the design and operation of a number of permanent dewatering wells to be installed at some future date.

The Company requests dewatering as described above be addressed in the following parts of the draft Midland NPDES permit issued January 2, 1980:

(1) Fact Sheet

(2) Final Effluent Limitations - Cooling Pond Discharge prior to outfall 001, page 6 of 19.

The dewatering discharge to the cooling pond is expected to commence January 31, 1980. Unless advised otherwise by Staff, the dewatering discharge to the pond will proceed as scheduled.

If you have any questions regarding this matter, please let me know.

Ronald L Fobes

R L Fobes
Environmental Advisor

CC Chang Bek

RLF/ksh

BCC TCCooke/RLBull, Midland
DLAndersen, Midland
RCBaumann, P-14-412
RFGreen, P-14-303
~~CAHunt~~/TRThiruvengadam, P-14-209B
w/o attachments

P/

Bechtel Associates Professional Corporation

SUBJECT: MCAR 24 (issued 9/7/78)

Settlement of the Diesel Generator Foundations and Building

INTERIM REPORT 4

DATE: February 16, 1979

PROJECT: Consumers Power Company
Midland Plant Units 1 & 2
Bechtel Job 7220

Introduction

This report is submitted to advise of the interim status of the project's actions relating to the settlement of the diesel generator foundation and building as described in MCAR 24 and NRC 1482. This report describes developments and action since Interim Report 3 dated December 27, 1978.

Description of Deficiency

The general diesel generator foundation and building settlements as of February 2, 1979, are shown in Figures 1 and 2 and Figures 13 through 16 (attached). Figures 15 and 16 have been added since Interim Report 3 and show the maximum/minimum time settlement curves for the diesel generator building and one diesel generator foundation, respectively. It should be noted that over the last 5 weeks the rate of settlement for these foundations has significantly decreased. *

Corrective Action

As discussed in Interim Report 3, preloading of the diesel generator building area was the selected option for corrective action. The preload sequence consists of placing granular fill inside the diesel generator building and for a distance of 20 feet outside the building. The level of preload will be brought up in a sequence in the designated areas as shown in Figures 11 and 12. The maximum expected height of preload will be 20 feet above final plant grade.

The placement of the preload between the diesel generator building and the turbine building will utilize temporary retaining forms. Because the turbine building is located just north of the diesel generator building, the preload will extend approximately 19 feet from the diesel generator building wall.

The instrumentation installed in and around the diesel generator building, as shown in Figures 1 and 17, will monitor settlement and changes in the soil conditions as the preload is placed. Cross sections showing elevations of the Borros anchors and piezometers in the diesel generator building area are presented in Figures 24 and 25. Mr. C.J. Dunnicliff, our soil instrumentation consultant, is presently preparing a report summarizing details of installation and monitoring of instrumentation.

Activities Completed Since the Previous Interim Report

1. Monitoring Cracks in the Diesel Generator Building Walls

   The existing cracks in the diesel generator building walls have been mapped to assist in the evaluation of the structure. Strain gages have been placed at select locations shown in Figures 17 and 18 to monitor changes in crack width during the preloading operations.

On February 2, 1979, the maximum recorded crack width was approximately 28 mils.

2. Utility Monitoring

The underground utilities passing near and under the diesel generator building are being monitored during the preload operation. Pipe profile settlement gage measurements have been taken on selected pipelines by Gold-Zoino-Dunnicliff & Associates under the direction of Mr. C.J. Dunnicliff. Figure 19 shows the location of all the surveyed pipelines and the locations of the readout points. Additional profiling of the condensate line under the diesel generator building will be performed after the preload steps IV, VI, and VII given by Table 1 of Figure 12. *

3. Soil Exploration

The soil borings and test pits addressed in MCAR 24, Interim Report 3 have been completed. Locations of these borings, pits, and dutch cone penetrations are shown in Figures 7, 8, and 20. Cross sections summarizing results of field work in the tank farm and diesel generator building are presented on Figures 21 through 28. The pocket penetrometer readings in the test pits are summarized on Figures 29 and 30. Results of density and compaction tests made in the test pits are presented in Figure 31. *

Laboratory soil tests have been performed by Goldberg-Zoino-Dunnicliff & Associates, Inc. These tests have been made to aid in selecting the remedial measures to be used in the different plant areas. These results include data on moisture content, unit weight, plasticity, gradations, strength, consolidation, compaction, mineralogy, and cation exchange capactiy. Graphical summaries of the diesel generator building soil plasticity, water content, dry unit weight, total unit weight, and shear strength are presented in Figures 32 through 37.

These tests indicate that the diesel generator building backfill samples had:

a. Plasticity characteristics from nonplastic to low plasticity (Figure 32)

b. Moisture content from ~~about~~ appoximately 2 to 35% averaging about 13% (Figure 35)

c. Dry unit weights between 96 and 130 pcf, averaging about 120 pcf (Figure 34)

d. Total unit weights between 112 and 143 pcf, averaging about 133 pcf (Figure 35)

? why different ?

e. Shear strengths based on unconfined compression test results on the samples obtained ranged from ~~about~~ approximately 250 to 3,646 psf (Figure 36)

f. A shear strength to moisture content relationship as shown in Figure 37

Additional laboratory tests are being made, including consolidated-undrained triaxial tests in which consolidation pressures will be selected to model stress histories that will be experienced in the field at the differenct locations.

4. NRC Inspection Report

In response to the conflicts addressed in NRC Inspection Reports 50-329/78-12 and 50-330/78-12 dated November 14, 1978, FSAR change notice has been initiated to address Items a, b, c, and d listed in Section 4 of Activities in Progress for Interim Report 3. Further evaluations of the additional items are continuing and will be addressed in subsequent reports. *

5. SEE INSERT A

Activities in Progress

1. Strengthening of the Turbine Building Wall

The structures in the area of the preload have been evaluated. *

Because of the close proximity of the turbine building, a temporary reinforcement of the below grade turbine building wall is required to support the lateral earth pressure resulting from the preload. This wall reinforcement consists of a system of tie rods between the buildings, shimming of the turbine building wall to existing structural elements inside the turbine building, and adding steel braces, buttresses, and composite reinforcement to the existing turbine building wall. This work will be completed before the preload is placed above el 644'-0".

Ⓐ Evaluation of Underground Pipe for Preload Pressur

The condensate pipes (20"ϕ), service water pipes (26"ϕ) and circulating water pipes (6'ϕ and 8'ϕ) have been evaluated for the pressure the preload will impose upon them.

The condensate ~~lines~~ and service water pipes can ~~resist~~ the temporarily imposed pressure. The evaluation of the circulating water pipes indicated that temporary internal bracing may be needed. A survey was made on the roundness of these lines which showed that the bracing may not be needed. The roundness survey will be ~~continued~~ preformed at key preload levels to verify that the pipe will not be adversely effected by the preload.

2. Preload Operation

Preloading of the diesel generator building is continuing. As of February 2, 1979, the granular fill material for the preload has been placed to the elevation shown in Figure 38.

3. Cutting of the Condensate Pipelines

The two 20-inch condensate lines and two 8-inch condensate lines shown in Figures 9 and 10 have been cut outside the turbine building wall to prevent potential overstressing of the pipes during preload. Continued surveillance will be provided on the cut pipelines and further evaluation will be provided in subsequent reports.

4. Evaluation of Field Records

Field density test results are being evaluated to determine if any additional work will be required.

5. Summary of Plant Fill Under Seismic Category I Structures *

Action required for ~~Class I~~ Seismic Category I sturctures on plant fill were discussed with Dr. R. Peck, Bechtel's consultant in a meeting in Alburquerque, New Mexico, on December 8, 1978. A discussion of the current status of these Seismic ~~Class I~~ Category I structures is given below. *

a) Tank Farm

Field studies in the tank farm area show generally stiff to very stiff clay backfill with some ~~stiff~~ soft zones and occasional medium to * very dense sand backfill over natural soils. Current plans involve continuing to monitor settlements until tanks are completed and then early loading foundation soils by filling the tanks and measuring structure settlements until expected additional settlements ~~would~~ will be within tolerable limits. No surcharge in addition to tank loading is planned, but settlement measurements will be continued after completion of preloading.

are?

[illegible] for Check.

b) Diesel Generator Building

Field studies in this area indicate that the backfill consists primarily of very soft to very stiff clay backfill with pockets and layers of very loose to dense sand backfill over natural soils. These backfill materials are highly variable in strength, moi~~n~~sture content, and unit weight, but are relatively uniform in plasticity and grain size distribution characteristics. The sands also have relatively uniform grain size distribution.

c) Diesel Fuel Tanks

Field studies made adjacent to the diesel fuel tanks show loose to dense sand backfill and stiff to very stiff clay backfill with some soft zones over natural soils. Settlement of these tanks will be monitored to observe the behavior of these tanks.

d) Retaining Walls Adjacent to the Service Water Pumphouse

Borings in the retaining wall areas indicate that this wall may be supported by stiff to very stiff clay backfill over natural soils.

The wall will continue to be monitored to allow further evaluation.

e) Service Water Building Area on Plant Fill

Borings in this area indicate loose to dense sand backfill exists adjacent to the building. Conditions of the building are under evaluation.

f) Service Water Pipes

Borings adjacent to the service water pipes showed soft to very stiff clay backfill with occasional dense sand backfill over natural soils. Borings Q-3 through Q-7 indicated some very soft clay backfill. These conditions are under evaluation. These pipes will be monitored for settlement.

6. Cooling Pond Fill

Since November 8, 1978, the cooling pond has been filled from el 621.9 ~~[illegible]~~ to its current level of 626'-0". Additional filling to the maximum level of 627'-0" will be accomplished after the spring riverflows begin.

Affect on Project Schedule

According to the present schedule, the 10-foot unifrom preload stage will be reached during the middle of March 1979. Further preload operation is dependent on the structural evaluation at that time. The removal of the prelaod material is anticipated in late June 1979. However, the present preload schedule is not anticipated to impact the scheduled fulc load dates.

Submitted by: _______________

Approved by: _______________

Concurrence by: _______________

RM/pd
2/6/4

DRAWING SUMMARY

Figures Included in MCAR 24

Figure	**Title**	**Submitted with Interim Report**
1	Diesel Generator Building Settlement Data	correct on card 1, 2
1	Foundation Settlement Monitoring	3, 4
2	Settlement Record Table	3, 4
3	Settlement Data	3
4	Settlement Data	3
5	Seismic Category I Structures	3
5a	Seismic Category II Structures	3
6	Diesel Generator Building	3
7	Bechtel Borings, Dutch Cone Penetrations, and Test Pit Locations in Main Plant Area (1978)	3, 4 *
8	Diesel Generator Building Boring Plan	3, 4
9	Diesel Generator Building Underground Utilities Plan	3
10	Diesel Generator Building Underground Utilities Section	3
11	Diesel Generator Building Proposed Surcharge Requirements	3, 4
12	Diesel Generator Building PROPOSED ~~Temporary~~ Surcharge Requirements Sections and Details	4 *
13	Diesel Generator Building Settlement Data After December 2, 1978	4
14	Diesel Generator Building Settlement Data After December 2, 1978	4

Bechtel Associates Professional Corporation

SUBJECT: MCAR # 24 (issued 9/7/78)

Settlement of the Diesel Generator Foundations and Building

INTERIM REPORT # 4

DATE: February 16, 1979

PROJECT: Consumers Power Company
Midland Plant Units 1 & 2
Bechtel Job 7220

Introduction

This report is submitted to advise of the interim status of the project's actions relating to the settlement of the diesel generator foundation and building as described in MCAR 24 and NRC 1482. This report describes developments and action since Interim Report 3, DATED DECEMBER 27, 1978. *

Description of Deficiency

The general diesel generator foundation and building settlements as of February 2, 1979, are shown in Figures 1 ~~through~~ AND 2 AND FIGURES 13 THROUGH [redacted] 16. (attached). *

FIGURES [redacted] 15 AND [redacted] 16 HAVE BEEN ADDED SINCE INTERIM REPORT #3 AND SHOWS THE ~~MAXIMUM~~ MINIMUM TIME SETTLEMENT CURVES FOR THE DIESEL GENERATOR BUILDING AND ONE DIESEL GENERATOR FOUNDATION(4). IT SHOULD BE NOTED THAT OVER THE LAST 5 WEEKS ONLY NOMINAL SETTLEMENTS WERE OBSERVED. ?

Corrective Action

As discussed in Interim Report 3, preloading of the diesel generator building area was the selected option for corrective action. The preload sequence consists of placing [redacted] granular fill inside the diesel generator building and for a [redacted] distance of 20 feet outside the building. The level of preload will be brought up in a sequence in the designated areas as shown in [redacted] Figures 11 AND 12. The maximum

2

COULD BE LESS THAN 20 FEET

expected height of preload will be 20 feet above final plant grade. However, ~~this~~ THE level ~~will be~~ depend~~ent~~ING upon the recorded settlement versus time behavior and the data obtained from the instrumentation ~~recorded~~ during the earlier stage of preload.

The placement of the preload between the diesel generator building and the turbine building will utilize temporary retaining forms. ~~These forms will be braced against the buildings as shown in Figure 11~~ to ~~prevent shifting and overturning~~. Because the turbine building is located just north of the diesel generator building, the preload ~~between these buildings~~ will extend ~~only 16~~ approximately 11 feet from the diesel generator building wall. ~~leaving a gap of 1 foot from the south face of the turbine building basement wall.~~

The instrumentation installed in and around the diesel generator building AS shown in Figure 1 AND 17 will monitor settlement and changeS in the soil conditions as the preload is placed. Mr. C.J. Dunnicliff, our soil instrumentation consultant, is presently preparing a report ~~on the installed~~ SUMMARIZING DETAILS OF INSTALLATION AND MONITORING OF instrumentation. The result of this report will be submitted in subsequent reports.

4" thick report — Summary would be better for NCAR report.

CROSS SECTIONS, SHOWING ELEVATIONS OF THE BORROS ANCHORS AND PIEZOMETERS IN THE DIESEL GENERATOR BUILDING AREA ARE PRESENTED ON FIGURES 24 AND 25

Activities Completed since the Previous Interim Report

1. Monitoring Cracks in the Diesel Generator Building Walls

The existing cracks in the diesel generator building walls have been mapped to assist in the evaluation of the structure. Strain gagas have been placed at select locations shown in Figure ~~12~~ 17 AND 18 to monitor crack changes during the preloading operations. As of February 2, 1979, the maximum recorded crack width is approximately 28 mils, OR APPROXIMATELY 8 MILS LARGER THAN WHAT WAS FIRST RECORDED DECEMBER 5, 1978.

modified

2. Utility Monitoring

The underground utilities passing near and under the diesel generator building are being ~~examined~~ MONITORED during the preload operation. Full profile settlement gage measurements have been taken on selected ~~existing~~ pipelines ~~and electrical conduits~~ by soil and rock instrumentation under the direction of Mr. C.J. Dunnicliff. Figure ~~13~~ 19 shows the locations of the surveyed pipelines and the locations of the readout points. Additional profiling of the condensate line under the diesel generator building will be performed after the preload hold points IV, VI, and VII shown on Table 1 of Figure ~~11~~ 12.

steps

5' 10' 20'

ht of preloading

4/

3. Soil Exploration

As discussed in Interim Report # 3, the permanent plant area fill under and around the diesel generator building below el 634'-0" has been investigated by means of ~~a~~ soils borings, test pits and Dutch cone penetrations at the locations shown in Figures 7, 8 and 20; ~~program. The~~ ~~results of these borings and tests are shown in Attachment~~ Cross sections of several plant fill areas are shown in Figures 21 through 28. Test pit penetrometer readings are summarized in Figures ~~28~~ 29 ~~through~~ and 30. See Insert A

4. NRC Inspection Report

In response to the conflicts addressed in NRC Inspection Reports 50-329/78-12 and 50-330/78-12 dated November 14, 1978, FSAR change notice No. ____ has been initiated to correct the ~~following~~ discrepancies. See Insert B ~~GEOTECH INPUT~~

To Typist: (Delete line)

This addresses

Further evaluations of the additional items are continuing and will be addressed in subsequent reports.

Activities in Progress

1. Strengthening of the Turbine Building Wall

Because of the close proximity of the turbine building, a temporary reinforcement of the below grade turbine building wall is required to support the lateral earth pressure resulting from the preload.

INSERT A

RESULTS OF FIELD DENSITY AND COMPACTION TESTS MADE IN THE TEST PITS ARE SHOWN IN FIGURES 31.

~~A REPORT SUMMARIZING THE RESULTS OF THE DUTCH CONE WORK WILL BE PREPARED BY DR. R. D. WOODS OF THE UNIVERSITY OF MICHIGAN, AND WILL BE INCLUDED IN SUBSEQUENT REPORTS.~~

Laboratory soil tests ~~results completed to date~~ HAVE BEEN PERFORMED by Goldberg-Zoino-Dunnicliff and Associates, Inc. ~~are presented in Appendix B.~~ These results include data on moisture content, unit weight, plasticity, gradations, strength, consolidation, compaction, mineralogy and cation exchange capacity. Graphical summaries of the diesel generator building soil plasticity, water content, dry unit weight, total unit weight and shear strength are presented on Figures 32 through 37. Additional laboratory tests are still being made, including consolidated-undrained triaxial tests in which consolidation pressures will be selected to model stress histories that will be experienced in the field at the different locations.

5. Other Plant Structure area

Actions required in other site areas were discussed with Dr. Ralph Peck, Bechtel's consultant, in a meeting in Alburquerque, New Mexico on December 8, 1978. A discussion of current status of th~~ese areas is~~ Seismic Class I Structures is given below.

INSERT A (CONT'D)

TANK FARM

Field studies show some soft to very stiff clay fill may exist beneath the tank foundations in this area. Current plans involve continuing to monitor settlements until tanks are completed and then preloading foundation soils by filling the tanks and measuring structure settlements until expected additional settlements would be within tolerable limits. No surcharge in addition to tank loading is planned, but settlement measurement will be continued. [illegible] [illegible] FSAR limits or predicts ?

?

DIESEL FUEL TANKS

Field studies in this area show some loose sand and soft clay fill adjacent to the tanks. Settlement of these structures will be monitored to determine the effects of this fill on the tanks.

~~UNIT 1 AND UNIT 2 MAIN AND STAND BY TRANSFORMERS~~

~~Field studies and settlement data indicate some soft clay fill may exist beneath these transformer foundations. Allowable differential settlements these structures can withstand will be determined from the manufacturer to allow evaluation of the feasibility of preloading these areas. Monitoring of settlement in these areas is being continued.~~

SERVICE WATER

Field studies in these areas indicate some soft clay fill exists beneath service water pipelines at borings Q-2 through Q-7. These conditions are under evaluation.

INSERT A (CONT'D)

SERVICE WATER BUILDING AREA

Field studies in this area indicate loose sand fill exists adjacent to ~~and possibly below this area~~ the building. ~~these~~ This condition~~s~~ ~~are~~ is under evaluation.

RETAINING WALLS

Field studies and settlement data indicate these walls should continue to be moniored for settlement to allow further evaluation at a future time.

INSERT B

IN FSAR TABLES 2.5-9, 2.5-14 AND 2.5-21, FSAR FIGURE 2.5-47 AND FSAR SECTION 2.5.4. FSAR TABLE 2.5-10 WAS FOUND TO BE CORRECT AND NO CHANGES WERE MADE.

a) para 4
c) 9 2nd para 3
g
r)

5

This wall reinforcement consists of a system of tie sp rods attached between the buildings, shimming of the turbine building wall to existing structur~~es~~AL ELEMENTS inside the TURBINE building, and adding steel braces, counterforts, and composite reinforcement to the existing turbine building wall. ~~The majority of~~ This work ~~has been performed~~ ~~and~~ will be completed before the preload is placed above el 644'-0". *

2. Preload Operation

Concrete completed ~ structure Condensate pipe

Preloading of the diesel generator building is continuing. As of February 2, 1979, the granular fill material for the preload has been placed to the elevation shown in Figure ~~14~~ 2. *

3. Cutting of the Condensate ~~and Service Water~~ Pipelines

The two ~~12~~ 20-inch condensate lines and two 8-inch ~~service water~~ CONDENSATE lines shown in Figures 9 and 10 have been cut outside the turbine building wall to prevent POTENTIAL OVERSTRESSING OF THE pipes ~~deflections~~ during preload. Continued surveillance will be provided on the cut pipelines and further evaluation will be provided in subsequent reports. *

INSERT C

E ~~A~~ffect on Project Schedule *

Based on the current schedule for ~~surcharge~~ PRELOAD preparation and placement, ~~continued structural building construction, and~~ THE removal of the ~~surcharge~~ PRELOAD material ~~[illegible]~~ IS ANTICIPATED in late June 1979, ~~there is a potential for a 2 to 3-month delay to the current March 1980 target completion requirement for the first two diesel generators~~. HOWEVER THE PRESENT PRELOAD SCHEDULE IS NOT ANTICIPATED TO IMPACT THE SCHEDULED FULL LOAD DATES. *

INSERT C.

4. COOLING POND FILL

~~THE COOLING POND HAS BEEN FILLED TO ELEVATION 626~~?.

SINCE NOVEMBER 8, 1978 THE COOLING POND HAS BEEN FILLED FROM EL 621.9 TO ITS CURRENT LEVEL OF 626'. NO ADDITIONAL FILLING WILL BE PERFORMED UNTIL THE SPRING RIVER FLOWS BEGIN.

Drawing Summary

Figures included in MCAR #24

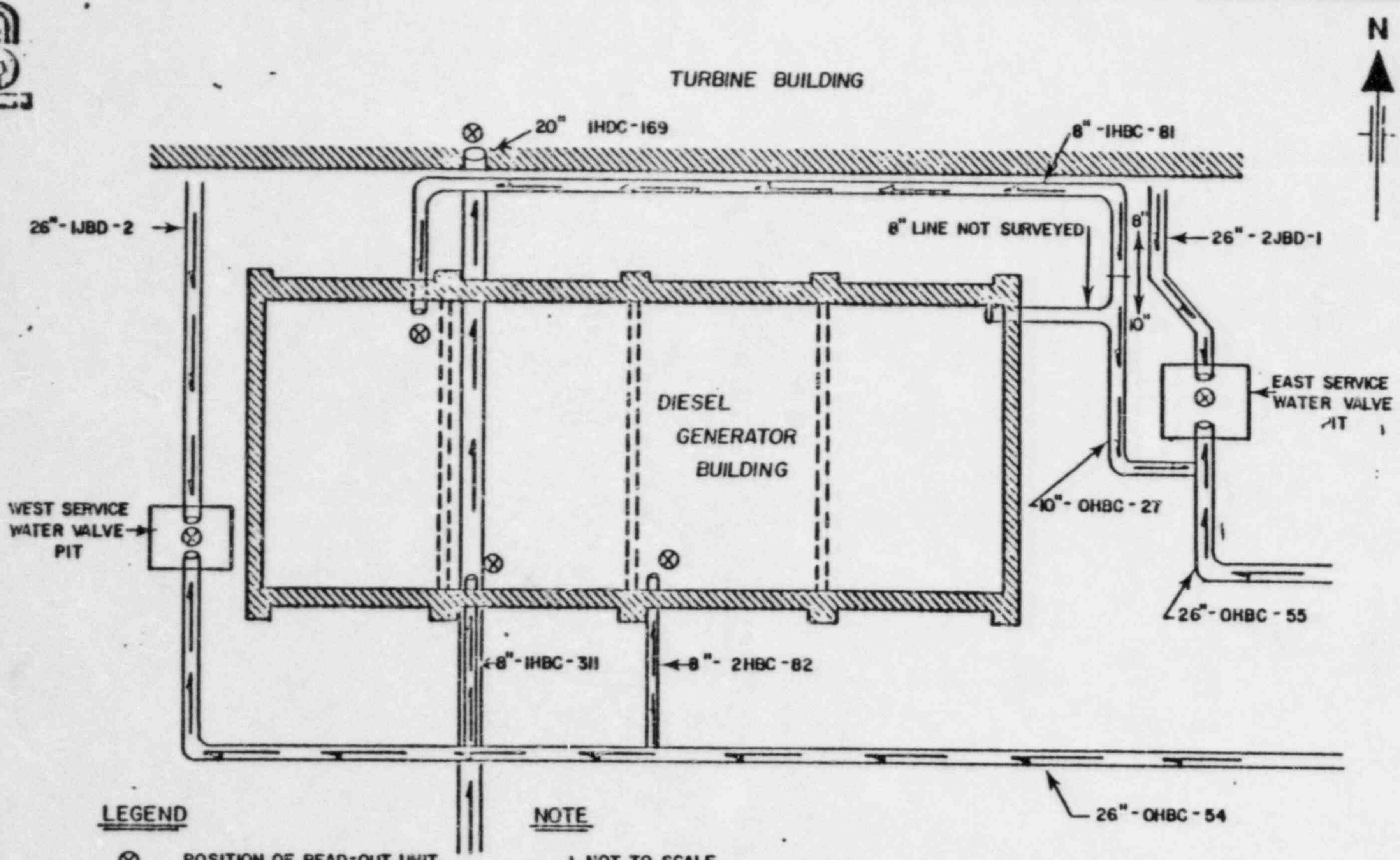
Figure No.	Title	Submitted with interim Report No.
1	DIESEL GENERATOR BUILDING SETTLEMENT, DATA	1, 2,
1	FOUNDATION SETTLEMENT MONITORING	3, 4
2	SETTLEMENT RECORD TABLE	3, 4
3.	SETTLEMENT DATA	3
4.	SETTLEMENT DATA	3
5	CLASS I STRUCTURES	3
5a	CLASS II STRUCTURES	3
6	DIESEL GENERATOR BUILDING	3
7	BECHTEL BORINGS, DUTCH CONE PENETRATIONS AND TEST PIT LOCATIONS IN MAIN PLANT AREA (1978)	3, 4
8	DIESEL GENERATOR BUILDING BORING PLAN	3, 4
9.	DIESEL GENERATOR BUILDING UNDERGROUND. UTILITIES PLAN	3
10.	DIESEL GENERATOR BUILDING UNDERGROUND UTILITIES SECTION	3

11	DIESEL GENERATOR BUILDING PROPOSED SURCHARGE REQUIREMENTS	3, 4
12	DIESEL GENERATOR BUILDING TEMPORARY SURCHARGE REQUIREMENTS SECTIONS AND DETAILS	4.
13.	DIESEL GENERATOR BUILDING SETTLEMENT DATA AFTER 12-2-78	4
14	DIESEL GENERATOR BUILDING SETTLEMENT DATA AFTER 12-2-78	4
15	DIESEL GENERATOR BUILDING SETTLEMENT DATA TIME RATE	4
16	DIESEL GENERATOR PEDESTAL No 4 SETTLEMENT DATA TIME RATE	4
17 ✓ GT	INSTRUMENTATION LOCATION PLAN	4
18	DIESEL GENERATOR BUILDING CRACK MONITORIING	4
19.	DESIGNATIONS AND LOCATIONS OF SURVEYED PIPELINES	4
20 GT.	TANK FARM BORING PLAN	4
21. GT	CROSS SECTION A-A' TANK FARM	4
22 GT	" " B-B' " "	4

38 DIESEL GENERATOR BUILDING PRELOAD PLAN 4

FILE No. 2220-R

GEOTECHNICAL INSTRUMENTATION ENGINEERS



LEGEND

⊗ POSITION OF READ-OUT UNIT

⇀ DIRECTION THAT PROBE WAS PULLED DURING READINGS

NOTE

1. NOT TO SCALE

MIDLAND PLANT MIDLAND, MICHIGAN	DESIGNATIONS AND LOCATIONS OF SURVEYED PIPELINES JAN. 1979

FIGURE No. ~~14~~ 19

to aid in selecting the remedial measures to be used in the different plant areas.

3. SOIL EXPLORATION

Fig 1 needs to be revised prior to issue

Results of soil borings, and test pits ~~and dutch cone penetrations~~ addressed in MCAR #24, Interim Report #3 are presented in the FSAR (?). Amendment # ~~Appendix A~~. Locations of these borings, pits, and dutch cone penetrations are shown on Figures 1 through ~~4~~ 3. Cross-sections summarizing results of ~~this~~ field work in the tank farm and diesel generator building ~~, condensate tank area, transformer area, radwaste building~~ and ~~gaurd house~~ are presented on Figures ~~5~~ ? through 11. ~~through 17.~~ Test pit pocket penentrometer readings are summarized on Figures ~~20~~ 12 through ~~21~~ 15. Results of density and compaction tests made in the test pits are presented in ~~Appendix 2.~~ the FSAR (Am #).

Laboratory test results completed to date by Goldberg-Zoino-Dunnicliff and Associates, Inc. are presented in ~~Appendix 3.~~ the FSAR (Am #). These tests have been made These results include data on moisture content, unit weight, plasticity, gradations, strength, consolidation, compaction, mineralogy and cation exchange capacity. Graphical summaries of the diesel generator building soil plasticity, water content, dry unit weight, total unit weight and shear strength are presented on Figures ~~22~~ 16 through ~~27.~~ 21 Insert PA on back of this sheet Additional laboratory tests are ~~still~~ being made, including consolidated-undrained triaxial tests in which consolidation pressures will be selected to model stress histories that will be experienced in the field at the different locations.

A report summarizing the results of the dutch cone work will be prepared by Dr. R. D. Woods of The University of Michigan. A final report summarizing the results of x-ray diffraction and cation exchange capacity tests will be prepared by Dr. Donald Gray of The University of Michigan.

These tests indicate
Samples had:

1. ~~ranged in~~ plasticity characteristics from nonplastic to having low plasticity (Figure 16)
2. ~~ranged in~~ moisture content from about 2 to 35 percent, averaging about 13 percent. (Figure 17)
3. dry unit weights between about 96 and 130 pcf, averaging about 120 pcf. (Figure 18)
4. total unit weights between about 112 and 143 pcf, averaging about 133 pcf. (Figure 19)
5. shear strengths based on unconfined compression test results on the samples obtained ranged from about 250 to 3646 PSF. (Figure 20)
6. a shear strength to moisture content relationship as shown on Figure 21.

STATUS

TANK FARM

~~[illegible]~~

FIELD STUDIES IN THE TANK FARM AREA SHOW generally SOFT TO VERY STIFF CLAYEY BACKFILL ~~[illegible]~~ OCCASIONAL MEDIUM TO VERY DENSE SAND BACKFILL OVER NATURAL SOILS. Current plans involve continuing to monitor settlements until tanks are completed and then preloading foundation soils by filling the tanks and measuring structure settlements until expected additional settlements would be within tolerable limits. No surcharge in addition to tank loading is planned, but settlement measurements will be continued after completion of preloading.

with some soft zones and

Summary of soil and [illegible] plant fill.

DIESEL GENERATOR BUILDING

FIELD STUDIES IN THIS AREA INDICATE THE BACKFILL CONSISTS primarily OF VERY SOFT TO VERY STIFF CLAY BACKFILL WITH POCKETS AND LAYERS OF VERY LOOSE TO DENSE SAND BACKFILL over natural soils. THE~~SE~~ clay BACKFILL MATERIALS ARE HIGHLY VARIABLE IN STRENGTH, MOISTURE CONTENT, and UNIT WEIGHT, BUT RELATIVELY UNIFORM IN PLASTICITY and grain size distribution characteristics. The sand also have relatively ~~[illegible]~~ ~~[illegible]~~ uniform grain size distribution.

Zone D grade

J Surry C-76 'Q' or not audit or not ?
Monitored

DIESEL FUEL TANKS

with some
soft zones

FIELD STUDIES MADE ADJACENT TO THE DIESEL FUEL TANKS SHOW LOOSE TO DENSE SAND BACKFILL AND ~~SOFT~~ stiff TO ~~HARD~~ very stiff CLAY BACKFILL OVER NATURAL SOILS. SETTLEMENT OF THESE TANKS WILL BE MONITORED TO DETERMINE OBSERVE THE BEHAVIOR OF THESE TANKS.

RETAINING WALLS Adjacent to Service water

BORINGS IN THE RETAINING WALL AREAS INDICATE THESE WALLS MAY BE SUPPORTED BY STIFF TO VERY STIFF CLAY BACKFILL AND/OR MEDIUM DENSE SAND BACKFILL over natural soils. THE WALLS WILL CONTINUE TO BE MONITORED TO ALLOW FURTHER EVALUATION. ~~AT A LATER DATE~~

SERVICE WATER BUILDING ?

BORINGS IN THIS AREA INDICATE LOOSE TO DENSE SAND BACKFILL EXISTS ~~ADJACENT~~ at the building TO THE BUILDING THESE CONDITIONS ~~AND CONDITIONS BENEATH THIS STRUCTURE~~ Are under evaluation.

Service Water Pipes

Borings adjacent to the service water pipes showed soft to very stiff clay backfill with occasional dense sand backfill over natural soils. Borings O-3 through Q-7 indicated some very soft clay backfill. These conditions are under evaluation. These pipes will be monitored for settlement.

In response to the conflicts addressed in NRC Inspection Reports 50-329/78-12 and 50-330/78-12 dated November 14, 1978, an FSAR change notice has been initiated to correct the ~~following~~ discrepancies.

To Typist:
(Delete line)

SEE INSERT B ~~GEOTECH INPUT~~

Further evaluations of the additional items are continuing and will be addressed in subsequent reports. *

Activities in Progress

1. EVALUATION OF FIELD Records - Field density test results are being evaluated to determine if any other remedial work? will be required.

additional

~~1~~ 2. Strengthening of the Turbine Building Wall

Because of the close proximity of the turbine building, a temporary reinforcement of the below grade turbine building wall is required to support the lateral earth pressure resulting from the preload.

and removal of th

June 1979, there is a potential for a

March 1980 target completion requirement for

rs.

*

92

49201 • (517) 788-0550

ontrol groundwater elevation in the
ring wells have been installed by
of Registration under Act 294 attached.
/2") have been installed since
dividual wells, well depth and estimated
is provided in the attached data sheets.
ttached drawing entitled "Midland Power
ions".

will be directed to the cooling pond.
he flow to the pond will be about 320
dewatering operation will aid in the
rmanent dewatering wells to be installed

scribed above be addressed in the follow-
ermit issued January 2, 1980:

oling Pond Discharge prior to cutfall

g pond is expected to commence January 31,
taff, the dewatering discharge to the pond

is matter, please let me know.

BCC TCCooke/RLBull, Midland
DLAndersen, Midland
RCBauman, P-14-412
RFGreen, P-14-303
~~CHunt~~/TRThiruvengadam, P-14-209B
w/o attachments

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4. NRC Inspection Report

In response to the conflicts addressed in NRC Inspection Reports 50-329/78-12 and 50-330/78-12 dated November 14, 1978, an FSAR change notice has been initiated to correct the ~~following~~ discrepancies.

To Typist: (Delete Line)

SEE INSERT B

~~GEOTECH INPUT~~

Further evaluations of the additional items are continuing and will be addressed in subsequent reports. *

Activities in Progress

1. EVALUATION OF FIELD Records - Field density test results are being evaluated to determine if any other remedial work will be required. ?

2. Strengthening of the Turbine Building Wall

To File

From JEBrunner, P-24-513 JEBrunner/ajg

Date October 3, 1980

CONSUMERS
POWER
COMPANY

Internal
Correspondence

Subject MIDLAND PROJECT
MINUTES OF 8/29/80 MEETING TO APPEAL NEED FOR ADDITIONAL BORINGS
FILE: 0485.16 UFI: 00234S, 71*01 SERIAL: 9610

CC
JWCook, P-14-113A
TCCooke, Midland
GSKeeley, P-14-113B
DBMiller, Midland
MIMiller, IL&B
JARutgers, Bechtel
TRThiruvengadam, P-14-400
CWiedner, Bechtel

The meeting was convened at 1:00 pm at the Midland Service Center. The attendance list is enclosed as Attachment 1. The agenda for the meeting is enclosed as Attachment 2. Following introductions, G S Keeley summarized historical events relating to the supply of soils-related information to the NRC. Keeley indicated that CP Co had submitted information via 50.54(f) responses, 50.55e reports, meetings and site visits, and responses to requests for document production covering a period of almost two years (See Attachment-3).

J D Wanzeck of Bechtel Geotech then described the soil investigation done to date, all of which excepting information on 59 borings have been supplied to the NRC in connection with CP Co's proposed soils fix. Wanzeck reviewed past borings taken to date, test pits, cross-hole shots, and settlement information as well as other aspects of CP Co's past efforts to develop soils data necessary to demonstrate the adequacy of the proposed fix. He stated that CP Co had taken over 900 borings at the Midland site and expressed the opinion that no additional borings are necessary.

Dr Ralph Peck, Bechtel's consultant, who is an internationally recognized expert on foundation soils, then discussed the technical basis for Consumer's conclusion that the pre-load program would provide an acceptable solution ot the diesel generator building settlement problem. Peck, with admirable clarity and organization, described the pre-load program, the settlements observed upon surcharging, pore pressure variations as observed through piezometer readings and the future settlements which may be predicted based on an extrapolation of observed settlements. Peck expressed the opinion that the pre-load approach is universally accepted in the soils field and that the information directly supplied via pre-loading would accurately predict future settlement behavior.

A method utilizing results from borings lacks this accuracy, according to Peck, because of inherent inaccuracies in an indirect approach, and because the "fix" would not eliminate all variations in soils parameters below the diesel generator building. Peck felt that the borings approach would erroneously predict greater settlements than would be observed.

Peck's presentation was illustrated with charts and graphs showing settlement measurements and predictions with and without the surcharge, variations in porewater pressure during and after the pre-load, and the loading level on

ic1080-0038b100

soils below the diesel generator building as a function of elevation during the preload. The latter clearly showed that the effective stresses in the fill up to elevation 603 under full surcharge load exceeded the post-surcharge effective stresses upon the fill with the full dead and live loads, including effects of permanent dewatering. This was documented in Amendment 81.

Peck was followed by A J Hendron, Jr, another noted expert in the field. Hendron began his presentation with an analysis of inherent errors that can be expected in settlement computations derived from consolidation tests performed on best-possible, undisturbed samples obtained from borings. His conclusion was that the measurement errors inherent in such an approach would totally eliminate any value otherwise obtainable.

Hendron then addressed the subject of bearing capacity. He stated that new calculations which he had recently performed provide a more accurate prediction of the behavior of the soils from a bearing capacity standpoint than had past analyses, which had excluded certain terms from the bearing capacity equation. His latest calculations, which included such terms, demonstrated a factor of safety from a bearing capacity failure on the order of 6 or 7. The design goal for bearing capacity safety factor is 3. Hendron concluded that additional borings were totally unnecessary to demonstrate adequate bearing capacity. This was documented in Amendment 81.

M T Davisson then concluded the technical part of CP Co's presentation with a discussion of underpinnings - piles and caissons. Davisson stated that the use of underpinnings was designed to eliminate the need to consider soils characteristics in plant fill. Additional borings were technically inferior to the in-place tests under load which would be carried out when underpinnings are installed. Davisson felt that additional borings would be useless and misleading. This was documented in Amendment 81.

After a short recess, the staff presented its arguments in favor of more borings. Lyman Heller, US NRC, in a short introductory statement, argued that the additional borings were not intended to "negate" field data, but only to supplement it. Heller also argued that the Corps had requested only 18 additional borings, compared with over 900 already taken. Heller further stated that the staff had been "burned" twice at North Anna by the use of field data alone.

Joseph D Kane, US NRC/NRR/HGEB, then presented the major substance of the NRR arguments. Referring first to the cooling pond dike, Kane stated that a series of borings and lab tests should be taken to provide the dikes stable under all conditions and to determine the properties of fill after compaction.

In the area where underpinnings would be installed, Kane stated that it was proper engineering procedure to estimate foundation behavior prior to any field tests. Kane also stated that borings were necessary because of possible space limitations if the number of caissons necessary to do the job was under estimated. He also expressed concern about negative skin friction being factored into underpinning design.

With respect to the diesel generator building, Kane admitted that field testing was advantageous, but that borings would confirm predicted values, that he was not sure if primary consolidation had been completed, that the building had settled 4" before pre-load and 3-1/2" during pre-loading, and that certain observations of piezometer levels taken during the surcharge may have resulted from errors introduced by varying the level of the cooling pond. Kane also mentioned that CP Co had presented only positive effects of surcharge, and had failed to address 4"-settlement which took place and its effects on structures. Kane failed to state what connection the latter point has with the additional borings issue.

After Kane's presentation, the NRR caucaused.

Messrs Vollmer and Knight then questioned the various individuals present. Vollmer indicated that, in view of the present political climate, he was somewhat surprised at CP Co's attitude toward not supplying additional technical information. He inquired of Mr Cook whether or not CP Co's objections went to the mere necessity of the borings or went to the possibility that the borings results would be actually misleading and counterproductive. Mr Cook answered that both points were primary objections.

Mr Knight wanted to know whether or not CP Co had been advised of the additional borings request when the latest 66 samples were taken. CP Co answered in the negative.

Following a discussion on the negative porewater pressure question (during which there was an exchange between Kane, Peck, Hendron, and Davisson, in which Peck stated that the results were exactly as he would expect), Vollmer indicated, though somewhat ambiguously, that the data supplied seemingly satisfied his concern on the settlement issue. He further stated that new information had been presented during the meeting and that this should formally be supplied. He stated that if he had to make a decision immediately he would have to agree with the staff's recommendation.

It was decided that CP Co would supply a sumary of all soils information including the additional information supplied at the meeting, by 9/15/80. The meeting was then adjourned.

On the same day as and prior to the above meeting, Mr G Lear (NRC) was shown pictures of the piping associated with the return of emergency service water. The part of the piping which is buried along the sides of the emergency cooling pond was exhibited to Lear using the following photos:

Cartridge 4253 Frame 1965
1966
2057
2058
2033
2039

Pictures 905
906
907
908
1080
1081

The review of the above photos showed that the pipe was located in an excavated trench in the berm and not the dike slope. Therefore, a postulated baffle dike failure precipitated by the trench is not considered to be a plausable scenario and would not interfere with functioning of the Emergency Cooling Pond.

WALKER FERN: SUMMARY [illegible]

NRC MEETINGS PROCEEDINGS

12

July 31, 1980 - Bethesda

<u>Discussion by R. B. Peck on Preload fill at Diesel Generator Building</u>

No doubt that the fill beneath the diesel generator building does not meet the control properties of ~~dewatering~~ density and degree of compaction. Their properties are much more variable than they should be. However, the only property that counts is the compressibility of the fill and this has been greatly improved to the extent that it has now reached a standard where settlement can be reliably predicted.

The water table at the time of preloading is significant. The pond was raised to try to saturate as much of the fill as was feasible. The pond level came to within <u>2 to 4 feet</u> of the bottom of the building footings. In this zone clays would consolidate but sands may not. However, during the permanent dewatering capillarity will be preserved in the sands. Item 2 of the NRC letter requires "additional studies to get an independent prediction of settlement". However, the requirements of drilling and sampling cannot be carried out without sample disturbance so that laboratory tests will indicate compressibilities that are too large and predicted settlements will consequently also be much too large. Also because of sample disturbance a large amount of scatter will be found in the test data and the scatter and high amounts of settlement will be difficult to answer. The preload programs carried out at the diesel generator building has resolved all of this. In fact, if studies had been made prior to preloading based on laboratory tests of the fill it is conceivable that it would have been decided to preload the area anyway in order to get meaningful answers. It should also be noted that there has been no settlement in the year since the preload fill was removed. Since the present foundation pressures are now very close to the final pressures, it therefore is clear that the predictions provided by our analyses are conservative. It can therefore, be clearly stated that we now know how the builidng will perform and the trend of settlements so that our predictions are reliable and indeed much more reliable than could be determined by testing.

The dewatering will provide a further check on the validity of the predictions so that prior to going into operation there will be further check of settlement.

The concept of not relying on drilling and testing but rather relying on field performance is not new. It has been used successfully before at the Kawanee Nuclear Plant. In that case, the initial studies were made based on laboratory testing of good quality samples and the predicted settlement was determined to be 15 inches. However, there was geological evidence of preconsolildation of the site soils. Based on upper limit values an estimate of the minimum preconsolidation pressure was~~a~~ made and using th~~em~~ is a prediction of 1-1/2 inches of settlement was determined. By constructing the foundation mat in segments and then not connecting the segments until about 90 percent of the load was in place.

At the Quanicassee site a similiar procedure wa~~a~~s used. J~~A~~ load test was carried out by drawing down the water table. The induced pore pressures in the soil and the resulting settlement as the pore pressures dissipated were measured and the properties of the foundation soils were back figured.

Based on his extensive experience, R. B. Peck stated that he was completely convinced that sampling and testing now will give predicted settlements at the diesel generator building that will be high enough that it will be difficult to know what to do with them and they will be wrong. The present prediction, based on preloading, is satisfactory, it is conservative, it can be checked again during dewtering and it is the most reliable possible prediction of settlement that can be made.

The current "state of the art" is fairly good in fairly soft, homogeneous clays but it is not good in preconsolidated soils and compacted fills.

The Corps of Engineers has commented on the raising of the cooling pond however, this raising was complete at the time the maximum preload surcharge was reached and the pond level and surcharge were maintained constant during the period of maximum preload. The purpose of raising the pond level was to eliminate as much capillarity as possible. The second reason was to ensure that the piezometers would react and would not be influenced by air-water pore pressures. The raising of the pond reduced the surcharge load by 3 or 4 feet of bouyancy. The actual effective stress profile will be worked out in detail for the conditions during surcharging and after the builidng is in operation so that it will be clear what the influence of this small reduction in surcharge is. It should be pointed out that, based on the design criteria, it appears that the equipment live load is 800 psf but in reality it is much less than this and this will be considered in the effective stress computations. We need to know these profiles precisely in order to better understand the implications of the loss of surcharge due to 3 to 4 feet of buoyancy and the trade off that was made in order to reduce capillarity.

The raising of the pond would have softened dryer lumps of soil which would have permitted reduction in voids. If this had happened it would have resulted in time lag and creep. The records show that this did not happen and even if there is some creep present it is in the recorded settlements and therefore in the prediction as secondary settlement. There is no basis for considering that the settlement trend will change in the future, therefore, extrapolation is possible.

Add to top of p. 29

What will be the effect on strength of consolidation of material wet of optimum? The present data indicate some small rebound following removal of the surcharge, therefore the foundation contact pressure is less than under the surcharged conditions. The factor of safety must be at least one and is clearly greater than this. There is experience (Fargo grain elevator) that even in stiff materials there is non-linear behavior at loads above about 80 percent of the ultimate. Therefore, the factor of safety is clearly significantly larger than one since non-linear behavior has not been recorded. The factors of safety beneath the generator pedestals will be even greater because the contact pressure is less beneath them. The settlement behavior looks right. The stresses in the ground during the preload surcharging decrease slightly with depth. Dewatering will induce a load that increases with depth. Under the dewatering load the lower materials will be stressed the most and because that material is further out on the e-log p curve it will compress less than the upper materials. Additional settelement due to drawdown, if any, will be small. Even if the stress at depth exceeds the stresses induced by the preload surcharge, the settlement will have taken place during the underpinning operations at the auxiliary building so that it will be quite clear from the record.

We can now be quite confident, from the preload surcharging, settlement and pore pressure measurements, that primary consolidation occurs in about 2 weeks. The underpinning will take several months so that any settlement will have occurred before the work is completed.

Corps and NRC Comments on Settlement Evaluation

The pore pressures observed in the fill were smaller than might be expected. This could be due to "~~budging~~ bridging" over clay zones. The pore pressures were ~~observed~~ influenced by the pond water level. When the load was removed the pore pressures dropped and then recovered. Does this result from excess pressure in the clay? The clay backfill was in chunks and the overall permeability was high so response was fast. The response measured is typical of compacted soil. Peck said that the sand was not dense so that ~~budging~~ bridging of clay lumps is not likely.

The NRC and Corps concerns are:

1. What will the settlement be doing to dewatering?

2. What is the ultimate bearing capacity?

3. What is the overall settlement?

The first item can be answered by dewatering and monitoring the settlement. The second can be evaluated from load tests. The interpretation of the overall settlement cannot be addressed more reliably than it already has. The procedures required by the Corps of drilling, sampling and testing are not due to sample disturbance, as reliable as the present procedure.

Auxiliary Building Underpinning

It is not clear what benefit additional borings will provide at the auxiliary building. The underpinning caissons will be carried into the till and each will be load tested to 1.5 times ~~it~~ the design load. Only vertical load is carried by the caissons. The till at the base of each caisson can be examined for assurance that it is satisfactory. The caissons are designed for end bearing. The Corps agreed that their comments on lateral loading only apply if the NRC structural people agree that it is rquired.

The NRC will be provided with the basis for the caisson design parameters. At the service water pump structure a pile load test will be made. The NRC said that they wanted to know the ultimate bearing capacity and time dependent effects.

Retaining Wall Stability and Settlement

Check

The Category I wall settled differentially about 1/4 inch right after construction but has not moved since then. The Corps want to know if the settlement has resulted in unacceptable (Code) stresses in the walls (Have the Code stresses been exceeded?). They also want to know if there is anything behind the Category II wall that could affect Category I items if the wall failed.

Cooling Pond Embankment

The Corps is interested because a failure of the embankment could influence recreational facilities. Failure might also influence Category I pipelines and if that is possible that portion of the dike should be Category I. They required borings to demonstrate that the embankment has properties as good as what were indicated in the design parameters.

The dikes are inspected twice yearly and repairs if any are required, are recommended. Settlements and pore pressures are monitored.

The dikes were built under a different specification which specified the equipment and construction procedures.

OCT 3 1 [illegible] 113

CC: CAHunt
DBMiller
TCCooke
RMWheeler

13

NRC Exit on Diesel Foundation -

Gallahger was asked to follow-up on 50.55(e) Report to fact-find on what brought it about and what our plans were. Findings which won't be infractions, but their management will evaluate. FSAR commits to checking settlement every 90 days. Assumes we will modify as necessary after we take corrective action.

FSAR 2.5-14 gives supporting materials as cohesive controlled fill. Another table shows clays. Thought it would not be sands. Feels random fills are not good policy. C-109 and -117 indicate Zone II, this is discrepancy from FSAR #1.

2.5.21 summarizes compaction requirement. Requires 4 minute passes but not req by C-210 until added in 1977 and was not imposed. C1.02 does not make reference to it. US Testing says they were not required to.

This is discrepancy from FSAR #2. 3.8.5.5 shallow footings settlements estimated to be 1/2" or less. Has to be corrected in FSAR.

Figure 2.5-47, Diesel Generator Building 634 but its at 628.

C-210; -211, 1.02 (QC instr) - C-210 Section 13.7.1 requires all cohesive backfill to 95% but 13.4 refers 12.4.5.4 to Bechtel Modified Proctor which gives unconservatism. 1.02 is confusing since has to compact to different requirements.

Dames & Moore 3/69 - recommends 100% and at or near 6" to 8".

Ductbanks and piping under building was looked at and probably effects diff settlement.

Using random fill makes it difficult to determine amount of settlement yet it was estimated as 1/4". Asked for calculation for basis of estimate but has not received. Crack on east wall. Does not feel these are minor but are flexural cracks and if so have to correct to meet ACI 318 Section 10.4. Feels Testing people are testing ok.

Does not believe material was placed as is indicated. Have low blow counts.

Pond level should and rate should be taken into account on effect on soil. Should evaluate and effect on BWST main transformer tanks. Diff water levels between diesel generator area and BWST area.

Reviewed plans for monitoring preload. NRC does not feel this is corrective action.

Says mat foundations are usually used with random fill.

GSKeeley/cg
10/30/78

TRT

Bechtel Power Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan
Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

013421

October 8, 1980

BLC-9839

CC: Sor
JEB

Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Attention: Mr. J.W. Cook
Vice President
Projects, Engineering and Construction

Subject: Midland Plant Units 1 and 2
Consumers Power Company
Bechtel Job 7220
50.54(f) September Status Report

Attached is the September Status Report giving the status of commitments made in the responses to NRC 50.54(f) Questions and supplementary questions from letters, meetings, etc. The structure of the report has been changed to group items by status code to allow greater visibility of outstanding items. The following is a summary of the attached report:

Status Codes:(1)	Ques. 1-22(1)	Ques. 23(1)	Ques. 24-35(1)	Supp. Ques.(1)
Code 1	62	30	0	0
Code 2	4	10	5	4
Code 3	21	11	2	0
Code 4	16	5	5	3
Code 5	8	0	0	2
Total Actions	111	56	12	9

(1) See first page of status report.

The October Status Report will be submitted by November 10, 1980.

Very truly yours,

for
John A. Rutgers
Project Manager

JAR/VDP/kes

Attachment: 50.54(f) September Status Report
cc: W.R. Bird ; G.R. Eagle (CPCo/AA); D.E. Horn; G.S. Keeley; B.W. Marguglio .
(all w/a)

Written Response Requested: No

RECEIVED
OCT 13 1980
MIDLAND PROJECT
MANAGEMENT

CONSUMERS POWER COMPANY

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES

STATUS SORT: PARTS I AND 2

013421

Bechtel Power Corporation

October 8, 1980

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES

LEGEND

Status Codes:

1	Complete, verified by quality assurance
2	Reported complete, not yet verified
3	Due, but not complete. Dates have been reforecast. Original due dates are in parentheses.
4	Not yet due
5	Insufficient documentation in 50.54(f) files to establish or verify status

RESPONSIBLE ORGANIZATIONS:

PD	Plant design
PS	Pipe stress
LS	Licensing
GT	Geotechnical services
CE	Civil engineering services
FE	Field engineering
QA	Quality assurance
QE	Quality engineering

CPCo	Consumers Power Company
CPCo QA	Consumers Power Company quality assurance
CPCo PMO	Consumers Power Company project management organization

Notes:

1. Commitment dates for action items indicated by asterisks (*) have been transmitted to the NRC. These dates will not be changed without a formal transmittal to the NRC.

2. Questions 1 through 22 action item numbers are basically the same as those used by the diesel generator building task group, but have been modified to acknowledge action items/commitments made in all revisions of the responses.

3. Question 23 action item numbering is based on the Response to Question 23 submitted to Consumers Power Company via via BLC68460, J.A. Rutgers to G.S. Keeley, dated November 14, 1979. These action item numbers have been modified to acknowledge action items/commitments made in all revisions of the responses.

4. Questions 24 through 35 action items were identified for the first time in the April issue of this status report and will be referred to by the action item numbers established in that issue.

References (applicable to Part II only):

A. Letter from G.S. Keeley to J.A. Rutgers, CPCo Serial 8548, 3/27/80

B. Commitments made in February 1980 meeting with NRC, Midland, Michigan

013421

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES

PART I: COMMITMENTS FROM QUESTIONS 1 to 35

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-5*	Review specifications not included in the specificity study initially	1-5 I-8	0 0	QE		790629	5	See Item 23-10
1-19*	Complete in-depth review of soil test results	I-17		GT		790731	5	
6-5	Monitor the piping between the BWST and the auxiliary building	6-1	1	CE			5	Ongoing activity
6-6	Evaluate the settlement from Item 6-3 in accordance with the procedure described in Question 17	6-1	1	PS			5	Complete monitor upon load test
7-2	Make results of continuity checks and settlement surveys available						5	See Item 7-1
7-3	If further corrective action is required, determine corrective measures						5	See Item 7-1
13-9 (13-2)	Review piping system for seismic response from Item 13-6	13-2	0	PD	A. Patel		5	
15-3	Prepare additional response to the NRC					791231	5	

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
4-6	Monitor the non-Seismic Category I condensate storage tanks	4-4	5	GT CE	J. Wanzeck S. Rao	801130	4	Load test ongoing; results will be evaluated by geotech and civil
4-8	Fill the BWST with water to perform a full-scale test of subsurface material	4-3	3	GT CE	J. Wanzeck S. Rao	801130	4	See Items 6-1, 6-3, 6-6, and 31-1. Dwg C-1148 issued for construction. Load test to start in 10/80
6-9	Determine long-term settlement based on the measured settlement of the loaded tanks	6-2	3	GT			4	Geotech to review load and predict long-term settlement based on Items 4-6, 4-8, and 4-9
8-3	Review and modify the monitoring frequency for the diesel generator pedestal markers after 1 year of operation	8-2	0	CPCo		850101	4	
12-5	Pressure grouting of void below the mud mat of the control tower as required	Tbl 12-1	0	CE	R. Zao	801231	4	
13-7 (13-1)	Review structural design for seismic response from Item 13-6	13-2	0	CE		801031	4	
13-8 (13-2)	Review Seismic Category I equipment for seismic response from Item 13-6	13-2	0	CE	B. McConnel	810201 (801231)	4	
13-10 (13-2)	Review electrical system for seismic response from Item 13-6	13-2	0	CE	B. McConnel	810201 (801231)	4	
13-11 (13-3)	Conduct a seismic reanalysis for the service water pump structure	13-2	0	CE	B. McConnel	801031	4	
13-13 (13-3)	Review Seismic Category I equipment for seismic response from Item 13-11	13-2	0	CE	B. McConnel	810201 (801231)	4	
13-14 (13-3)	Review piping system for seismic response from Item 13-11	13-2	0	PD			4	
13-18 (13-4)	Review Seismic Category I equipment for seismic response from Item 13-16	13-3	0	CE	B. McConnel	801231	4	
13-19 (13-4)	Review piping system for seismic response from Item 13-16	13-3	0	PD			4	

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
13-20 (13-4)	Review electrical system for seismic response from Item 13-16	13-3	0	CE	B. McConnel	801231	4	
13-21 (13-5)	Investigate the effect on underground utilities for differential building displacement resulting from Items 13-6, 13-11, 13-16	13-5	0	CE PS	B. McConnel	810131	4	
17-4	Profile the borated water lines by optical means	17-1	2	CE			4	Tracked by Item 6-5
23-37*	Consistent with the intent of Items 23-35 and 23-36, QA will review nonconformance reports which were open as of November 13, 1979, or became open prior to implementation of the improved Project Quality Assurance Trend Analysis program as stated in Item 36.	23-33	5	QA		801231	4	
23-40* (31)	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 24, 1980, and field engineering and quality control review is scheduled for completion by November 28, 1980.	I-11, 23-20, 23-30	4	FE,QC		801128	4	Project engineering to provide list of design documents to FE and QC to start this item
23-41*	QCIs in use will be reviewed to ascertain that provisions have been included consistent with the revised control document, SF/PSP G-6.1, Quality Control Inspection Plans.	I-18, 23-22, 23-25	5	QC		801115	4	See Item 23-34

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-42* (31) (40)	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 24, 1980, and field engineering and quality control review is scheduled for completion by November 28, 1980. Any revisions required will be completed by January 23, 1981.	I-11, 23-22, 23-30	4	PE, FE,QC		810123	4	
23-43*	The impact of Item 41 on completed work will be evaluated, and appropriate actions will be taken as necessary.	23-22, 23-25	4	QC		810115	4	
24-1	Determine final number of observation wells	24-21	5	GT		811031	4	Ongoing activity
24-2	Develop frequency for monitoring the observation wells	24-21	5	GT		810131	4	Ongoing activity
24-3	Develop system and schedule for monitoring sand removal	24-22	5	GT		810131	4	Ongoing activity
24-4	Evaluate results of temporary dewatering system to verify design bases	24-8	5	GT		811031	4	Ongoing activity
25-3	Revise seismic analysis for service water pump structure using soil properties determined by the recent investigation and any foundation modification	25-5	5	CE			4	Tracked by Item 13-11

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-21A	Modify QCIs based on Item 1-21	NA		QC	E. Smith	801115 (800901)	3	See Items 23-19A, 23-34, and 23-41
1-23	Incorporate scientific sampling plans for inspection	I-20		QC		801115 (791019)	3	See Item 23-34. Committed statements not yet compiled with
13-6 (13-1)	Conduct a seismic reanalysis for the diesel generator building	13-2	0	CE	B. McConnel	801115 (801015)	3	
13-12 (13-3)	Review structural design for seismic response from Item 13-11	13-2	0	CE		801231 (800831)	3	
13-15 (13-3)	Review electrical system for seismic response from Item 13-11	13-2	0	CE	B. McConnel	810201 (801231)	3	
13-16 (13-4)	Conduct a seismic reanalysis for the auxiliary building	13-3	0	CE	B. McConnel	801215 (800815)	3	
13-17 (13-4)	Review structural design for seismic response from Item 13-16	13-3	0	CE	R. Zao	801130 (800930)	3	
14-7	Analyze the BWST foundation for variable foundation properties	14-2	5	CE	R. Zao	801231 (800831)	3	Analysis ongoing
14-8	Compare allowable versus calculated forces and moments at critical sections for auxiliary building electrical penetration area and service water pump structure	14-5	5	CE		801231 (800831)	3	Analysis ongoing
15-2	Expand the Midland project structural design criteria for Seismic Category I structures to include the differential settlement effect.	15-2	0	CE	D. Reeves	801130 (800831)	3	Design criteria in CPCo review
17-5	Analyze buried piping considering the probable ultimate settlement. Provide unique resolution for any unacceptable stress conditions for the portion of the system	17-3	5	PS	J. Legette	810131 (800801)	3	Report on method for analysis being reviewed
17-6	Investigate the excess rounding of profile data	Tbl 17-2	2	PS	J. Legette	810131 (800801)	3	Same as Item 17-5

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
18-1	Perform reexamination of the stresses in all Seismic Category I connecting piping between buildings as a normal iteration of design. Consider stresses induced by differential settlement after connecting pipe and anticipated future settlement	18-1	0	PS	J. Legette	810131 (800801)	3	Same as Item 17-5
18-2	Perform final analyses to demonstrate the margin of acceptability for additional differential settlement beyond that expected for the life of the plant	18-2	5	PS	J. Legette	810131 (800801)	3	Same as Item 17-5
18-3	Design piping connecting from the diesel generator building to the pedestals which will accommodate the expected future settlement	18-2	5	PS	J. Legette	810131 (800801)	3	Dependent on 17-5
19-1	Profile pipes in the vicinity of diesel generator building after removal of preload and evaluate as described in the Response to Question 17	19-1	0	PS	J. Legette	810131 (800801)	3	Dependent on 17-5
19-3*	Perform a complete evaluation of safety-related piping after completion of the preload program	19-3	0	PS	J. Legette	810131 (800801)	3	Dependent on Item 18-1
20-1	Analytically check the Seismic Category I systems affected by settlement for pump and nozzle loadings and verify that they are within specified or vendor-accepted limits	20-1	5	PS	J. Legette	810131 (800801)	3	Dependent on Item 18-1
20-2	Verify piping support loads for systems subjected to settlement-induced loads	20-1	5	PS	J. Legette	810131 (800801)	3	Dependent on Item 18-1
20-3	Prepare additional response to the NRC					810131 (800801)	3	
20-4	Evaluate active valves affected by settlement for imposed loads and reactions; compare to the allowable for operability	20-1	5	PS	J. Legette	810131 (800801)	3	Dependent on Item 18-1

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-19A*	This action modified to include necessary revision to QCIs resulting from evaluation of surveillance and review callouts	I-18		QC	E. Smith	801115 (800901)	3	To be completed when Item 23-41 is completed and QC Procedure G6.1 is approved by CPCo. See Item 1-21A
23-20*	Field Instruction 1.100 will be supplemented by establishing requirements for demonstrating equipment capability, including responsibility for equipment approval, and providing records identifying this capability.	23-18	5	FE		801231 (791204)	3	Awaiting equipment qualification report from geotechnical services based on CPCo NCR
23-25*	Quality assurance will issue a Nuclear Quality Assurance Manual amendment to clarify the requirement that procedures include measures for qualifying equipment under specified conditions.	23-18		QA		801017 (800902)	3	Awaiting issuance of remaining NQAM procedures needed for the CPCo/Bechtel QA integration
23-28*	Civil/Structural Design Criteria 7220-C-501 will be modified to contain the requirements that a duct bank penetration shall be designed to eliminate the possibility of the nonspecific size duct interacting with the structures.	23-15	5	CE	D. Reeves	801130 (800831)	3	Design criteria in CPCo review
23-30* (39)	Engineering will clarify specifications and construction will prepare procedures (governing the soils compaction equipment) to implement the requirements of the Nuclear Quality Assurance Manual as stated in Item 25	23-18	5	CE/FE		801230 (800912)	3	Dependent on compaction report and NQAM
23-31*	Design documents, instructions, and procedures for those activities requiring inprocess controls will be reviewed to assess the adequacy of existing procedural controls and technical direction. Engineering review is scheduled for completion by October 24, 1980.	I-11, 23-20, 23-30	5	PE	C. Russell	801131 (801024)	3	

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-33*	The quality assurance audit and monitoring program will be revised to emphasize and increase attention to the need for evaluating policy and procedural adequacy and assessment of product quality. A specialized audit training program will be developed and implemented to ensure guidance for this revised approach.	23-35	5	QA		800912	3	Action completed except developing audit training program
23-34*	Control Document SF/PSP G-6.1 will be revised to provide requirements for inspection planning specificity and for the utilization of scientific sampling rather than percentage sampling.	I-20, 23-22, 23-24	5	QC		801115 (800915)	3	SF/PSP G-6.1 has been submitted for review. See Item 1-23
23-39* (30)	Engineering will clarify specifications and construction will prepare procedures (governing the soils compaction equipment) to implement the requirements of the Nuclear Quality Assurance Manual as stated in Item 25.	23-18	5	PE		801231 (801017)	3	
23-44A*	The audit committed to in our response to Question 1, Part b and described in Part 2, Section 5.0 will be conducted once during the FSAR rereview (commencing March 17, 1980) and again after completion of the rereview (commencing September 1, 1980).		4	QA		801231 (800901)	3	See Item 1-4
23-47*	See Item 23-4	23-9, 23-25	4	PE		801231 (801031)	3	
26-1	Analyze the effect of differential settlement of the diesel generator building in accordance with ACI 349 as supplemented by Regulatory Guide 1.142	26-2	5	CE	R. Zao	801031 (800930)	3	

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
33-1	Fill the diesel fuel oil tanks with oil prior to preoperational testing	33-2	5	CE		810831 (800829)	3	See Items 4-9 and 6-4 Will be accomplished just prior to preoperational testing

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
4-7	Remove unsuitable material in the tank farm and replace by compacted fill	4-3	3	GT	J. Wanzeck S. Rao	791130	2	
15-1*	Evaluate the differential settlements in accordance with provisions of ACI 318-71 for Seismic Category I structures founded partially upon natural soil and partially upon fill material	15-1	0	CE		791231	2	Superseded by Items 26-1 and 26-2. See Item 14-6
17-2	If future profiles show any extreme conditions, analyze the piping system and make necessary repairs	17-3	0	CE		790901	2	Superseded by Item 17-5
19-2	Take additional gap measurements between embedded sleeves and pipes when surcharge is removed. Coordinate this information with the profile data	19-2	0	CE			2	Closed by Rev 5
23-35*	Control Document SF/PSP G-3.2. Control of Nonconforming Items, is being revised to improve the definition of implementing requirements for identifying repetitive nonconforming conditions.	23-33	5	QC		800815	2	See Item 1-24. PSP G-3.2 Rev. 6 issued 6/10/80
23-44*	FSAR sections are being rereviewed as discussed in the Response to Question 23, Part 2.	23-7, 23-11	4	PE		800931	2	See Item 1-2
23-45*	U.S. Testing will be required to demonstrate to the cognizant engineering representative that testing procedures, equipment, and personnel used for quality verification testing (for other than NDE and soils) were, and are, capable of providing accurate test results in accordance with the requirements of applicable design documents.	I-18, 23-27, 23-31	5	CE		801001	2	Report submitted to QA
23-46*	A sampling of U.S. Testing's test reports (for other than NDE and soils) will be reviewed by the cognizant engineering representative to ascertain that results evidence conformance to testing requirements and design document limits.	23-28, 23-31	5	CE		801001	2	Report submitted to QA

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-48*	CPCo will implement overinspection for soils placement, utilizing a specific overinspection plan.	I-11, I-16	4	CPCo-QA		NA	2	(1) Ongoing activity
23-49*	CPCo will perform overinspection of the U.S. Testing soils testing activities and reports, utilizing a specific overinspection plan.	I-17	4	CPCo-QA		NA	2	(1) Ongoing activity
23-50*	CPCo project management and QA review field procedures (new and revised) and CPCo QA reviews QCIs (new and revised) in line with Bechtel before release.	I-19	4	CPCo-QA, CPCo-PMO		NA	2	(1) Ongoing activity
23-51*	In 1978, CPCo implemented an overinspection plan to independently verify the adequacy of construction and the Bechtel inspection process, with the exception of civil activities. Reinforcing steel and embeds were covered in the overinspection.	I-19	4	CPCo-QA		NA	2	(1) Ongoing activity
23-52*	CPCo reviews onsite subcontractor QA manuals and covers their work in the audit process.	I-19	4	CPCo-QA		NA	2	(1) Ongoing activity
23-53*	An ongoing effort is improving the "surveillance" mode called for in the QCIs by causing more specific accountability as to what characteristics are inspected on what specific hardware and in some cases changing "surveillance" to "inspection."	I-19	4	QC		NA	2	See Item 23-19A
25-1	Revise seismic analysis for diesel generator building using the soil properties determined by the recent investigation and any foundation modifications	25-3	5	CE			2	Tracked by Item 13-6
25-2	Revise seismic analysis for auxiliary building using the soil properties determined by the recent investigation and any foundation modifications	25-3	5	CE			2	Tracked by Item 13-16

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(1) Bechtel verification of this item is not required.

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
26-2	Incorporate in the Midland project standard design criteria the effect of differential settlement of structures which are founded partially or totally on fill	26-1	5	CE			2	Tracked by Item 15-2
27-1	Prohibit final piping connection to the diesel generator building before 12/31/81	Fig 27-9	5	PD	R. Tulloch	800731	2	
31-1	Perform full-scale load test by filling the BWST with water	31-2	5	GT CE		801130	2	Tracked by Item 4-8

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-1*	Perform a final review and update of PSAR commitment list	1-3	1	LS		800101	1	
1-2*	Review sections of the FSAR determined to be inactive	1-4	1	LS		800101	1	Superseded by Item 23-44
1-3*	Review EDP 4.22	1-4	0	QE		790629	1	
1-4	Audit action items 1-3	1-4	0	QA		801101	1	Superseded by Item 23-44A
1-6*	Complete review of the Dames and Moore report	I-6		GT		790629	1	
1-7*	Complete review of pertinent portions of FSAR Sections 2.5 and 3.8	I-6		GT,CE		790629	1	
1-8	Correct settlement calculations	I-6		GT		791101	1	
1-9	Schedule audits of the geotech sections on a 6-month basis	I-7		QA		790504	1	
1-10*	Review drawings for possible effect of vertical duct bank restrictions	I-7		CE		790106	1	
1-11*	Complete actions in response to DRVCL audit	I-7/8		QE		790518	1	
1-12*	Revise EDP 4-49 to incorporate clarifications and instructions for use of SCN	I-8		QE		790504	1	See Item 23-4
1-13	Schedule audits of each design discipline calculations on a yearly basis	I-8/9		QA		790504	1	
1-14	Reevaluate construction equipment used for compaction	I-11		FE		791204	1	See Item 23-20
1-15	Assign field soils engineer and soils engineer from design section	I-11		FE		790501	1	
1-16*	Review construction specifications and procedures to identify equipment requiring qualification	I-11		FE		790629	1	See Item 23-8
1-17*	Review field procedure FPG-3.00 to ensure clarity and completeness	I-11		FE		790531	1	See Item 23-7A

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
1-18	Revise PQCI C-1.02 to provide inspection rather than surveillance and to record inspections	I-16		QC		800801	1	
1-20*	Perform in-depth audit of U.S. Testing	I-18		QA		790531	1	See Item 23-15
1-21*	Review all active QCIs for surveillance callouts	I-18		QC		790629	1	See Item 23-19
1-22*	Evaluate documentation (review) callouts on QCIs	I-18	1	QC		790629	1	Superseded by Item 23-19
1-24*	Complete in-depth review of the Bechtel trend program	I-22		QA		790601	1	See Items 23-18, 23-35, and 23-36
1-25*	Conduct QA training	I-22		QA		790601	1	Superseded by Items 23-16 and 23-17
3-1*	Clarify the Response to Question 362.12 in FSAR Revision 18	3-1	0	LS		790531	1	
4-1*	Provide criteria for permissible residual settlement	4-1	3	GT CE		791231	1	
4-2*	Provide details of treatment of loose sands	4-2	0	GT CE		790831	1	
4-3	Take dynamic modular measurements upon removal of preloads for diesel generator building and other buildings	4-3	3	GT		791031	1	
4-4	Use data of Item 4-3 to evaluate the seismic response of the structures	4-3	3	CE		791130	1	Partial Requirement of Items 13-6, 13-11, 13-16
4-5	Prepare additional response to NRC for Items 4-1 and 4-2	NA		CE		790831	1	
4-9	Fill the diesel fuel oil tank with water to perform a full-scale test of the foundation soil	4-2	0	GT			1	See Item 6-4
5-1	Monitor the settlement of the structures (which were subjected to preload) during the life of the plant to provide a record of performance	5-1	0	GT			1	Ongoing activity, requirements in Dwg C-994, Spec C-76

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
6-1	Construct and fill the borated water tank to make a full-scale test of the foundation soils	6-1	0	GT CE			1	Tracked by Item 4-8
6-2	Delay the piping connections to the BWST until most of the settlement has taken place under the test load	6-1	0				2	
6-3	Use settlement data from BWST to allow conservative piping connection design		0	NA			1	Tracked by Item 4-8
6-4	Evaluate the load test result of the diesel fuel oil tank and provide precise corrective measures if required	6-2	0	GT			1	See Item 4-9
6-7	Remove all unsuitable material in the tank farm area and replace with suitable compacted fill	6-1	3	GT			1	Tracked by Item 4-7
6-8	Monitor the non-Seismic Category I condensate storage tanks	6-2	3	GT			1	Tracked by Item 4-6
7-1*	Perform continuity check on duct banks after completion of preload program	7-3	3	FE		791130	1	
8-1	Establish a requirement to realign diesel generators if manufacturer's tolerance for pitch and roll are exceeded	8-2	0	CE		800304	1	Requirement shown in Dwg C-1011, Note 4
8-2	Monitor the diesel generator pedestal markers on a 60-day cycle throughout the construction phase.	8-2	0	CE		NA	1	Ongoing activity. Requirements in Dwg C-994 and Spec C-76. Included in Item 5-1
12-1	Complete one additional boring in the middle of diesel fuel oil tank area	12-1	0	GT		790423	1	
12-2	Complete three additional borings in the auxiliary building control tower area	12-1	0	GT		790531	1	
12-3	Complete Table 12-1 for soils investigation and planned remedial measures; respond to NRC	Tbl 12-1	1	CE		790531	1	
12-4	Provide supporting soil condition for Seismic Category I utilities	Tbl 12-1	0	CE		790531	1	

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
12-6	Provide a detailed description of planned corrective actions in Interim Report 6 of MCAR 24	Tbl 12-1	1	CE		790630	1	
12-7	Perform a continuity check on one conduit in each duct bank made with a hard-fiber rabbit prior to cable pulling	Tbl 12-1 Pg 4	1	FE		800630	1	See Item 7-1. Ongoing activity. See field procedure FIE 4.500
12-8	Measure the gaps between embedded sleeves and pipes entering the service water valve pits when the surcharge is removed	Tbl 12-1 Pg 5	3	CE			1	
13-1	Complete seismic reanalysis of diesel generator building to account for current lack of compaction	13-1	0	CE		791031	1	Superseded by Items 13-6 and 13-7
13-2	Review diesel generator building design and Seismic Category I equipment piping, and electrical systems to the enveloped seismic responses	13-		CE		791231	1	Superseded by Items 13-8 through 13-10
13-3A	Conduct a seismic reanalysis to account for revised soil structure interaction of service water pump structure	13-2	0	CE		791231	1	Superseded by Items 13-11 through 13-15
13-3B	Review structural design and Seismic Category I equipment, piping, and electrical systems and incorporate the seismic responses of the reanalysis for the service water pump structure	13-2	0	CE		791231	1	Superseded by Items 13-11 through 13-15
13-4A	If significant change of foundation properties of the auxiliary building result, conduct a seismic reanalysis;			CE		791231	1	Superseded by Items 13-16 through 13-20
13-4B	Review structural design and Seismic Category I equipment, piping, and electrical systems and incorporate the seismic response of the reanalysis for the auxiliary building			CE		791231	1	Superseded by Items 13-16 through 13-20

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
13-5	Underground utilities - Investigate the change in differential displacement separately for buildings founded on fill pending results of seismic reanalysis					791231	1	Superseded by Item 13-21
14-1	Review the estimated settlement upon completion of the load test program of the BWST	14-1	5	GT		810131	1	Tracked by Item 4-8
14-2	Analyze flexible buildings for differential settlement based on stiffness at the time of distortion. Evaluate forces due to arching or distortion according to Question 15	14-2	0	CE			1	Superseded by Item 26-1. See Item 14-6
14-3*	Map significant cracks in auxiliary building, feedwater isolation valve pits, and ring foundation for the BWSTs	14-3	0	CE		790630	1	
14-4*	Analyze buildings affected by differential settlement for observed differential settlement plus predicted differential settlement	14-4	0	CE		790831	1	Superseded by Item 26-1. See Items 14-2 and 14-6
14-5	Prepare additional response to the NRC	14-		CE		790831	1	
14-6*	Analyze the diesel generator building for variable foundation properties by finite element model	14-2	3	CE		791231	1	
16-1*	Perform soil borings in areas of buried pipes	16-1	0	GT		790831	1	Deleted in Rev 5. Requirement to perform borings is in Dwg C-1146
17-1*	Evaluate impact of the failure of buried non-Seismic Category I piping on safety-related structures, foundations, and equipment	17-1	0	CE		790629	1	Deleted in Rev 2. Evaluation was not requested by NRC.
17-3	Prepare additional response to the NRC					790629	1	

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-1*	Consultant reports other than Dames & Moore were considered in accordance with the guidelines provided in NRC Regulatory Guide 1.70, Revision 2. Consultant reports were not attached to the FSAR, but portions of consultant reports were extracted and incorporated into the FSAR text itself. Those portions incorporated into the FSAR become commitments. Therefore, disposition of recommendations in consulting reports has been adequately accounted for in the preparation of the FSAR. Verification that those portions of consultant reports determined to be commitments and incorporated into the FSAR have been adequately reflected in project design documents is being accomplished via the FSAR rereview program described in the response to Question 23, Part 2. The two Bechtel QA audit findings reported in our April 24, 1979, response (Paragraph D.1, Page I-8) have been closed.	I-8, 23-7	4	PE		790518	1	
23-2*	On April 3, 1979, Midland project engineering group supervisors in all disciplines were reinstructed that the only procedurally correct methods of implementing specification changes are through the use of specification revisions or specification change notices. This was followed by an interoffice memorandum from the project engineer to all engineering group supervisors on April 12, 1979.	23-8, 23-24	4	PE		790312	1	
23-3*	Engineering Department Project Instruction 4.49.1 was revised in Revision 2 to state, "Under no circumstances will interoffice memoranda, memoranda, telexes, TWXs, etc be used to change the requirements of a specification."	I-8, 23-9, 23-24	4	PE			1	

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Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-4*	A review of interoffice memoranda, memoranda, telexes, TWXs, and other correspondence relating to specifications for construction and selected procurements of Q-listed items will be initiated. The purpose of the review will be to identify any clarifications which might reasonably have been interpreted as modifying a specification requirement and for which the specification itself was not formally changed. An evaluation will be made to determine the effect on the technical acceptability, safety implications of the potential specification modification, and any work that has been or may be affected. If it is determined that the interpretation may have affected any completed work or future work, a formal change will be issued and remedial action necessary for product quality will be taken in accordance with approved procedures. The foregoing procedure will be followed for all specifications applying to construction of Q-listed items. For specifications concerning the procurement of Q-listed items, the foregoing procedure will be implemented on a random sampling basis. The sample size has been established and the specification selection has been made.	23-5, 23-9	4	PE			1	
(21)	Review and acceptance criteria for the specifications will be defined by March 14, 1980.							
(47)	The review of construction and selected procurement specifications is scheduled to be completed by October 1980.							

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
	If the acceptance criteria are not met, the review will be expanded to include other specifications for Q-listed items. At that time, a revised completion date will be established.							
23-5*	A study was completed which examined current procedures and practices for the preparation and control of the FSAR in view of these experiences. Procedural changes will be initiated by the revision of or addition to the engineering department procedures. This action is scheduled to be completed by January 31, 1980.	23-11	5			800131	1	
23-6*	An interoffice memorandum dated April 12, 1979, was issued by geotechnical services to alert personnel of the need to revise or annotate calculations to reflect current design status.	23-13	4	GT		790312	1	
23-7*	Field Instruction FIC 1.100, Q-listed Soils Placement Job Responsibilities Matrix, has been prepared and establishes responsibilities for performing soils placement and compaction.	I-11, 23-18, 23-20, 23-30		FE			1	
23-7A*	Review Field Procedure FPG 3.000 to ensure clarity and completeness	I-11		FE			1	See Item 1-17
23-8*	Construction specifications, instructions, and procedures were reviewed to identify any other equipment requiring qualification which had not yet been qualified. No such equipment was identified.	I-11, 23-18	5	FE			1	See Item 1-16
23-9*	A dimensional tolerance study was completed using the reactor building spray pump and ancillary system as the study mechanism.	I-8	4	PE			1	
23-10*	Engineering reviewed specifications not previously reviewed for the specificity or tolerance studies.	I-8					1	See Item 1-5

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MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-11*	A specific review of the FSAR and specification requirements for the qualification of electrical and mechanical components has been made as part of the corrective action relating to CPCo's 50.55(e) report on component qualification.	I-8					1	
23-12*	Quality assurance will schedule yearly audits of the design calculational process for techniques and actual analysis in each of the design disciplines.	I-8					1	
23-13*	Audits of ITT Grinnell hanger design and CPCo relay setting calculation have been conducted.	I-8		QA			1	See Item 1-13
23-14*	Bechtel project engineering will review design drawings for cases where ducts penetrate vertically through foundations. The possibility of the duct being enlarged over the design requirements and the effect this enlargement may have upon the structure's behavior will be evaluated by June 1, 1979. Proper remedial measures will be taken if the investigation shows potential problems.	I-7					1	
23-15*	An in-depth audit of U.S. Testing operations, covering testing and implementation of its QA program, will be conducted in late April or early May 1979, by Bechtel project QA and engineering.	I-18		QA			1	See Item 1-20
23-16*	An in-depth training session will be given to Midland QA engineers covering the settlement problem and methods to identify similar conditions in the future.	I-22	4	QA		791130	1	See Items 1-25 and 23-17
23-17*	An in-depth training session will be given to all CPCo and Bechtel QA engineers and auditors to increase their awareness of the settlement problem and discuss auditing and monitoring techniques to increase audit effectiveness.	I-22	4	QA		800229	1	See Item 1-25 and 23-16

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PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-18*	An in-depth review of the Bechtel trend program data will be undertaken by Bechtel QA management to assure the identification of any other similar areas that were not analyzed in sufficient depth in the past reviews.	I-22	4	QA			1	See Item 1-24
23-19*	Quality control instructions will be evaluated to ensure that the documentation characteristics which are to be inspected (i.e., surveillance and review callouts) are clearly specified.	I-18	4	QC			1	See Items 1-21 and 1-22
23-21*	See Item 23-4		5	FE		800314	1	
23-22*	Guidelines for surveillance of testing operations will be developed and included in field instructions for the onsite soils engineer. Engineering/geotechnical services will develop the guidelines by November 30, 1979.	23-27	5	GT		791130	1	
23-23*	Engineering will revise Engineering Department Procedure 4.22 by December 1, 1979, to clarify that engineering personnel preparing the FSAR will follow the requirements of Regulatory Guide 1.70, Revision 2, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (September 1975). Specifically, Regulatory Guide 1.70 (Pages iv and v of the Introduction) requires that such consultant reports only be referenced with the applicable commitments and supporting information included in the text (third paragraph, Page v). Such a requirement would preclude repetition of this circumstance.	23-7, 23-46	5	PE		791130	1	
23-24*	To preclude any future inconsistencies between the FSAR and specifications, Engineering Department Project Instruction 4.1.1 will be revised to state that all specification changes, rather than just "major changes," will be reviewed for consistency with the FSAR.	23-11	5	PE		791130	1	

013421

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
23-26*	In view of Item 6, geotechnical services will revise Procedure FP-6437 by December 31, 1979, to require that calculations be annotated to reflect current design status.	23-13	5	GT		800328	1	
23-27*	Engineering Department Procedure 4.37 will also be revised by December 31, 1979, to require that calculations be annotated to reflect current design status.	23-13	5	QA		791227	1	
23-29*	The civil standard detail drawings will be revised to include a detail showing horizontal and vertical clearance requirements for duct bank penetrations. The detail will address any mud mat restrictions.	23-15	5	CE		791231	1	Shown in Dwg C-141
23-32*	Guidelines for surveillance of testing operations will be developed and included in field instructions for the onsite soils engineer. Engineering/geotechnical services will develop the guidelines by November 30, 1979, and field engineering will prepare the instructions by February 29, 1980.	23-27	5	FE		800229	1	
23-36*	Control Document QADP C-101, Project Quality Assurance Trend Analysis, is being revised to improve the definition of implementing requirements for identifying repetitive nonconforming conditions.	23-33	5	QA		800124	1	See Item 1-24
23-38*	A study was completed by October 31, 1979, to examine current procedures and practices for the preparation and control of the FSAR in view of these experiences. Procedural changes will be initiated by the revision of or addition to the engineering department procedures.	23-11	5	LS		791130	1	

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART I: COMMITMENTS FROM QUESTIONS 1 to 35 (Continued)

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
2-0	No Action Item						-	
9-0	No Action Item	NA					-	
10-0	No Action Item	NA					-	
11-0	No Action Item	NA					-	
21-0	No Action Item						-	
22-0	No Action Item						-	
28-0	No Action Item						-	
29-0	No Action Item						-	
30-0	No Action Item						-	
32-0	No Action Item						-	
34-0	No Action Item						-	
35-0	No Action Item						-	

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART II: COMMITMENTS FROM SUPPLEMENTARY QUESTIONS

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
S-6	Continue involvement of CPCo/Bechtel consultants for reviewing remedial actions	B					5	
S-7	Monitor service water pump structure and pile displacement during jacking operation to verify pile dynamic stiffness used in seismic analysis	B		GT CE	B. McConnel		5	

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART II: COMMITMENTS FROM SUPPLEMENTARY QUESTIONS

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
S-1	Advise Bechtel to commence dewatering and underpinning activities	A		CPCo			4	After favorable SER
S-2	Develop settlement time rate criteria for all Seismic Category I structures	A		GT		810331	4	
S-3	Monitor concrete cracks for service water pump structure and auxiliary building electrical penetration areas and the feedwater isolation valve pits before and after installation of piles and caissons	B		CE		801031	4	Due date is for incorporating requirement into drawing

MIDLAND UNITS 1 AND 2

MASTER LIST OF COMMITMENTS TO NRC ON 10 CFR 50.54(f) RESPONSES (Continued)

PART II: COMMITMENTS FROM SUPPLEMENTARY QUESTIONS

Item	Description	Page	Rev	Resp Org	Responsible Engineer	Due Date	Status	Status Remarks
S-4	Monitor concrete cracks in the BWST valve pits and repair any observed crack exceeding the ACI code limits	B		CE		800630	2	Due date is for incorporating requirement into drawing. Dwg C-1148 has been issued.
S-5	Grout the local gaps between diesel generator building footing and mud mat	B		CE		800407	2	Grouting requirement in Dwg C-1147
S-8	Envelope pile stiffness for the seismic analysis of service water pump structure	B		CE	B. McConnel		2	Completed seismic model. See Item 13-11.
S-9	Check the limited clearance between the service water pipe at the building penetration	B		PD CE	R. Tulloch	800731	2	See Response to Question 45

⑪

D.G. Building - Meeting at Bechtel. with Consultants Hendron, Davisson and Gould. May 10, 1979. Thursday

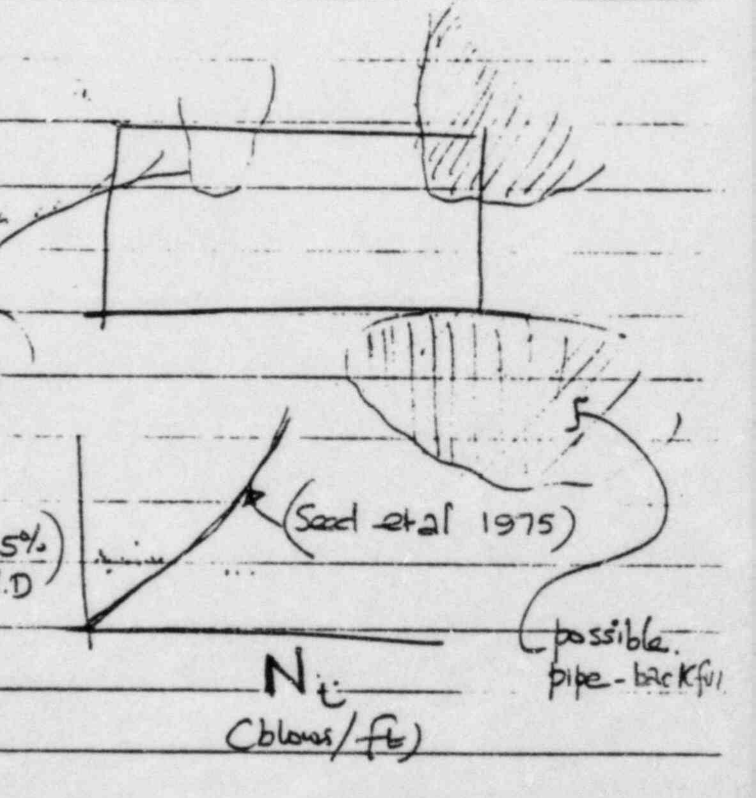
① Accuracy - How much 1/4. 1/8, 1/32 ?
when to remove the surcharge ~~the~~
How much flat is flat or flat enough.
No need to answer any more surcharge.

② Liquifaction
1) Blow count Analysis
Locate sand boundy through boring info.

2) Gradation curve - extremely variable.

3) (FS.1.0)

Depth	FS=1.2	FS = 1.5 (75% R.D)
5 (623)	8	11
10 (618)	13	13
15 (613)	14	15
20 (608)	15	17
25 (603)	16	20
30	18	22



Design ground surface 628'. (No need of new borings)

In general - free field is the worst case.
∴ Surcharge would help.

What is the recommended safety factor against Liquifaction.
or which sand and how far deep, should we go
with grouting - ?

<u>Recom</u>

~~Can~~ Atleast go upto 75%: but not less than that.

Atleast 20 blow count for
Gibbs & Holz Correction curve → }

Blow count above 615 (±): would be less than N = 20.

Put many holes than needed
Keep sequencing, and ~~to~~ get minimum takes.
Borings → start from borings

Liquifaction → demand is saturated weight 125 psf
water is only 62psf.

<u>Recomm:</u>

(Creep in sand - 6 weeks in literature)
Leave the surcharge for 2 to 5 weeks

Rebound — we would be lucky enough to get any
rebound at all. If you have rebound then there is no settlement
under its own wt. rebound is a good point with NRC

Location of piezometer is critical → to make sure.
Hydrodynamic effects

Exploration

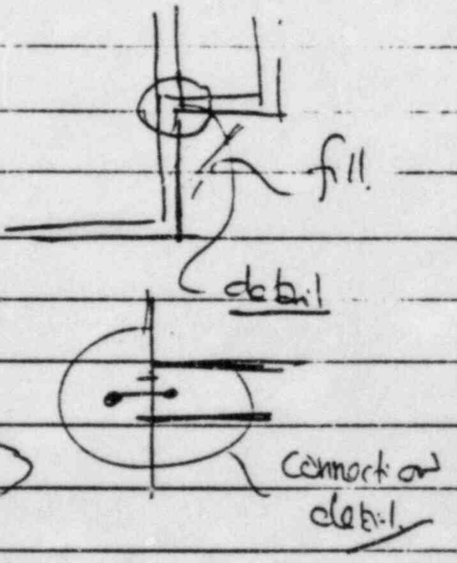
All borings are complete. - very extensive boring programs
Some draw down test are being completed.
Rebound measurement gage would be put on next week.
Test pits - next week.

500fps → shear wave velocity.
actual ? 600 to 800 fps.

— x —

Fix

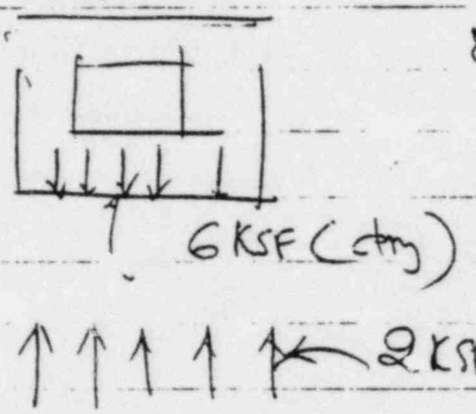
Aux Bldg ~~&~~ Rail Road bay.
Three borings Ax 1, 2 and 10.
2 to 2½KSF Load on cl.
bott of mar is 8ft below 634
N=11, 11 & 33 / Ax-1
< 10-ft layer?
Ax-2 is better
Ax-10 is same as Ax-1.



~~Prof. Sloss:~~ ~~Amin~~

Draw down of water - does it cause additional settlement.
Changing the effective stress

Effective stress would increase —.



Draw down test → careful about piping problems
Total dewatering - 1/2 to 1/4 mill

Consultants → Global dewatery

25% of total Cost is Dewat

Lockey ?

$ 3million: for Diesel Bldg
(1mill for supporting Turb Bld.)

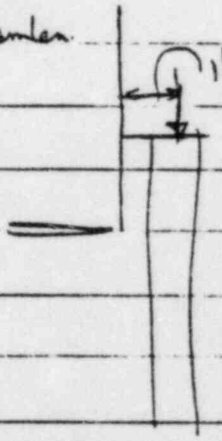
Pneumatic Caisson:

8000 kips Total bldg:
1500 kips - Skyhook:

100 Ton pile — H-Piles. Tip reinf - yes.
Glacial Till:
H-pile — Pipe Pile preferable — 12"- 3/8" wall,
12 3/4" OD - 3/8" minimum
plenty of drivability.
Make the Concrete pretty, strip — 5ksi concrete
are
Slump 5" ± 1" [nothing under 4"]. one bar in the middle.
3/4" max Aggregate. Good Concrete
1 1/2" min thickness closure plate. — 13 1/2 Drill it first
Hammer → 24000 ft lbs —
That pile would be ok without load test - one load test 200T min.
ASTM A252 Grade 2 Seamless

Pile

AE1 - 543



DIESEL GENERATOR BUILDING

Meeting on May 11 1979

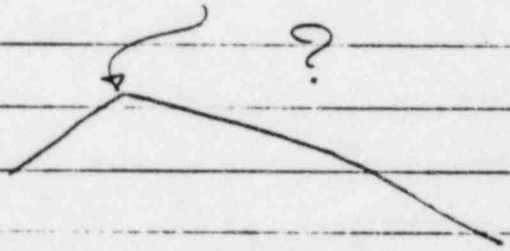
at Bechtel, Ann Arbor

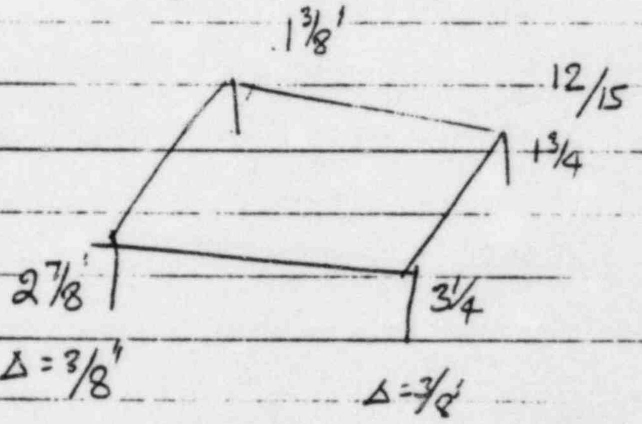
① Agenda for the meeting —.

KW

① Presentation of curves — says the bldg is still in place. ?

South wall:





Piezometer - didn't response substantially. only 4 showed.

Make a decision when to take [illegible] off — in one month

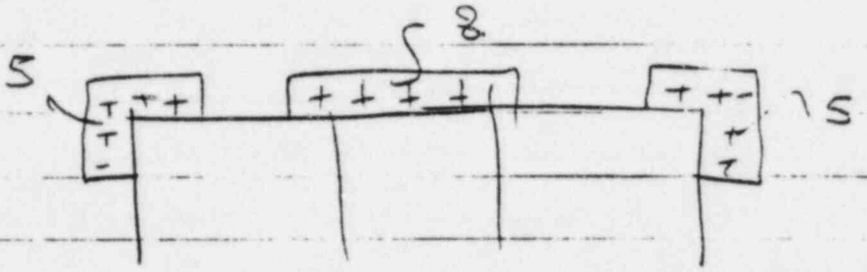
② Sheriff

③ Almeb: fix

Service water building fix —.

ΣH is adequate by friction.

Pile Test
Q Pile



① Valve Pits:
Support from Turbine bldg and

② Penetration Room Skyhook + Jacking pls

③ ~~Train~~ Railroad Bays - Grouting in the solution. for Liquefaction.

Test pit for grout effectiveness.

4. Dhar.
Tanks & Misc Structures
ED. Tank

BWST Tank: Settlement - 2

5. Other Structures
Service water valve pit - under preload

Gaurdhouse: rearrange sand drain - redesign foundⁿ
Transformer Pad - preload
Retaining wall - Just Monitor -

6. Underground Facilities

McCunnel

7. Cost + Schedule Jones

① SWB — ½ mill
② AUX B Penet — 3.8 mill
③ Deaster 0.7
Centi pla Skylab 0.2
0.4

④ Chem Grout — 2.0 mill

7.2

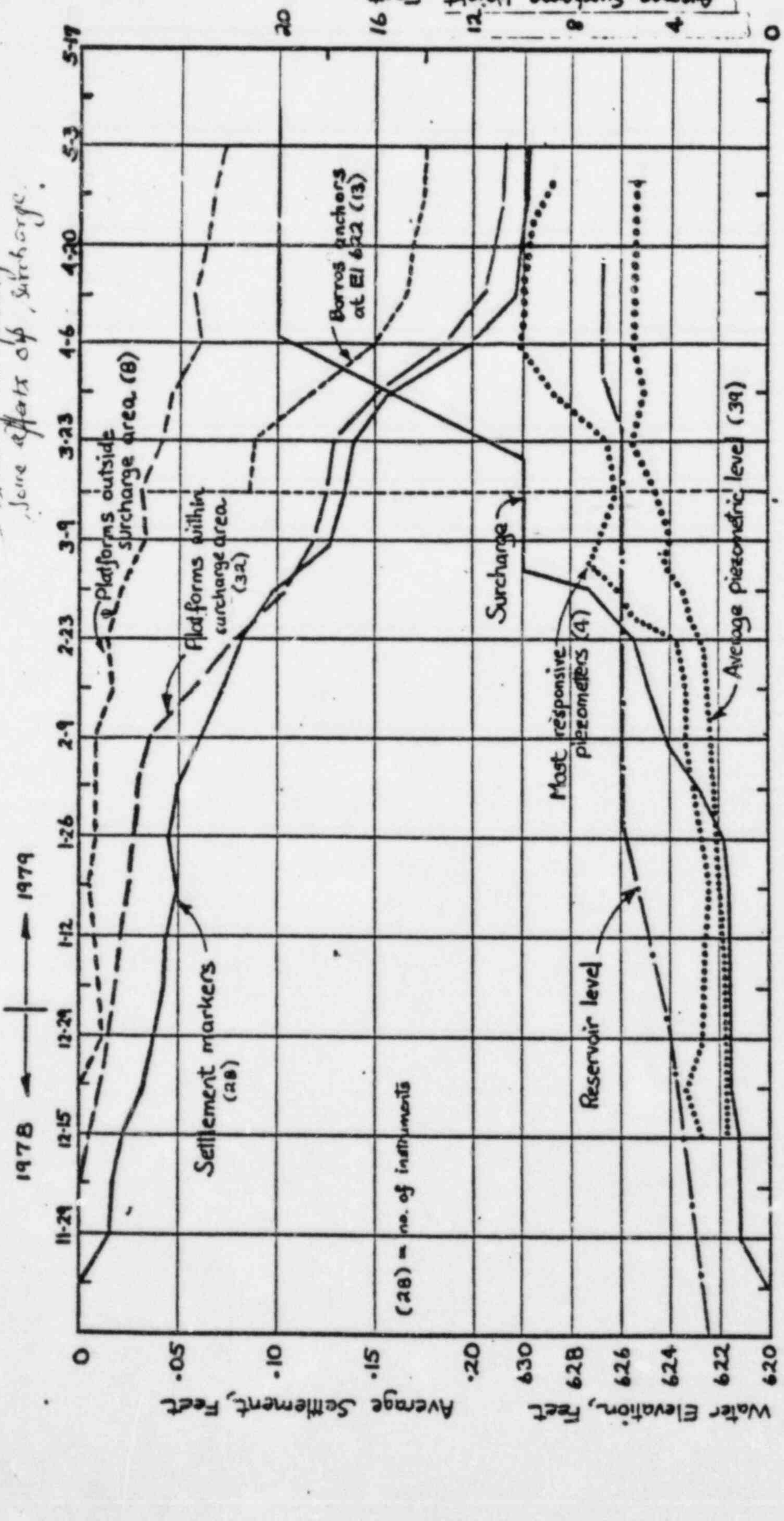
John Davie

D.G Building   T.R Thiruvengadam

Handed over during the meeting on May 10, 1979 w. Consultants Hendron, Davisson and Gould.

settling uniformly. Some effects of surcharge.

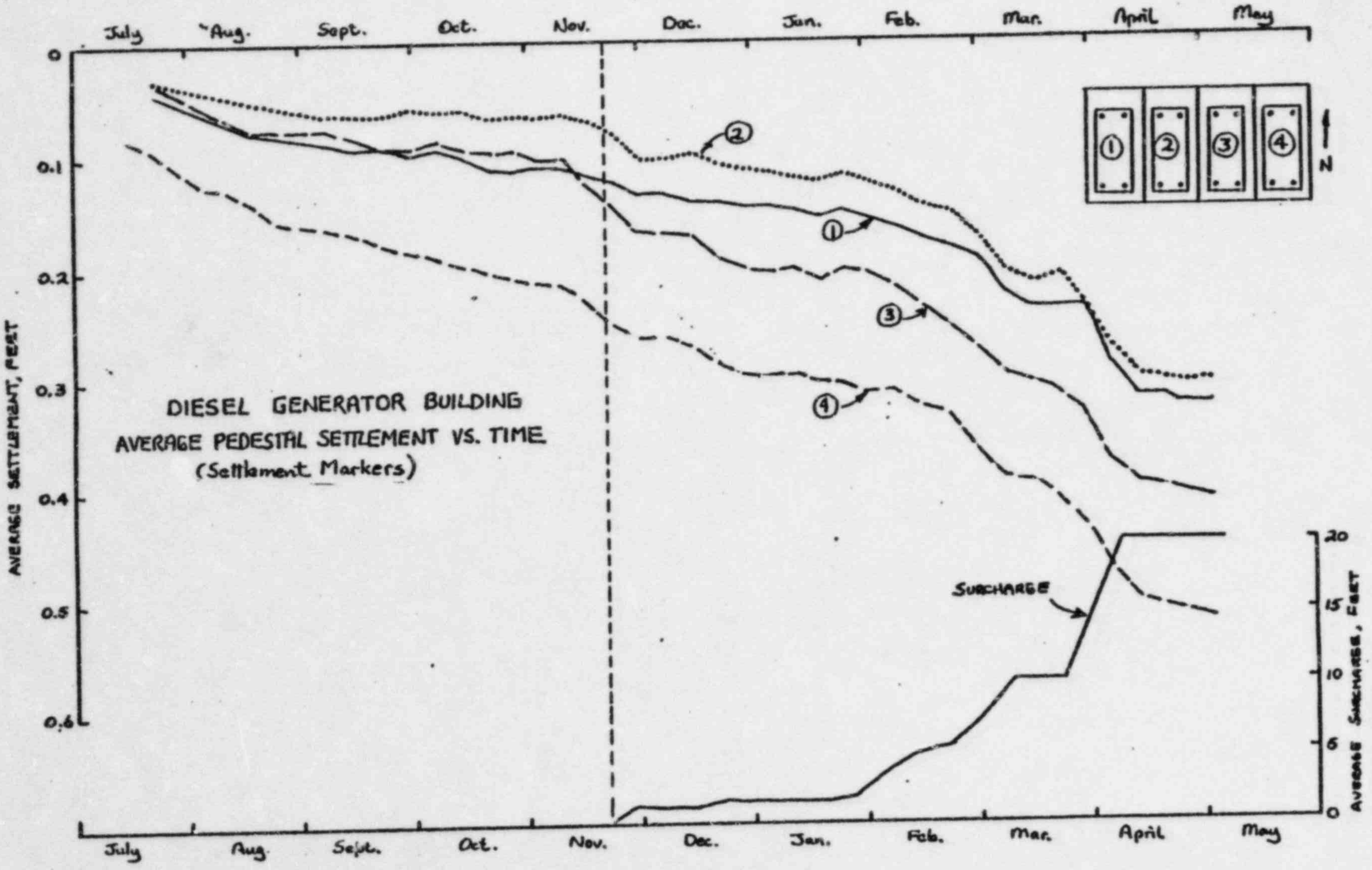
update till last Friday.



DIESEL GENERATOR BLDG: AVG SETTLEMENT, SURCHARGE & WATER LEVEL VS TIME

Almost all piez : 625 (±)

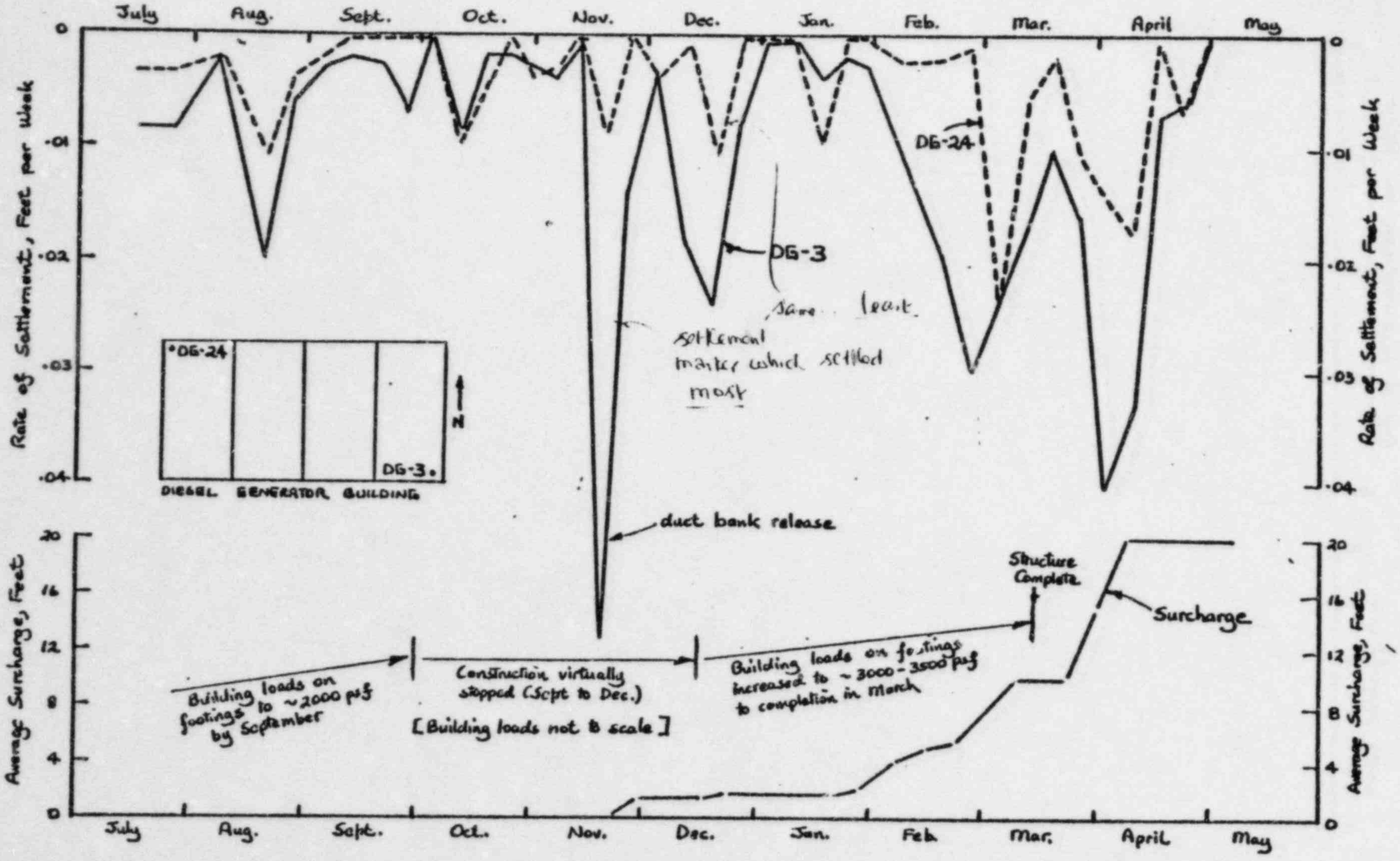
ORIGINATOR ______ DATE ______ CHECKED ______ DATE ______
PROJECT ______ JOB NO. ______
SUBJECT ______ SHEET NO. ______



DIESEL GENERATOR BUILDING
AVERAGE PEDESTAL SETTLEMENT VS. TIME
(Settlement Markers)

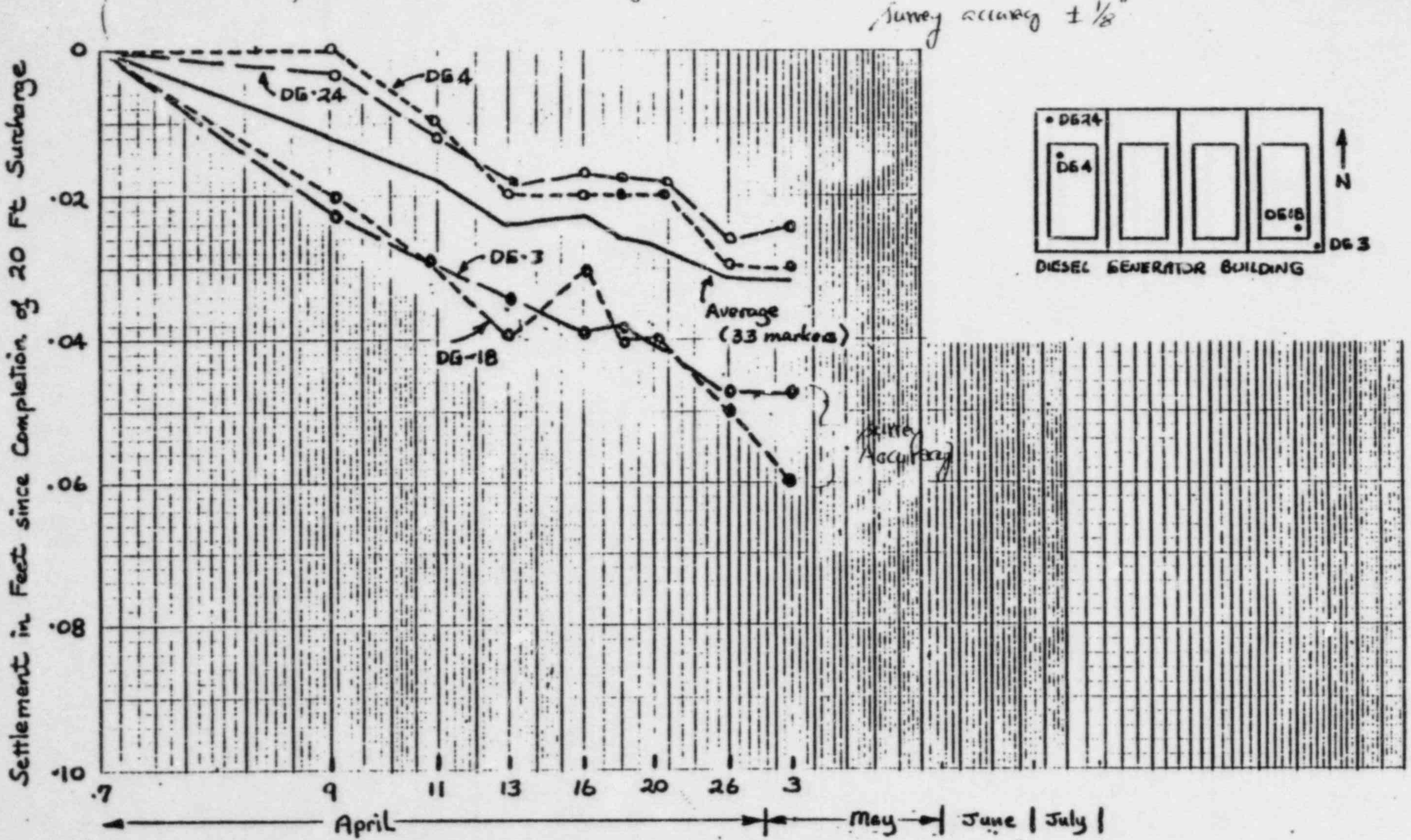
PROJECT ______________________ JOB NO. ______________________

SUBJECT ______________________ SHEET NO. ______________________



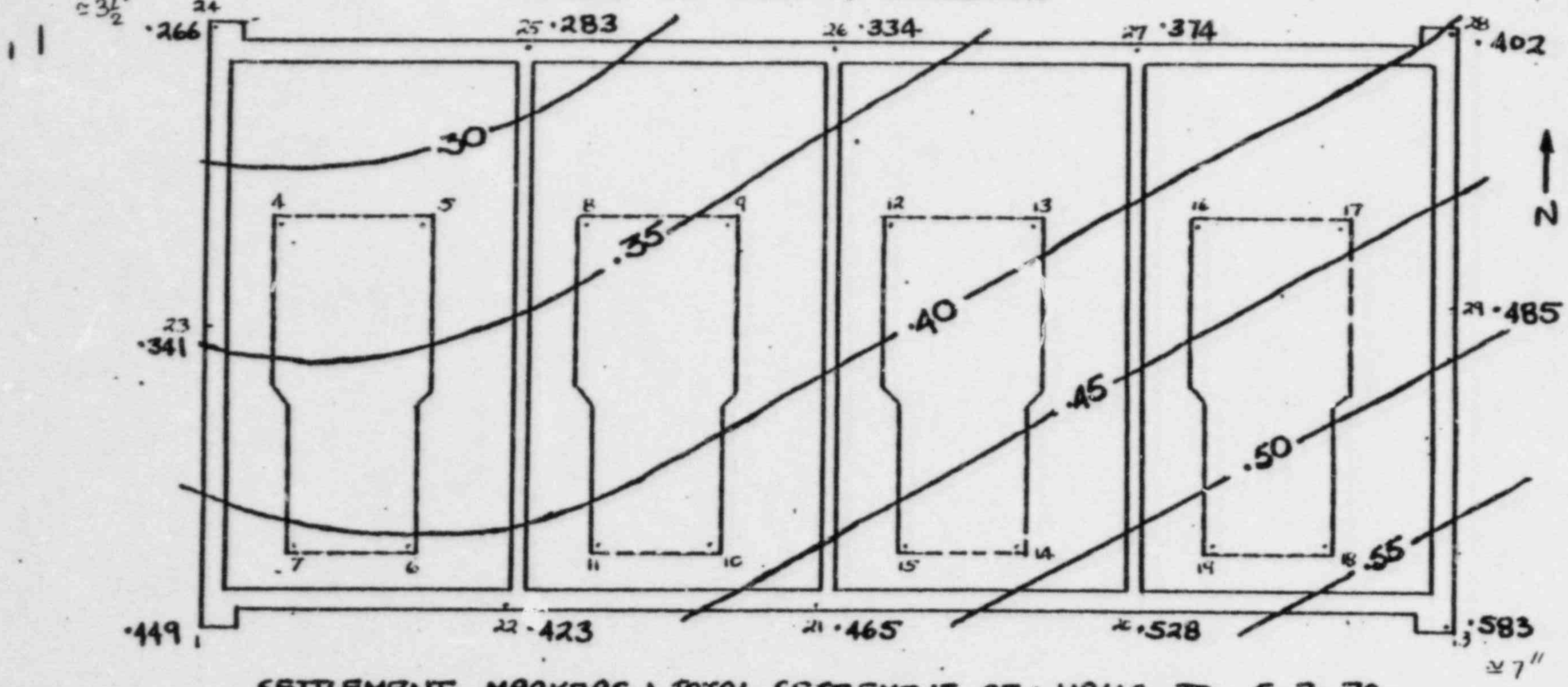
DIESEL GENERATOR BUILDING : SETTLEMENT MARKERS — SETTLEMENT RATE VERSUS TIME

Settlement, since completion of 20ft of Surcharge.



DIESEL GENERATOR BUILDING : SETTLEMENT VERSUS LOG TIME

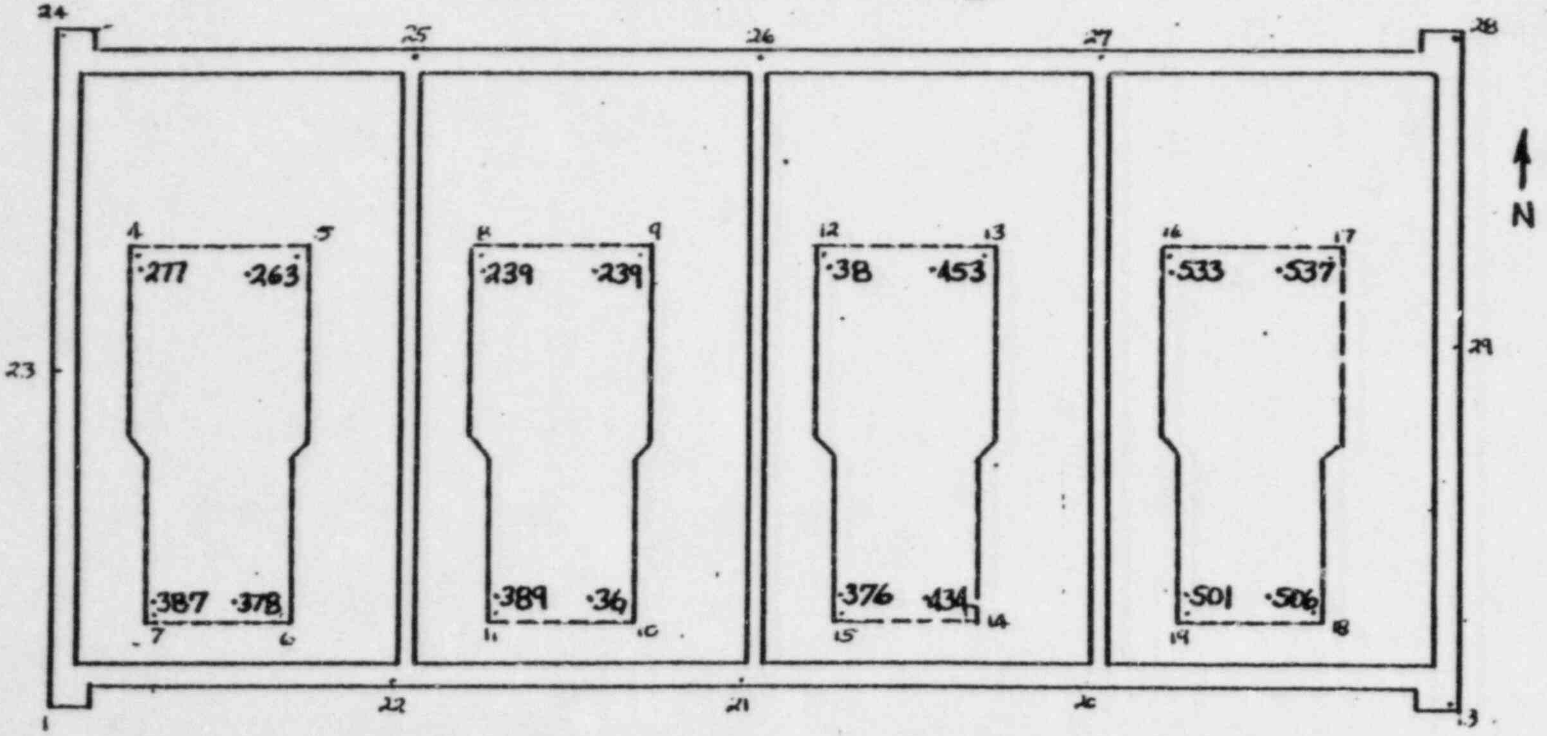
DIESEL GENERATOR BUILDING



SETTLEMENT MARKERS : TOTAL SETTLEMENT OF WALLS TO 5-3-79
Readings in Feet ; Total Surcharge of 20 ft (2200 psf)

Total settlements on building walls only

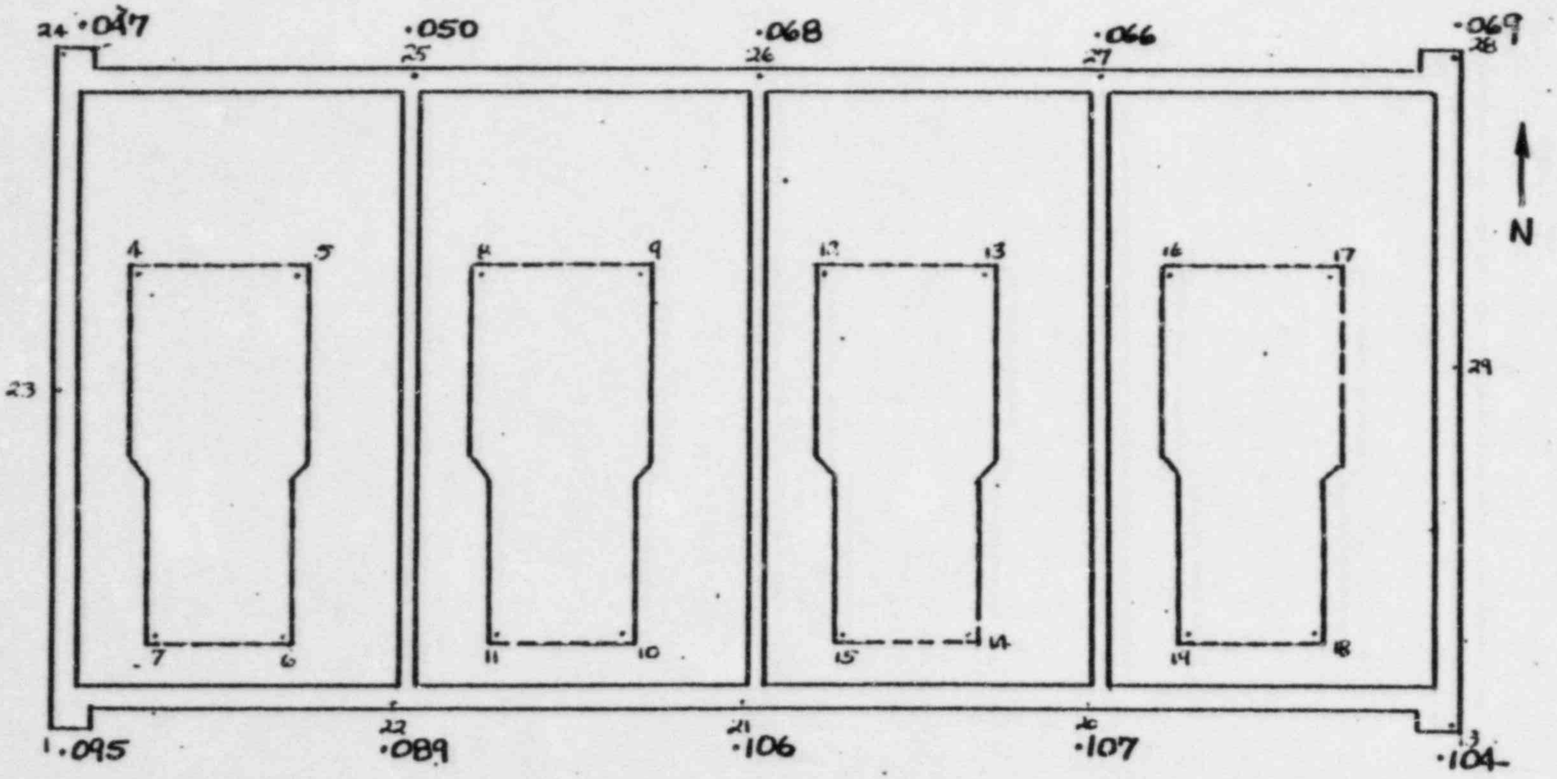
DIESEL GENERATOR BUILDING



SETTLEMENT MARKERS: TOTAL SETTLEMENT OF PEDESTALS to 5-3-79

Readings in Feet; Total Surcharge of 20 Ft (2200 psf)

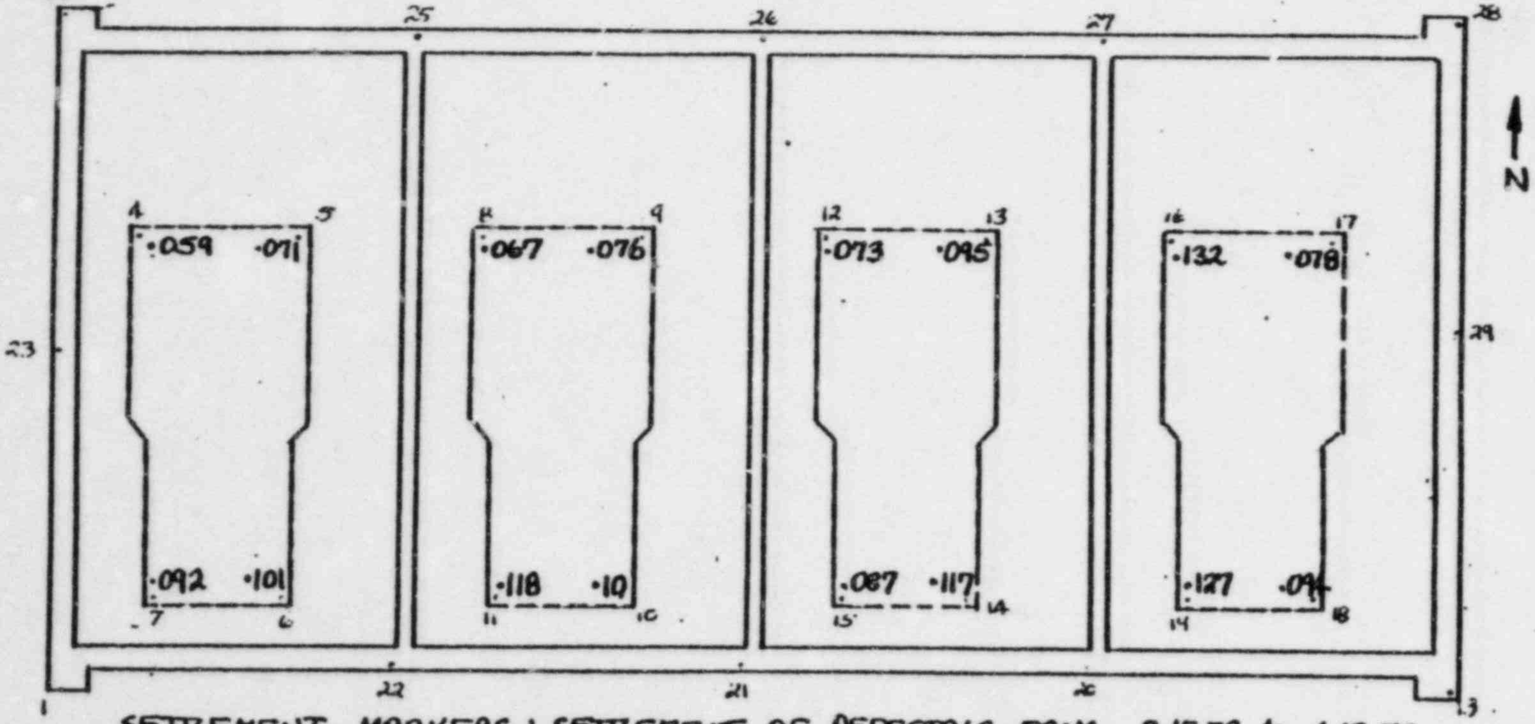
DIESEL GENERATOR BUILDING



SETTLEMENT MARKERS: SETTLEMENT OF WALLS FROM 3-15-79 to 4-13-79

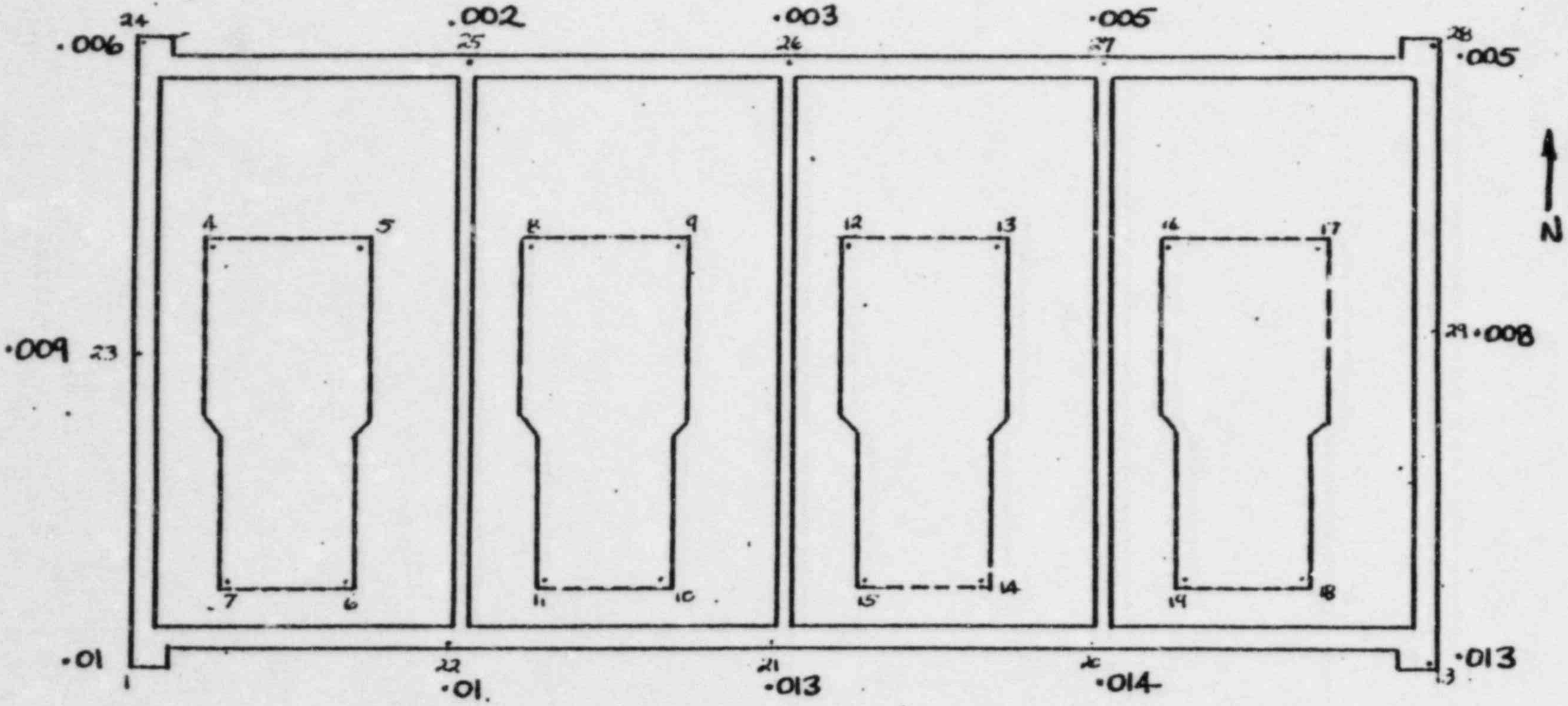
Readings in Feet ; 10 Ft Surcharge Added

DIESEL GENERATOR BUILDING



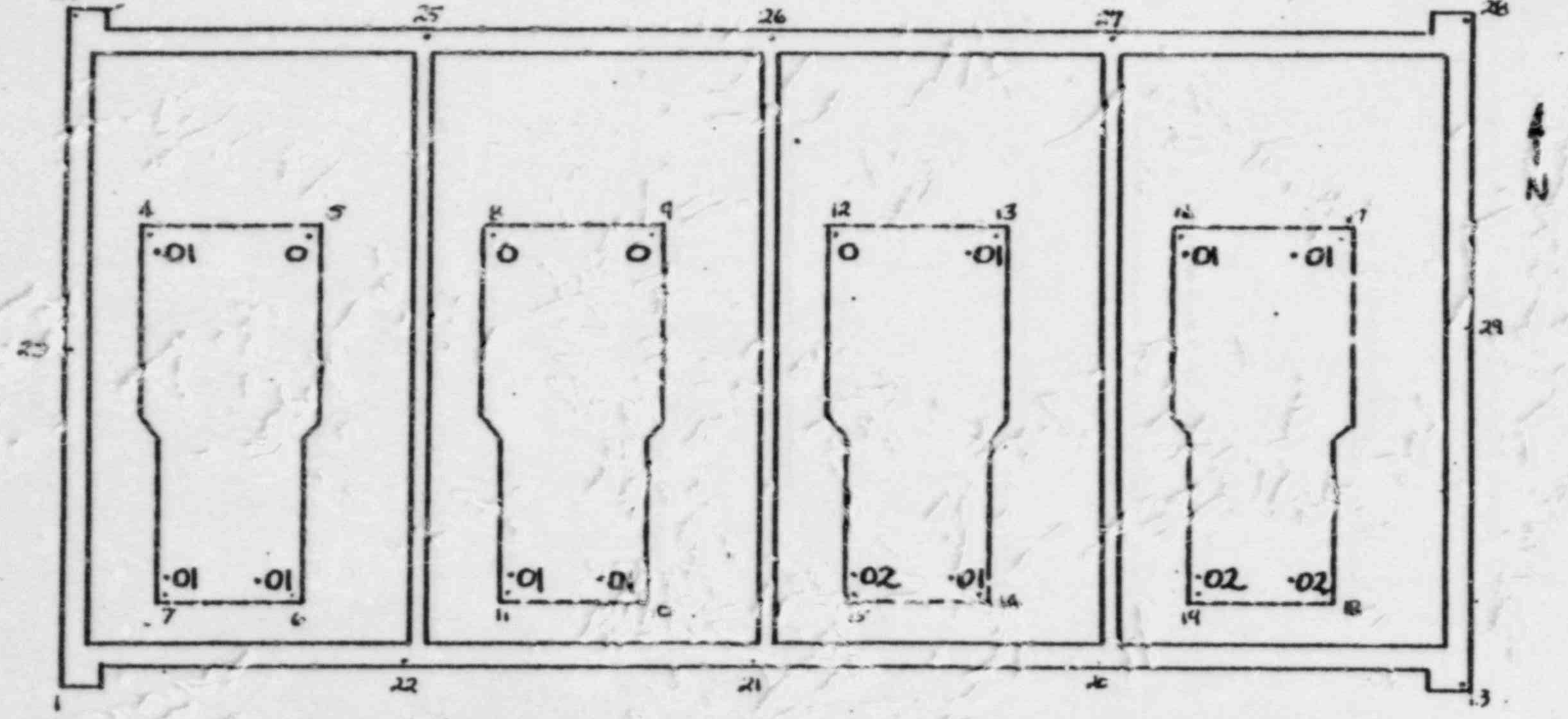
SETTLEMENT MARKERS : SETTLEMENT OF PEDESTALS FROM 3-15-79 to 4-13-79
Readings in Feet ; 10 Ft of Surcharge Added

DIESEL GENERATOR BUILDING



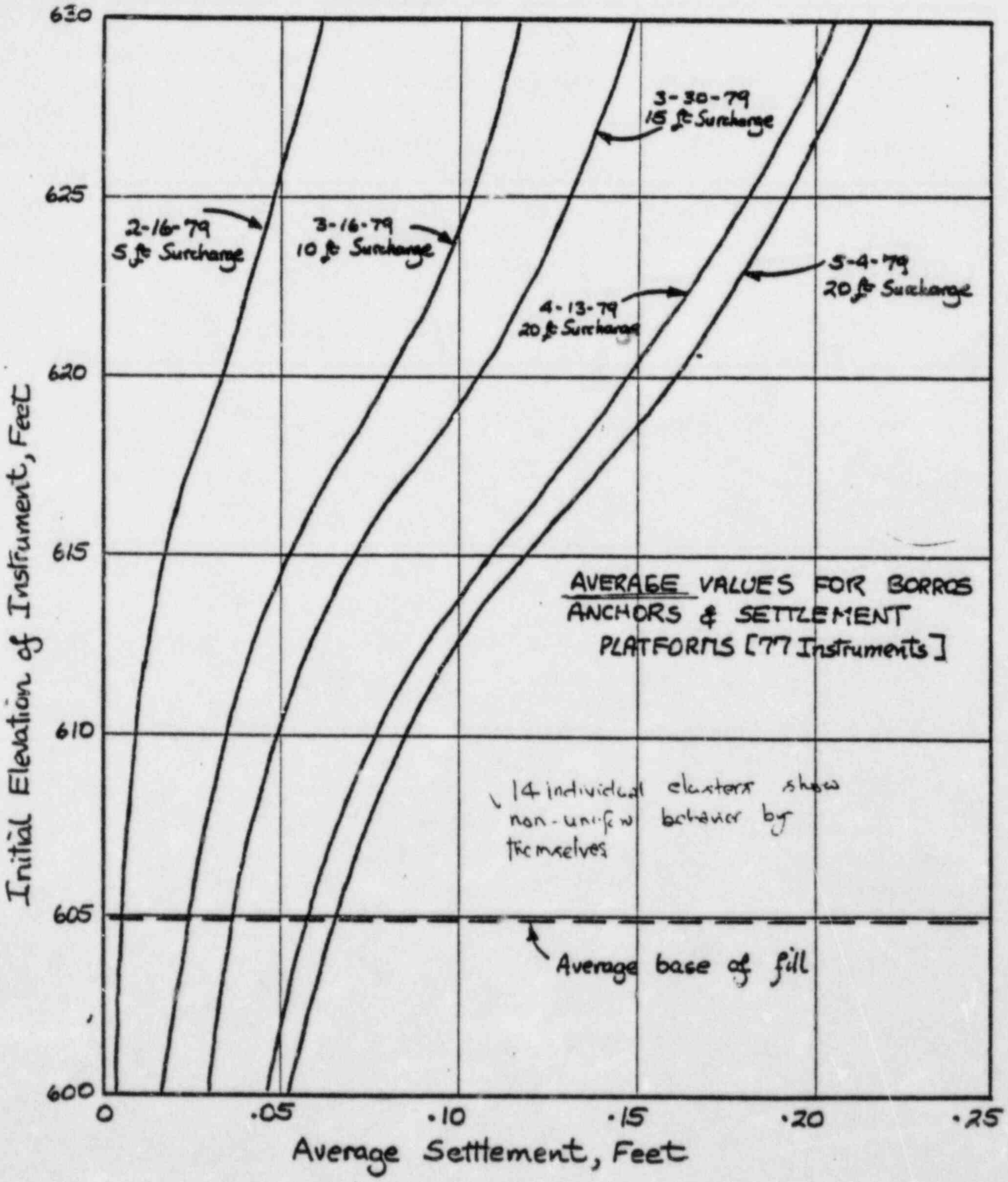
SETTLEMENT MARKERS : SETTLEMENT OF WALLS FROM 4-13-79 to 5-3-79
Readings in Feet; O Ft of Surcharge Added

DIESEL GENERATOR BUILDING



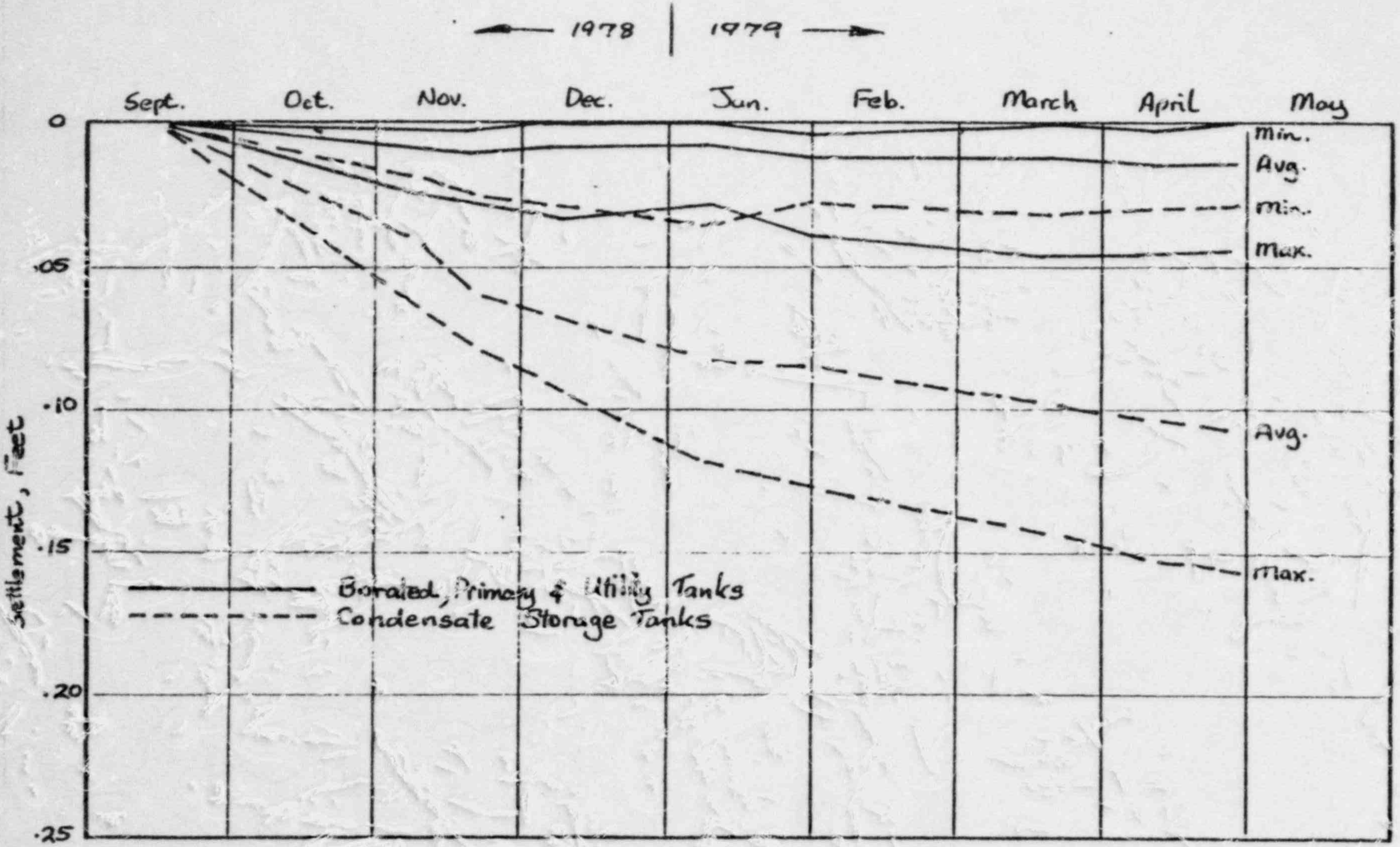
SETTLEMENT MARKERS : SETTLEMENT OF PEDESTALS FROM 4-13-79 to 5-3-79

Readings in Feet ; 0 Ft of Surcharge Added



AVERAGE VALUES FOR BORROS ANCHORS & SETTLEMENT PLATFORMS [77 Instruments]

14 individual clusters show non-uniform behavior by themselves



STORAGE TANKS : SETTLEMENT MARKERS ON TANK RINGWALLS

Borated water placed first

REPORT ON DIESEL GENERATOR BUILDING

SECTION ON SURCHARGE & INSTRUMENTATION PROGRAM

INTRODUCTION

DESCRIPTION OF INSTRUMENTATION PROGRAM
- Settlement Markers
- Borros Anchors
- Settlement Platforms
- Crack Measuring Gages
- Pipe Profile Settlement Gage
- Piesometers
- Heave Profile Measurement Devices

DESCRIPTION OF SURCHARGE PROGRAM
- Surcharge Material
- Equipment Used
- Surcharge Timetable

RESULTS OF INSTRUMENTATION PROGRAM
- Summary of Results
- Settlement, Heave & Piezometer Readings
    - Variation with Time
    - Variation with Area
    - Variation with Depth
- Crack Measurement
- Pipe Profile Settlement

INTERPRETATION & DISCUSSION OF RESULTS
- Settlement, Heave & Piezometer Readings
- Crack Measurement
- Pipe Profile Settlement

APPENDIX — COMPLETE TABULATION OF RESULTS

PECK & HENDRON Meeting

I. Thiruvengadam

Tuesday. March 20. 1979 17

Meeting with Consultants Peck, Hendron and Dunnicliff.

Brief intro by PM. SF Manager. Harris Burke.

To review status of settlement problem with Consultants - DG for further action re. the fixes.

Agenda - C

① DG. Bldg. Surcharge program: - John Davis.

FDN level 628 ft Fill 605'.

Boring Plan —.

10ft Av. Strip footing. - ½ of total area - area taken by footing.

10 ft surcharge.

16 markers on the building } Settlement markers.
10 markers on the pedestal }

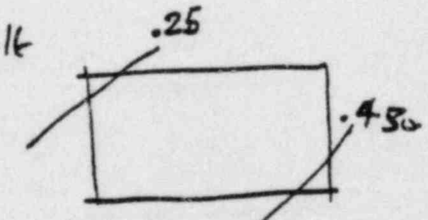
Boris Anchors or settlement platforms.

53 anchors — 32 in surcharge Area
9 outside the surcharge area

cluster instrumentation. with piezometers. — 14 cluster of Instr.

Plots

Settlement Markers (1) building itself. uniform tilt

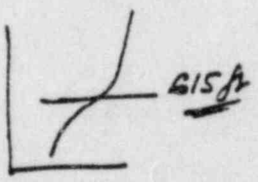


(2) Pedestal. settlement non-uniform.

(3) Settlement markers - before surcharging - Sept 1978.

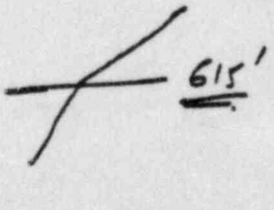
(4) Electrical ductbanks isolated.

(5) [illegible] Pattern of settlement during surcharge
Pedestals + Bldgs are behaving together!



⑥ settlement w/depth.

(7) Same 5 ft of surch & 10 ft of surcharge.



⑧ Variation of Δ, piez. with time.

<u>Hendron</u>

Averaging of settlement markers + Borros Anchors - questionable.
∴ North east end has more of sand and South - clay.
Should separate into region.
Why more sand on N.W. end.

—

<u>S Afifi</u>. Should we proceed for
① Step - no reason to slow the rate of surcharge. - we should proceed with <u>full 10 ft.</u>
② <u>Acceptance Criteria</u>. What condition satisfactory. NRC Q.
Peck - Experiment is not finished yet! so can't answer that question.
underground piping -.
20 ft - is that going to be it.?
Load - settlement - relation is linear - hope to see taper off.
25 is max probable - but the effect of time.
NRC should satisfy on the basis of <u>performance</u> →. Peck
(to satisfy original boring requirement - NRC - Acceptance Criteria)
to get it back to specified values.

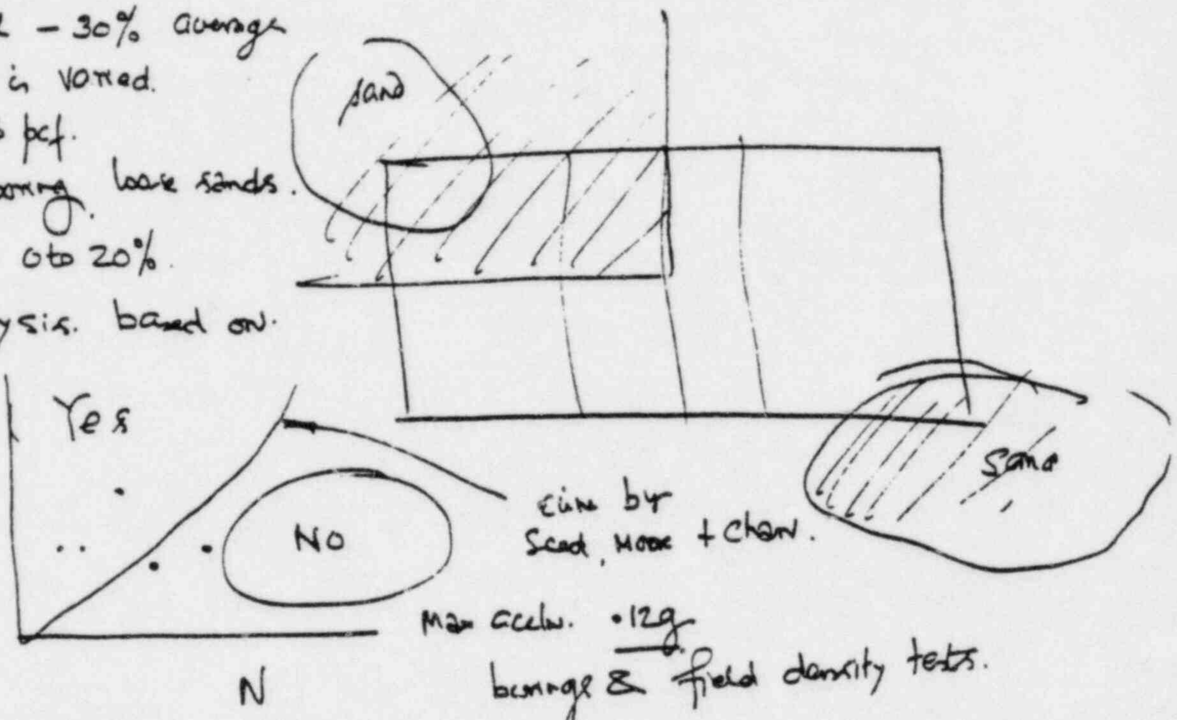
—

Surcharge will improve settlement characteristics of Bldgs — not seismic behavior of sands - liquefaction should be addressed separately.

<u>Milandin Q</u>
<u>Peck</u> - not excit pore pressure - build up. quick build up - as uniform as possible.
Non-uniform →.
unloaded rebound! Longer hold 20 ft will leave a flatter part of curve.
fill was settling. It is a time element not load problem.
after rebound — (no elastic effect.) — final settlement should be less than.

Liquifaction Potential Calcs PK Chen.

Sand material – 30% average
Distr. of sand is varied.
93pcf to 133 pcf.
615 to 625 boring loose sands.
passing 200 – 0 to 20%.
Liquif. Analysis based on
STP.



Max accln. .12g
borings & field density tests.

NW is the worst one.
blow count normalised to exist Load
N. = 10 or less. 15 points to the left. NW –
Summary. Good possibility of Liquifaction at .12g.
Consultants: Would the soil Liquify and wh

Method of proposed Corr (by PK)

1) Make more boring to determine
    1) bounds of sand layers or lenses
    2) Record blowcounts to evaluate liquifac statistically

Grouting
- 1) Conv. method
- 2) Chemical

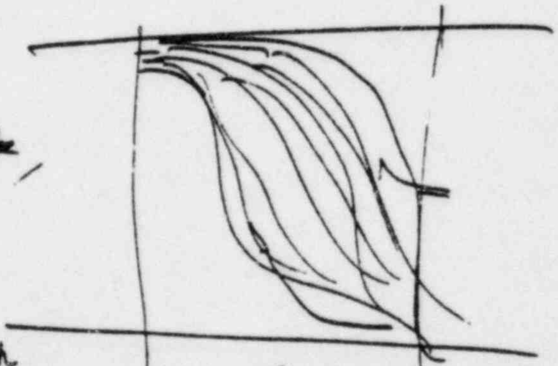
Compact
- 1) Vibro
- 2) Piles

Excavate & replace by ~~Appr mat~~ Appropriate materials

Liquifaction.

Settle approximates 2" during EQ.
Large sand lenses would affect the settlement. 40'×80'.
really didn't know how to analyze W. Ferris!
Peck. On the basis of no we have, liquifaction is a problem.
rather spend the money on fix than elaborate analysis.
blow counts is still the best method
Loose sands — assume liquifaction — it's academic to calculate the settlement
skip.

Peck. Liquf. sand boil.
bldg. may be ok. however, piping may
tend to float up 2 to 3 ft. This may be
a problem.
Loose sands — preloading doesn't
solve it.
Densify the sand → Convert into high
→ permeability channels
— to dissipate pore pressure.



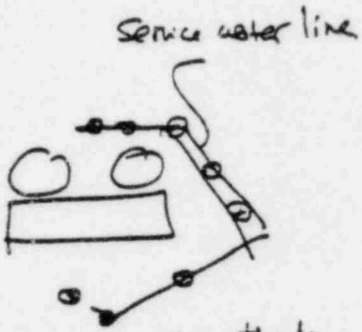
Grain size distribution.

gravel channels — reduce the pore pr. to the GWT.
series of cylindrical wells filled with gravel material.
10' centre — drill in sand. —.
Peck — wait till Boor's plot is seen. — to understand the extent of the problem.
40 or 50 ft — would be a size big enough to behave as sand.
Compaction Grouting →. Chemical grouting. or drainage. all 3
may be used. 2 to 5 blows — Compaction would be better.

⑤

Underground Piping & Electrical Duct Banks

C. McConnell:



① Under ground utility - sketch.

Additional borings along the service water line.

② Pipe line profiles -.

No profile in duct banks
but did continuity check. found ok. - foam rubber - rabbit pulled through.

NRC

(a) Physical Contact between fill & pipe. ie fill have settled away
(b) Liquefaction of bedding materials
(c) Drag effect - ? due to liquifaction.

Skip - liquefaction idea is carried to the extreme. - it would preclude use of granular fill - bedding - which is far easier to do than backfilling with clay.

Two Q. ① Fill underneath the piping. around it
② Fill ~~around the p~~ adjacent to the piping.

(Face to face meeting!) Questions are already written! GIK.

Condensate line → holding the building - pivoting →.

To establish the area of problem and area of problem. to
Justify breakage (piping) in that area would be good. - defining boundaries
bet^{n} good & bad. - record searching.

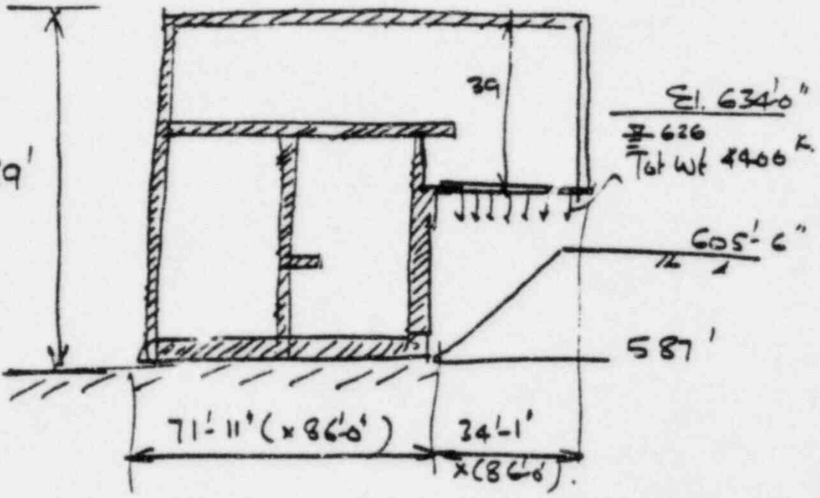
How can you answer the quake. - gap bet^{n} pipe and embedding soil.

Continue to do the boring

P.M.

Service Water Pump Structure

A. Description of Str.



B. Boring logs.

There are cracks in the building.

4 borings:

No contact - NW. Corner?

Cracks - slight seepage.

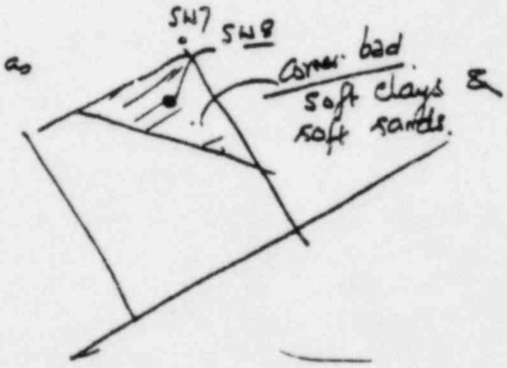
Bearing pr. (Gross)

Present : 5.44 k/□' original.

Present + Cant = 8.35

Present + Cant (present) = 6.59

settlement hasn't shown up as major.



C. Corrective items

Wt : 4400 — Cantilever portion.

Buoyancy : 1700

2700k

Capacity : 3700k.

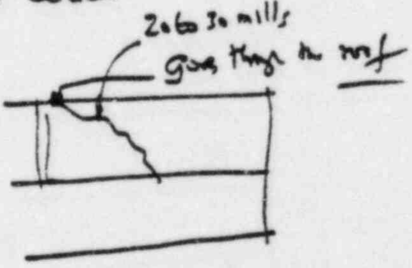
Holding up. by Cantilever action:

Cracks sump

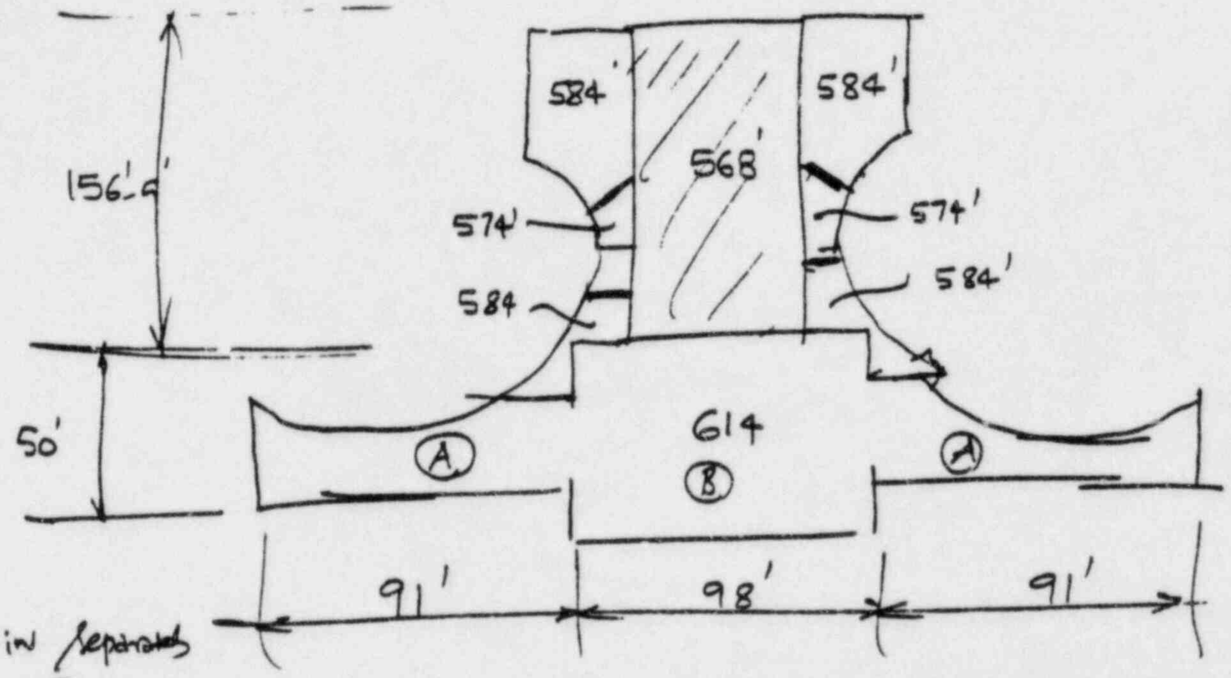
20 to 30 mills - where is it more:

Need more investigation of the cracking pattern.

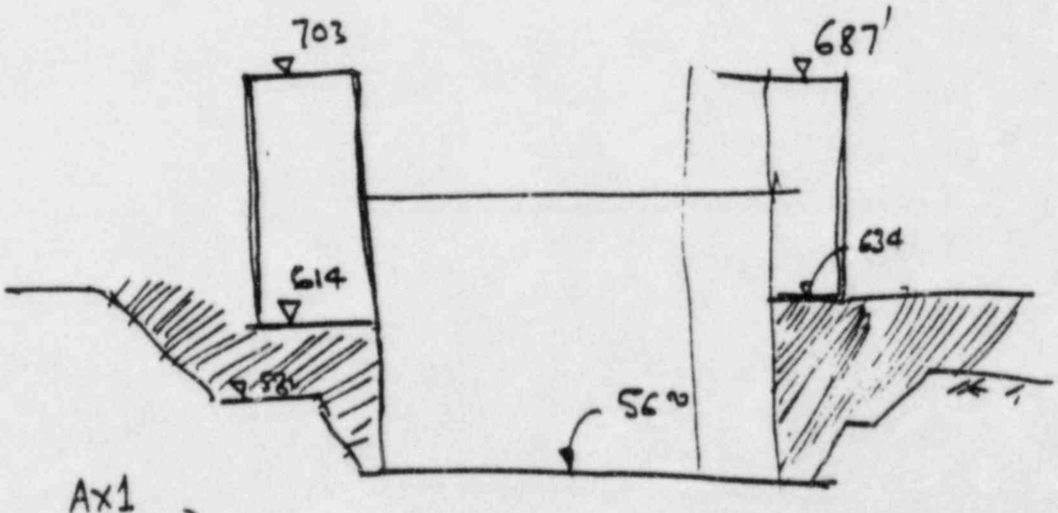
Review Construction records.

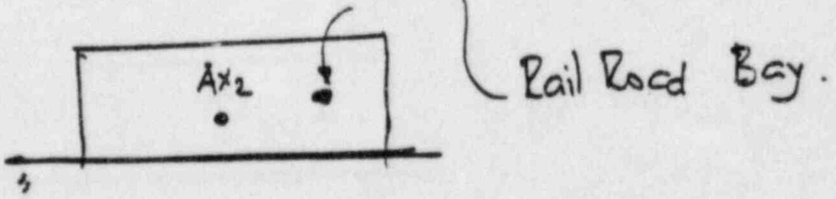


Auxiliary Building



Ⓑ Pour in separately than Ⓐ





Ax4 — Valve Pit Unit 2 Side

Ax5 — " — Unit 1 Side

Control Tower : 5 ftg Conc 614. 609 Conc. 609 to 589. 10 ft of sand N ≥ 40. 6" Conc. mud mat. - Str. Sand N > 100.

Wings — Do we need borings? Sk.p. - yes ∵ No settlement measurements have been made.
Two borings → in Control Tower.
Two borings → in Wings

Soil Structure Interaction

A. Meeting with Dr Newmark

buried piping - no amplification of input acceleration. seismic.

Service water St.

Secondary stress - Not required to satisfy static equilibrium.
Look at curvature, concrete, put a limit on strain (?)
Σ Strain...

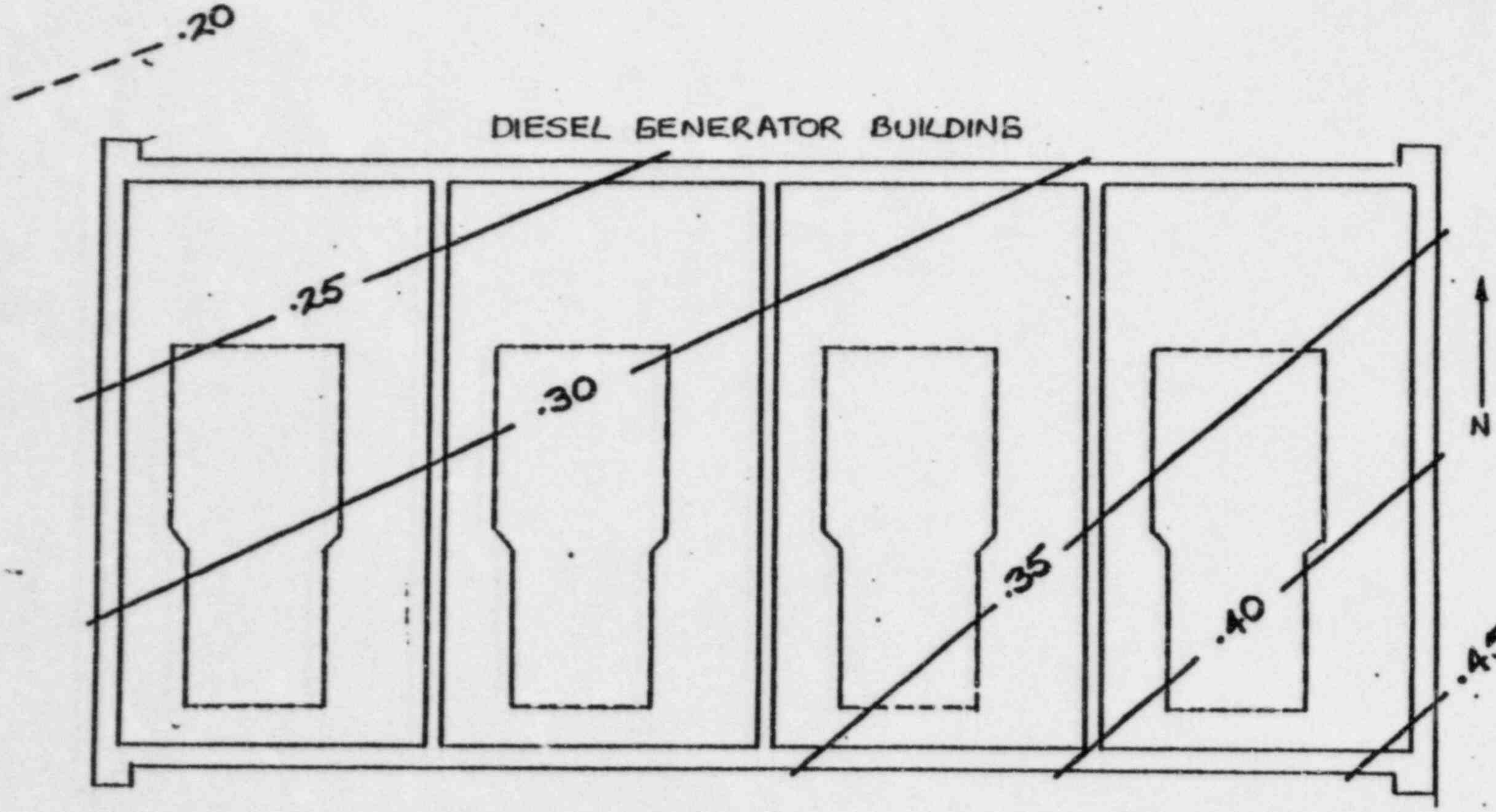
B. Properties →

Rebound measurement →. could be quite small.

Tank farm - shear wave velocity -
400 to 600 fps shear wave vel on fill.
water table is not supposed to affect shear wave velocity rather than p wave.
That's why we measure S wave,

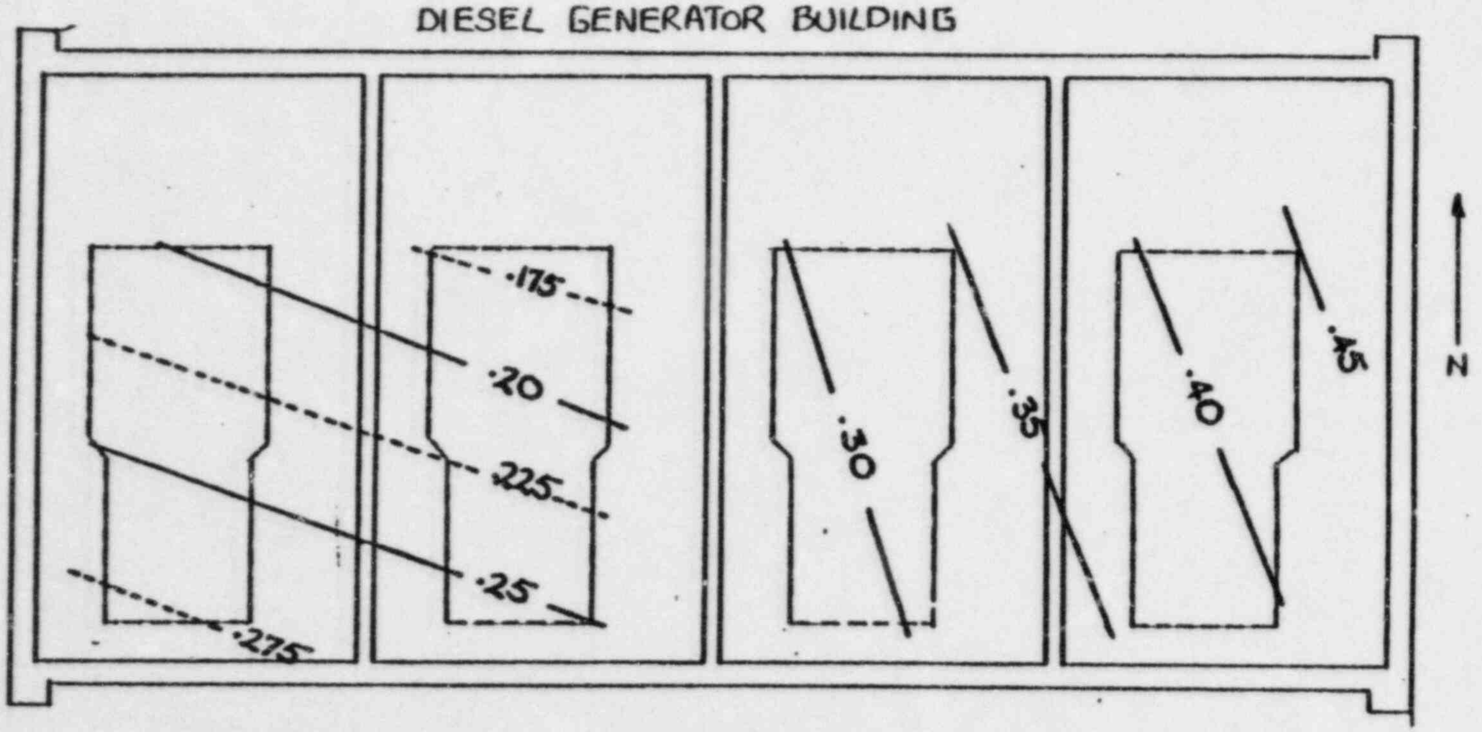
Peck: one deep anchor - permanent anchor! Tech. Spec to monitor. — Boris Anchor

1



SETTLEMENT MARKERS : TOTAL SETTLEMENT OF BUILDING WALLS to 3-16-79
Readings in Feet ; Total Surcharge of 1100 psf (10 Feet)

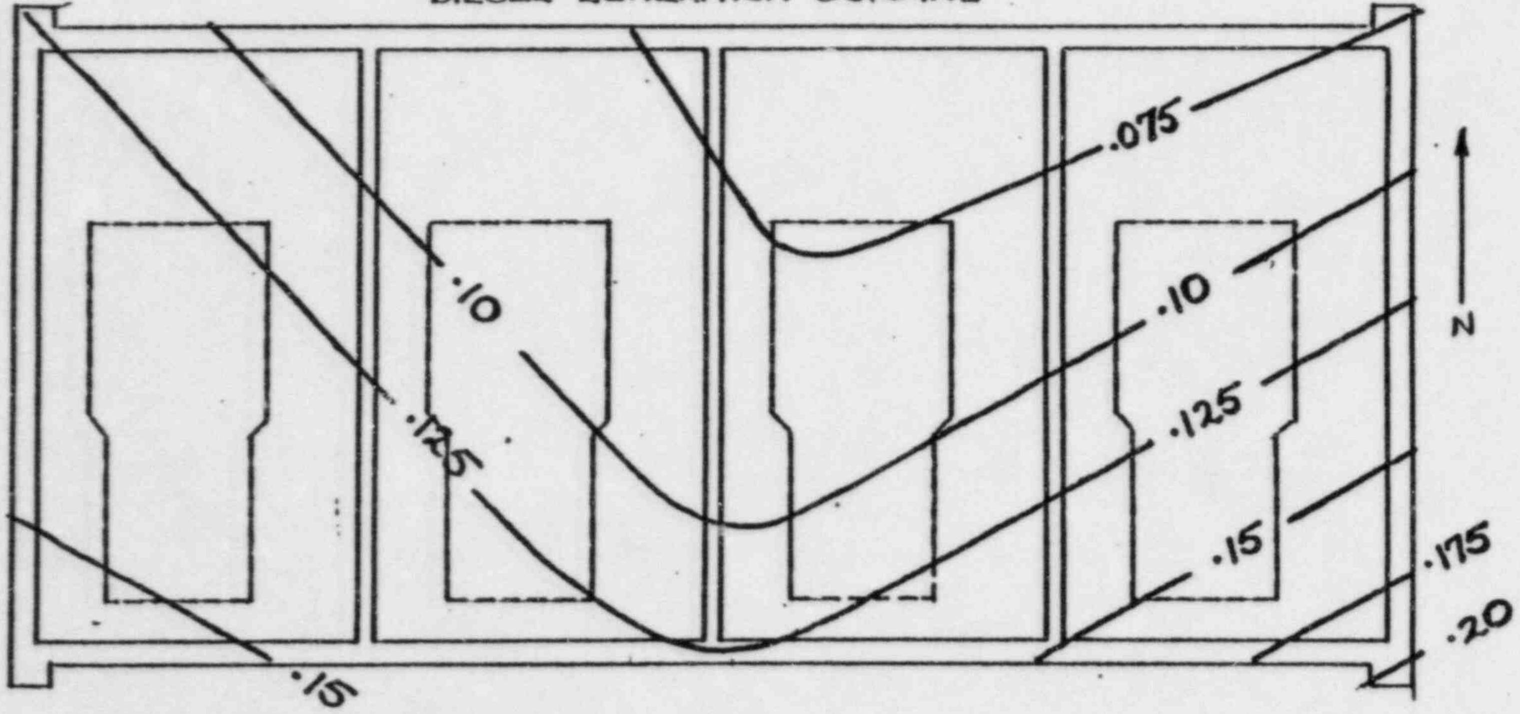
Handout - Presented at the meeting - w. Peck & Hendron
on Tuesday March 20, 1979



SETTLEMENT MARKERS: TOTAL SETTLEMENT OF PEDESTALS to 3-16-79

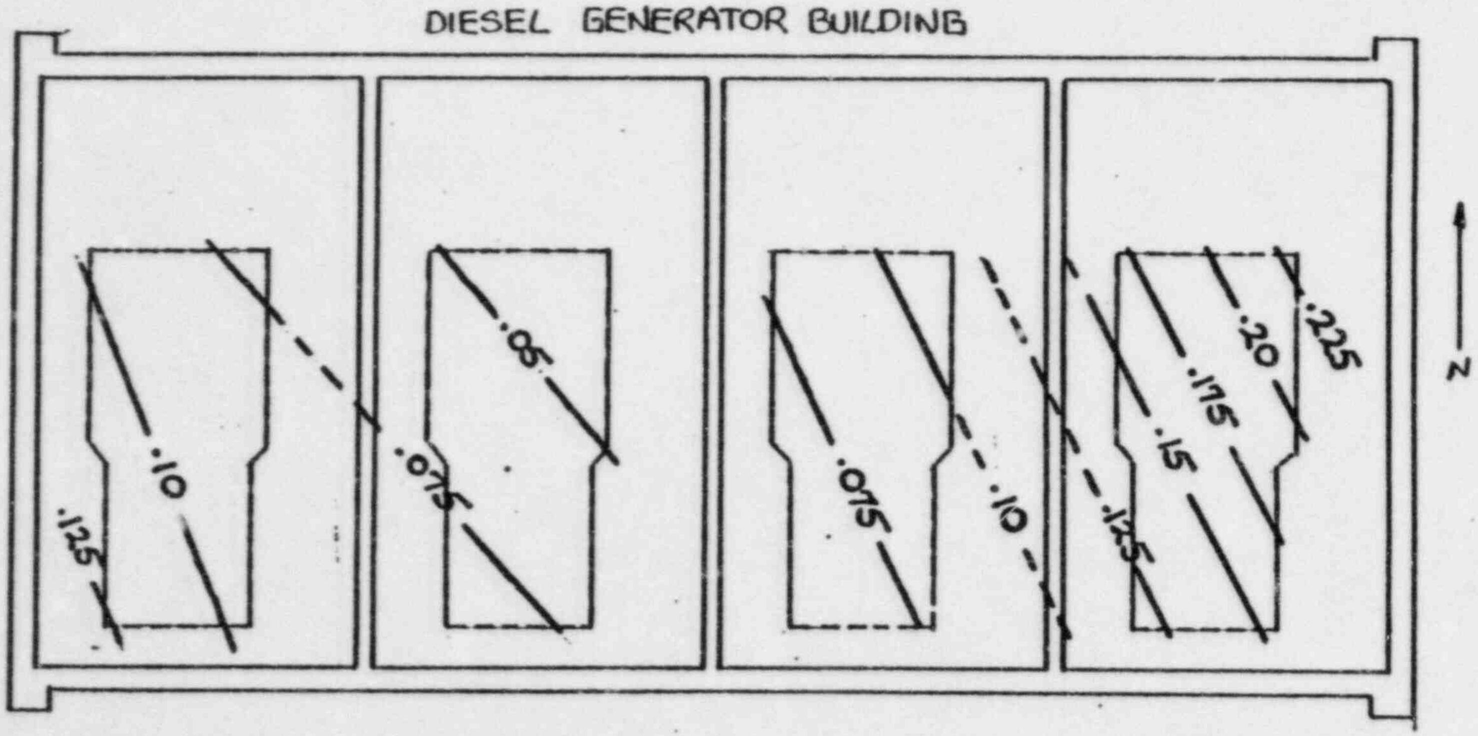
Readings in Feet; Total Surcharge of 1100 psf (10 Feet)

DIESEL GENERATOR BUILDING



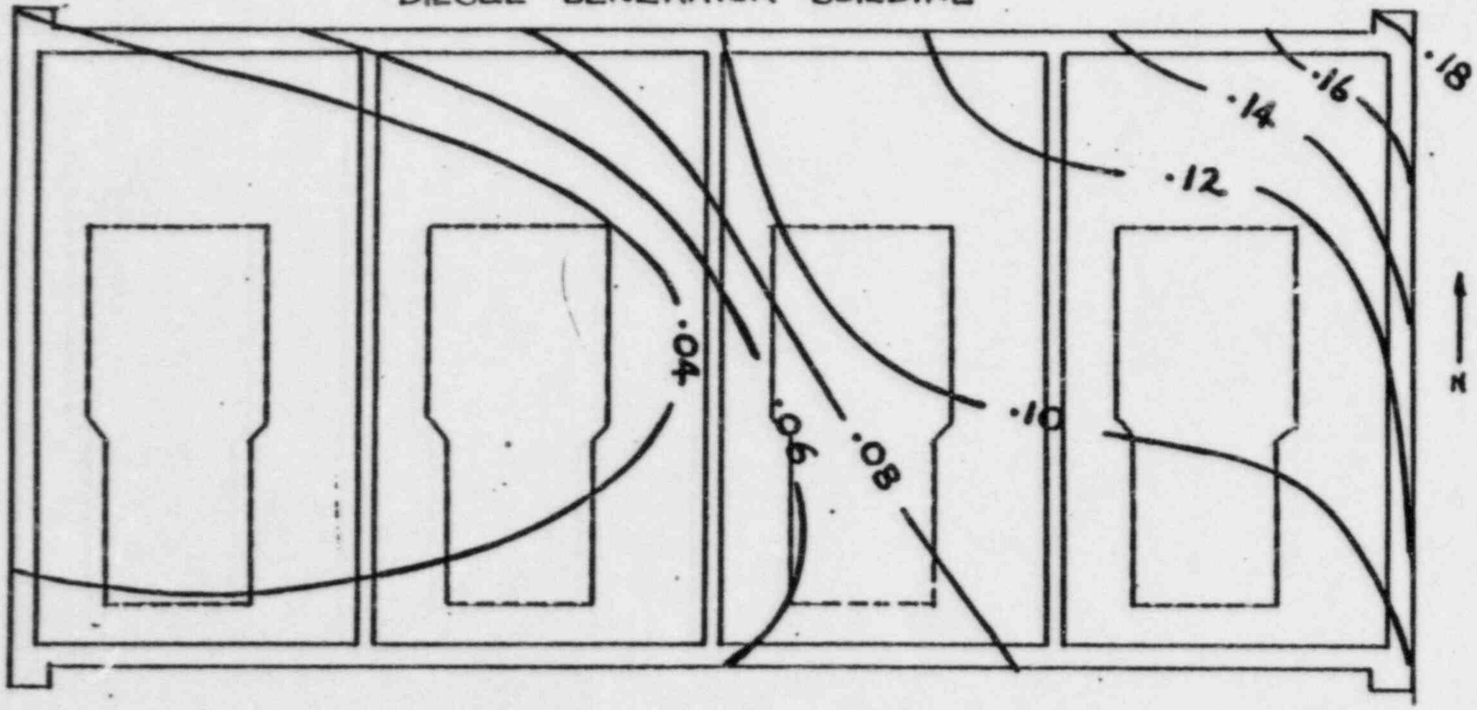
SETTLEMENT MARKERS: TOTAL SETTLEMENT OF BUILDING WALLS to 9-15-78

Readings in Feet; No Surcharge; Electrical Ducts Attached

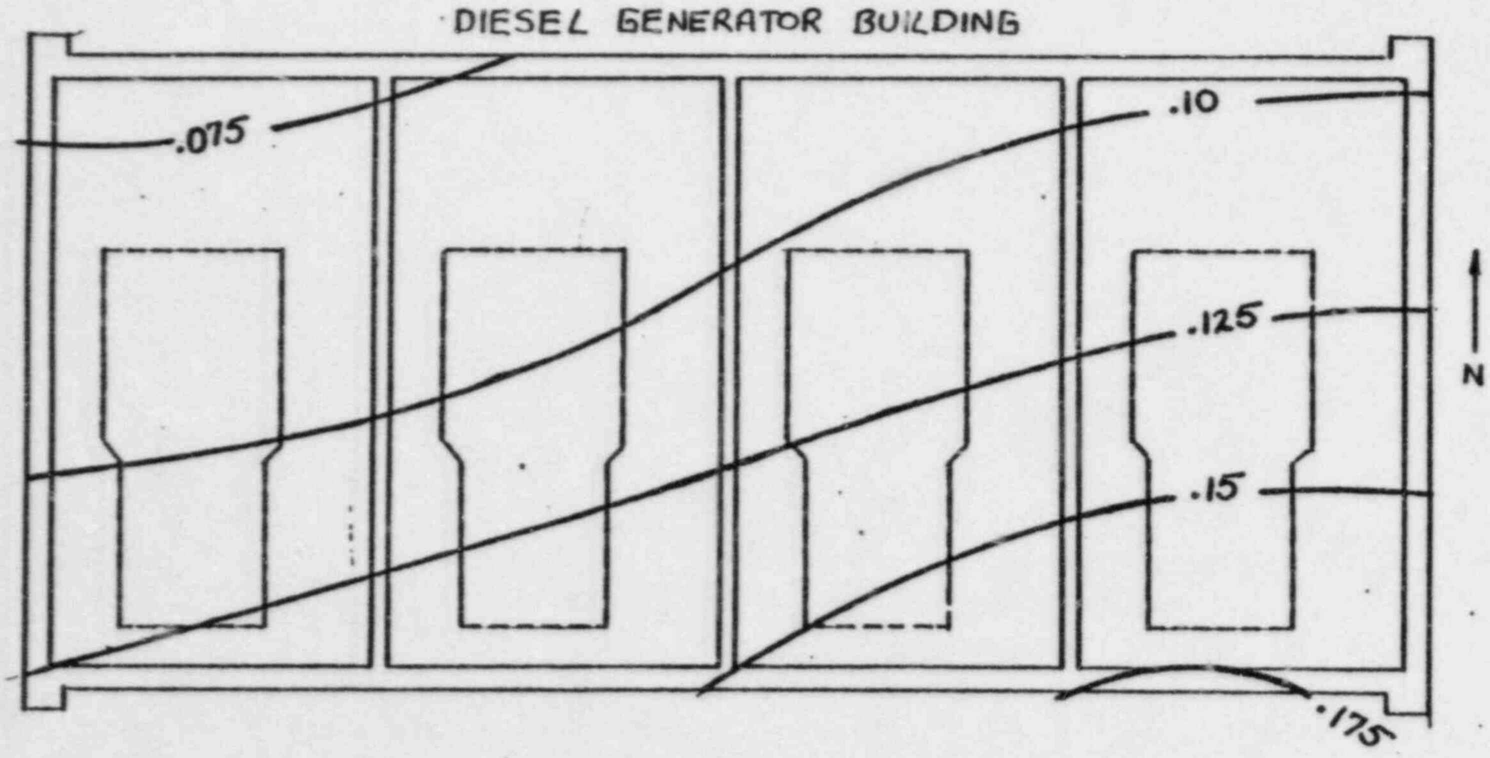


SETTLEMENT MARKERS: TOTAL SETTLEMENT OF PEDESTALS to 9-15-78
Readings in Feet ; No Surcharge ; Electrical Ducts Attached

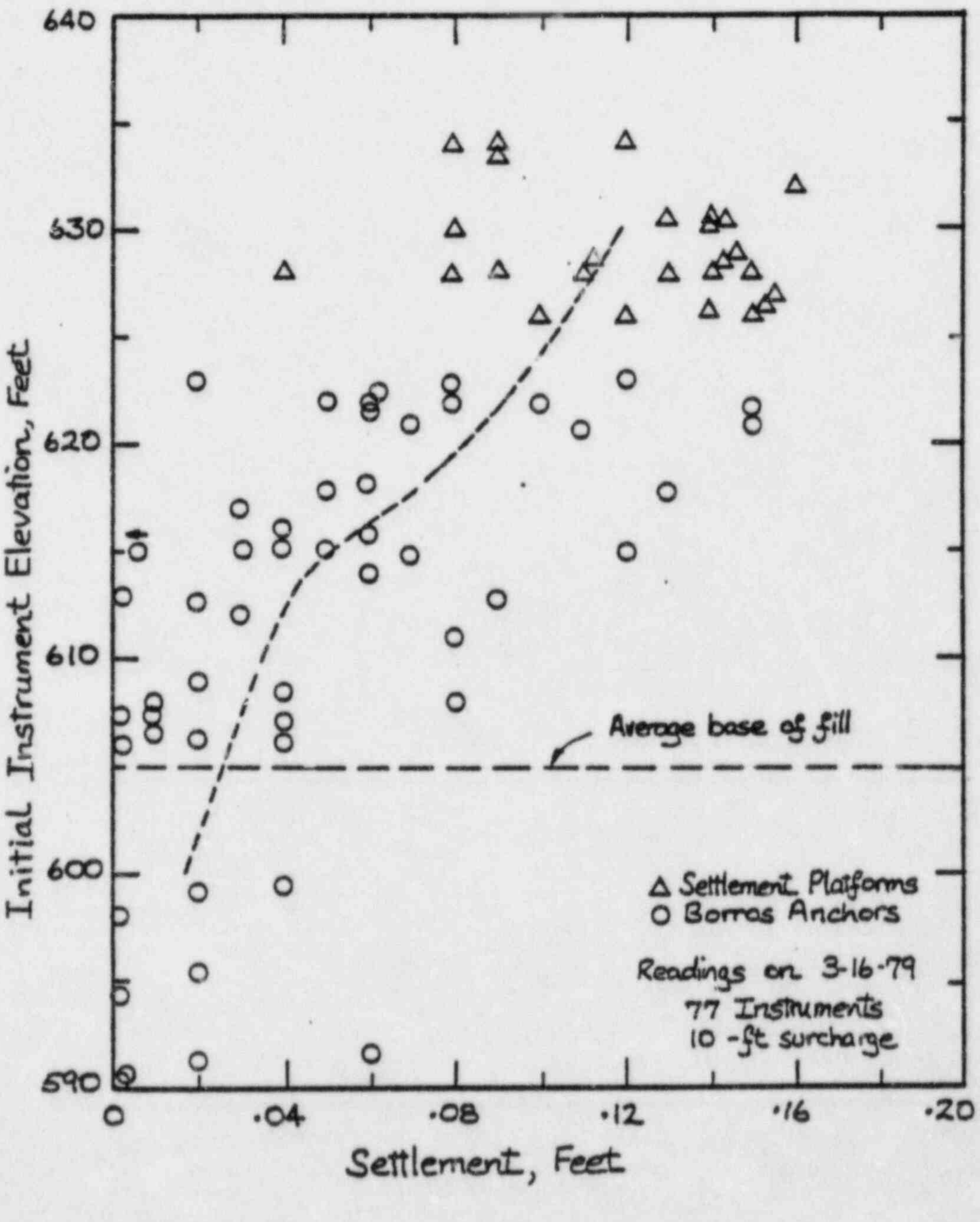
DIESEL GENERATOR BUILDING



SETTLEMENT MARKERS: DIFFERENTIAL SETTLEMENT, 9-15-78 to 12-8-78
Readings in Feet; Electrical Ducts Isolated in Period
BUILDING WALLS & PEDESTALS

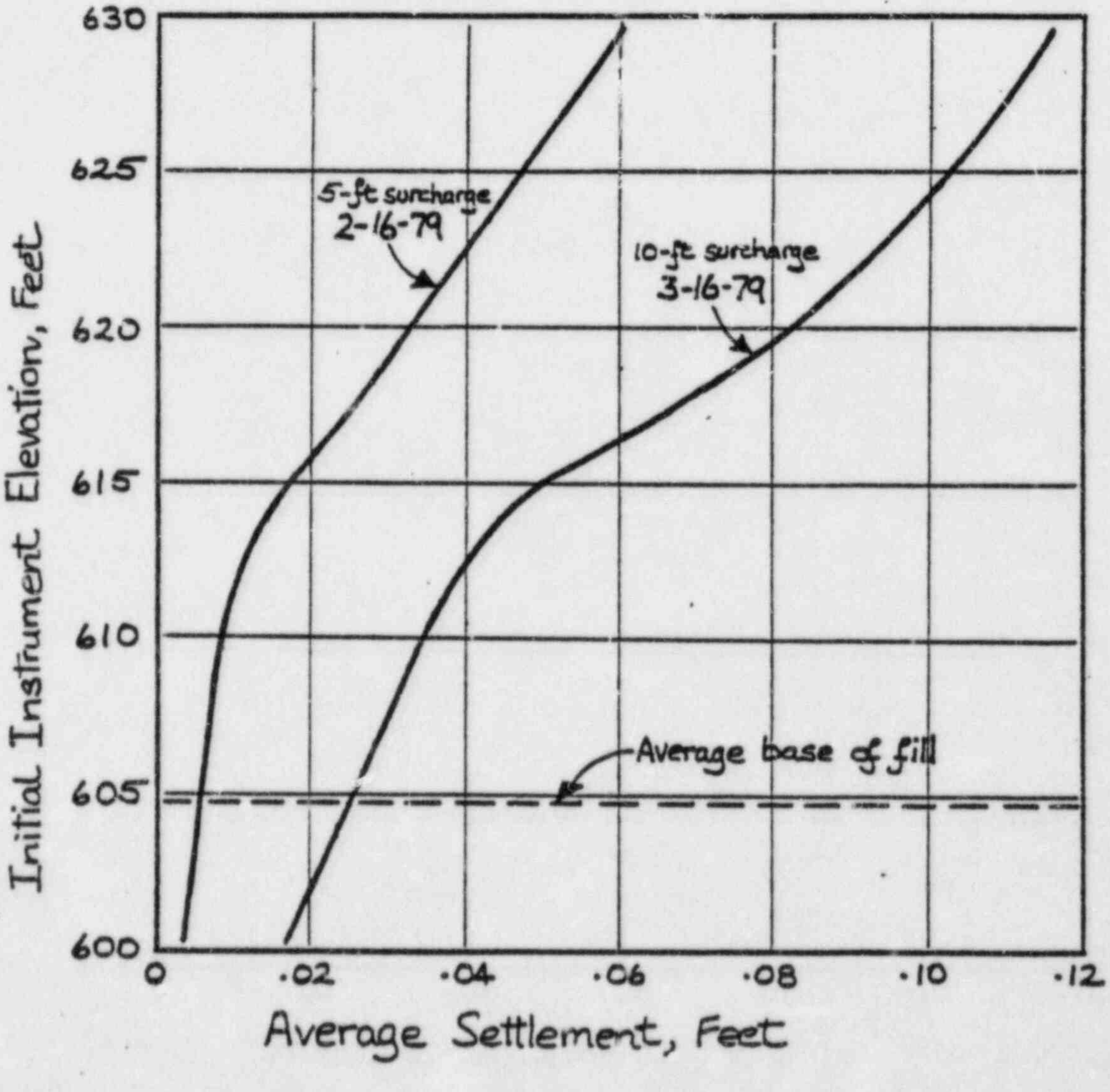


SETTLEMENT MARKERS : DIFFERENTIAL SETTLEMENT, 12-8-78 to 3-16-79
Readings in Feet ; 950 psf Surcharge added in Period
BUILDING WALLS & PEDESTALS

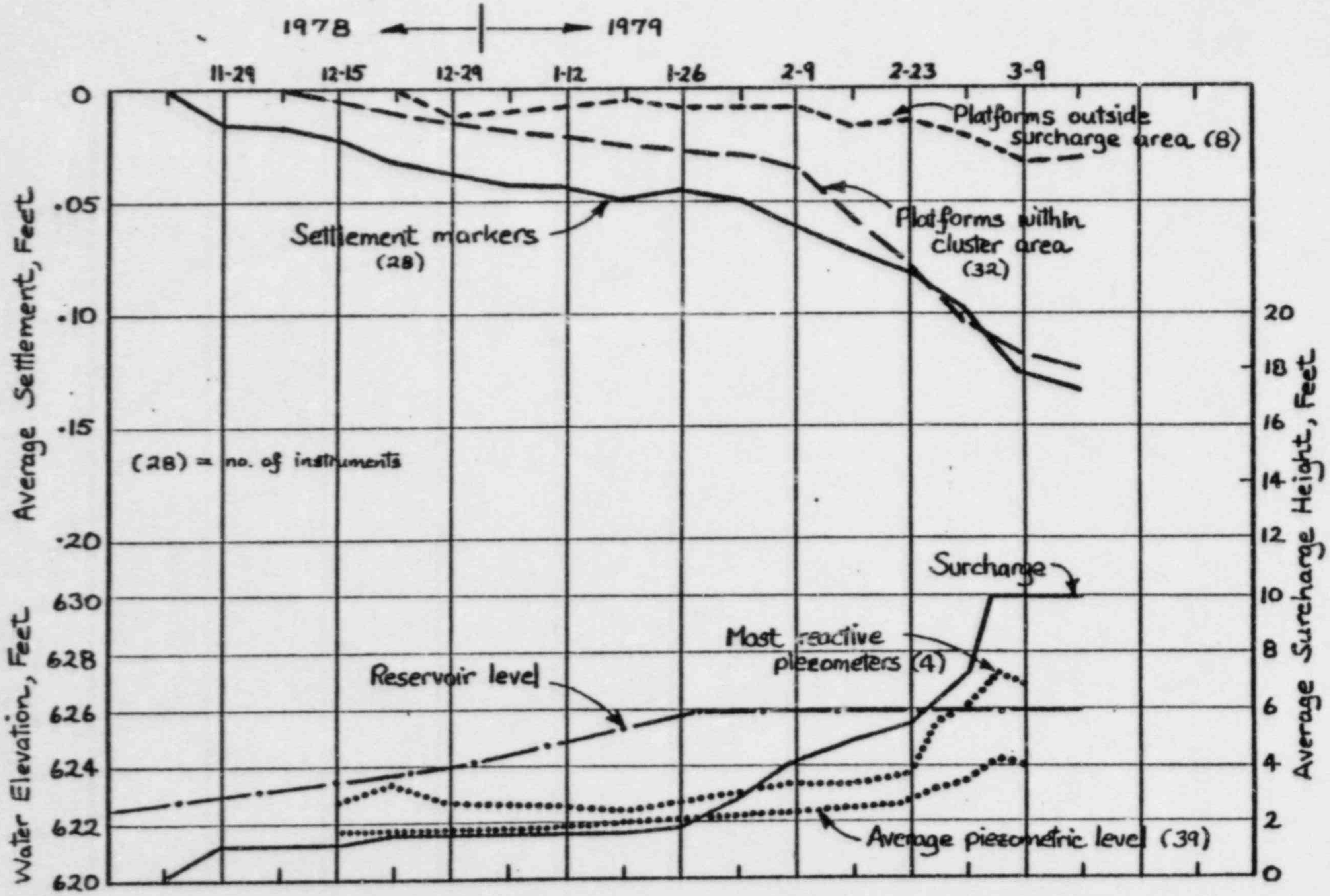


DIESEL GENERATOR BUILDING

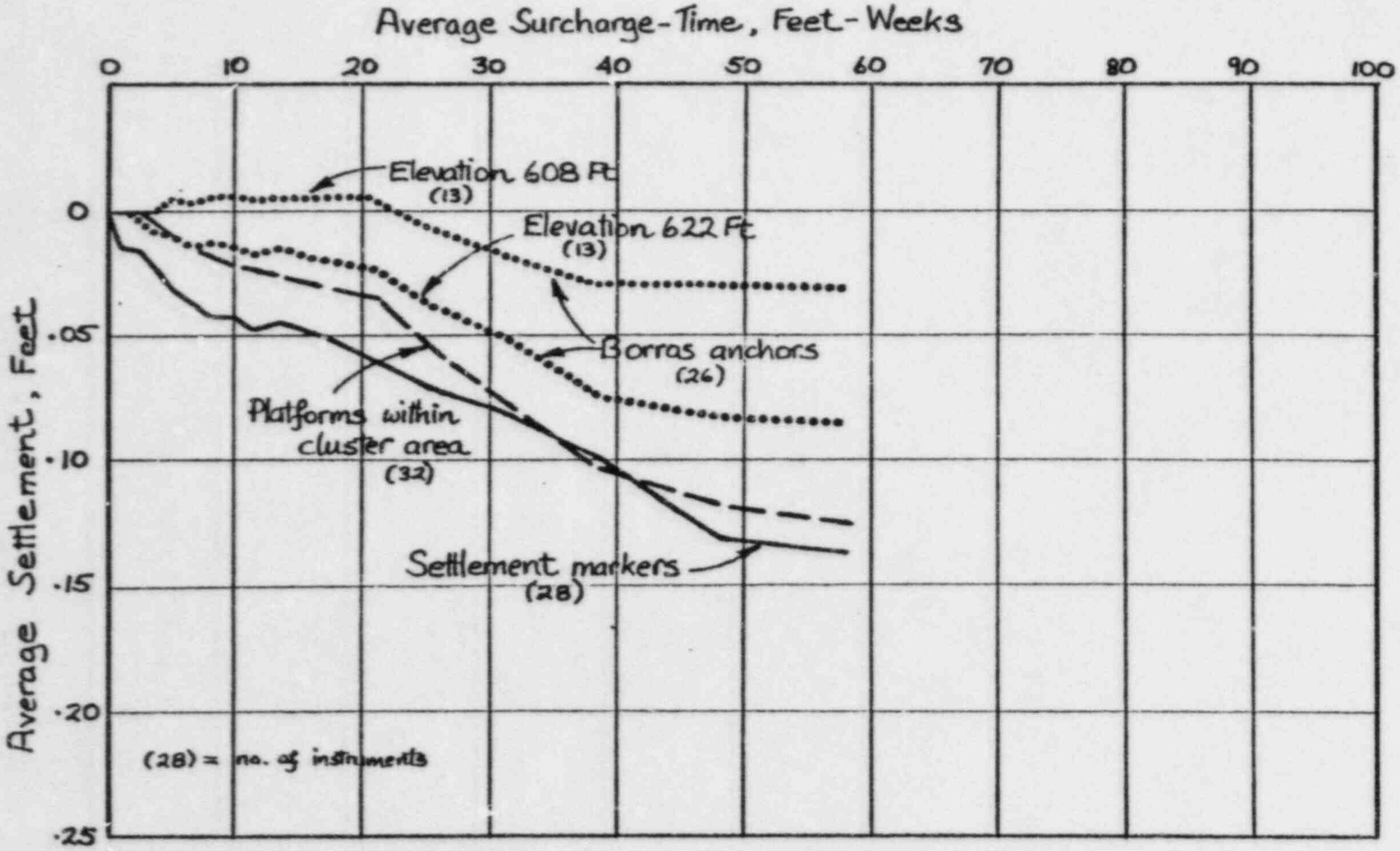
BORROS ANCHORS & SETTLEMENT PLATFORMS



DIESEL GENERATOR BUILDING
BORROS ANCHORS & SETTLEMENT PLATFORMS



DIESEL GENERATOR BLDG : AVG SETTLEMENT, SURCHARGE & WATER LEVEL VS TIME



DIESEL GENERATOR BUILDING: AVERAGE SETTLEMENT VS. SURCHARGE-TIME

Hand out – Presented at the meeting with Peck & Hendron on Tuesday March 20 1979

34
9T
P

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND UNITS 1 AND 2	7220	1 of 2	AX-2

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
AUXILIARY BUILDING	S 4702 ; E 232	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
3/10/79	3-12-79	RAYMOND INTN'L	Acker Skid	[illegible]	—	—	

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—			634.5		—

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140# /30"		MARSHALL / WANZECK

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.5	0		0-8'3" : REINFORCED CONCRETE	1. CUT THROUGH REBAR AT ABOUT 6". 2. 53' PVC (2") installed in boring.
							626.25	8.25			
SS 2"	18"	14"	20	6	8	12			1	8.26 ~~-12~~ FEET: clean SAND, ~~brown~~, medium dense, nonplastic, medium grained, moist, occasional gravel (SP) (FILL)	
SS 2"	18"	12"	33	7	14	19		10	2		
SS 2"	18"	11"	32	6	13	19			3		
SS 2"	18"	8"	31	7	12	19			4		
								15		gravel	
SS 2"	18"	8"	23	8	10	13			5		
SS 2"	18"	8"	30	11	11	19			6		
								20			
SS 2"	18"	8"	38	11	11	19			7		
SS 2"	18"	8"	41	11	17	24			8		
								25			
SS 2"	18"	4"	68	11	29	39			9	25.0' 32.5' DENSE	
SS 2"	18"	8"	33-	8	14	19			10		
								30			
SS 2"	18"	10"	70	23	27	43			11		
SS 2	18"	12"	35	20	19	17		35	12		

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
AUXILIARY BUILDING	AX-2

BECHTEL

BORING LOG

PROJECT MIDLAND UNITS 1 & 2	JOB NO.	SHEET NO. 2 - 2	HOLE NO. AX-2	
SITE AUXILARY BLDG	COORDINATES S 4702 · E 232	ANGLE FROM HORIZ.	BEARING	

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS /6" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	18"	18"	66	26	30	36				13	V' DENSE 35.0-42.5'	
SS 2"	18"	18"	82	19	33	49		40		14		
SS 2"	18"	10"	85	15	40	45	592.0			15	425-45.0 MED <u>CLAY</u> BROWN F SANDY SOME SILT & GRAVEL (FILL)	* CLAY IN TIP OF SAMPLE #15
SS 2"	12"	6"	18	6	12	12	589.5	45		16		
SS 2"	12"	8"	101	33	68					16 b	450 - 51.5 VERY DENSE SAND NON PLASTIC MED TO FINE TAN · [illegible] TRACE GRVL	
SS 2"	18"	12"	130	33	55	75				17		
SS 2"	18"	13"	160	36	70	40	583.0	50		18		
								55			TOTAL DEPTH = 51.5' BOTTOM ELEV = 583.0'	

SS = SPLIT SPOON ST = SHELBY TUBE:
D = DENISON; P = PITCHER; O = OTHER

SITE

HOLE NO. A X-2

MIKE

#2

BORING LOG

PROJECT: MIDLAND UNITS 1 AND 2
JOB NO.: 7220
SHEET NO.: 1 - 2
HOLE NO.: AX-1
SITE: Auxiliary Building
COORDINATES: S 4702 ; E263
ANGLE FROM HORIZ.: 90°
BEARING: —
BEGUN: 1/8/79
COMPLETED:
DRILLER: RAYMOND INTN'L
DRILL MAKE AND MODEL: ACKER SKID
HOLE SIZE: 2 15/16"
OVERBURDEN (FT.): —
ROCK (FT.): —
TOTAL DEPTH:
CORE RECOVERY (FT./%): —
CORE BOXES: —
SAMPLES:
EL. TOP OF CASING:
GROUND EL.: 634.5
DEPTH/EL. GROUND WATER:
DEPTH/EL. TOP OF ROCK: —
SAMPLE HAMMER WEIGHT/FALL: 140 lbs / 30"
CASING LEFT IN HOLE: DIA./LENGTH:
LOGGED BY: MARSHALL / WANZECK

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.5	0 5			0-8'3" : REINFORCED CONCRETE	1. CUT THROUGH 2 REBARS AT about 12" AND 7' 2. DRILLED WITH TRICONE bit and bentonite Mud.
SS 2"	18"	8"	16	4	7	9	626.25	8.25		1	8.25-27.5 FEET: clean SAND, brown, medium dense, nonplastic, medium graine, moist, fine grained and yellow-brown at 8.25-8.50 feet. (SP)(FILL)	
SS 2"	18"	9"	14	7	7	7		10		2		
SS 2"	18"	10"	11	2	3	8				3		
SS 2"	18"	9"	11	3	4	7				4		
SS 2"	18"	6"	13	5	6	7		15		5	trace gravel	
SS 2"	18"	12"	15	5	5	10				6		
SS 2"	18"	7"	23	3	9	14				7		INSTALLED 55.0' PVC 2" FOR PIEZO METER
								20				
SS 2"	18"	10"	25	11	11	14				8		
SS 2"	18"	8"	24	7	12	12		25		9		
SS 2"	18"	12"	69	17	26	43				10		
								30				
SS 2"	18"	10"	27	7	13	14				11		
SS 2"	18"	12"	36	13	16	20				12		
							599.5	35				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: AUXILIARY BUILDING

HOLE NO.: AX-1

BECHTEL

BORING LOG

PROJECT MIDLAND UNITS 1 & 2	JOB NO. 7220	SHEET NO. 2 - 2	HOLE NO. AX-1

SITE AUXILARY BLDG	COORDINATES S 4702 E 263	ANGLE FROM HORIZ.	BEARING

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							550					
SS 2"	18"	12"	87	17	33	54				13		
											37.5 - 49.0' V DENSE COARSE BROWN SAND SOME GRAVEL	
SS 2"	18"	16"	155	26	68	87		40		14		
SS 2"	18"	18"	108	26	48	60				15		
SS 2"	18"	18"	70	18	25	45		45		16	Some Gravel	
											SP	
SS 2"	18"	18	135	35	57	78				17		
								50			49.0 - 53.0 V DENSE MED SAND SOME SILT	
SS 2"	18"	18"	150+	31	150+					18	SP	
								55			TOTAL DEPTH 53.0' BOTTOM ELEVATION = 581.0'	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO. AX-1

BORING LOG

BORING LOG	MIDLAND Units 1 AND 2	7220	1	KW-1

Auxiliary Building	S 4883 ; E 468	90°	—

3/10/79	3/12/79	Raymond Intn'l	Acker Monkey	3"	—	—	18.0

—	—	3	—	634.0	—	—

140# / 30"	—	MARSHALL

				PENETRATION BLOWS			ELEVATION			DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.0	0		0-3.5 FEET: GRAVEL, SAND, some CLAY (FILL)	1) DRILLED WITH WATER.
							630.5	3.5		3.5-17.5 FEET: clean SAND, brown, medium dense, non plastic, moist, medium grained (SP) (FILL)	
SS 2"	18"	8"	25	10	10	15			1		
								5			
SS 2"	18"	16"	29	9	12	17		10	2		
								15			
SS 2"	18"	14"	11	1	3	8			3		
										17.5-18 FEET: sandy CLAY, brown, stiff, low plasticity, moist (CL) (FILL)	
							616.0	18		BOTTOM OF HOLE AT 18 FEET	
								20			
								25			
								30			
								35			

Building

BORING LOG

JOB NO. 7220
SHEET NO. 1 - 2
HOLE NO. SW-3
PROJECT Midland Units 1 and 2
ANGLE FROM HORIZ. 90°
BEARING —
COORDINATES S 5036; E 706
TOTAL DEPTH 49.0
SITE Service Water Bldg
HOLE SIZE 2 15/16"
OVERBURDEN (FT.) —
ROCK (FT.) —
DRILL MAKE AND MODEL CME-45
DEPTH/EL. TOP OF ROCK —
BEGUN 3/10/79
COMPLETED 3/12/79
DRILLER RAYMOND INT'L
DEPTH/EL. GROUND WATER —
GROUND EL. 634.5
EL. TOP OF CASING —
SAMPLES 17
CORE BOXES —
CORE RECOVERY (FT./%) —
LOGGED BY MARSHALL
CASING LEFT IN HOLE: DIA./LENGTH —
SAMPLE HAMMER WEIGHT/FALL 140#/30"

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS	PENETRATION BLOWS		
SS 2"	18"	12"	15	5	8	7
SS 2"	18"	8"	14	5	6	8
SS 2"	18"	12"	33	11	13	20
SS 2"	18"	12"	34	9	14	30
SS 2"	18"	12"	65	14	30	35
SS 2"	18"	8"	19	4	9	10
SS 2"	18"	8"	25	8	12	13
SS 2"	18"	12"	50	20	30	20
SS 2"	12"	12"	—	6	8	100/0
SS 2"	18"	18"	11	5	5	6
SS 2"	18"	18"	29	8	11	18
SS 2"	18"	10"	80	45	50	30

ELEVATION: 634.5, 631.0, 608.5, 608.0, 605.5, 602.0, 599.5

DEPTH: 0, 3.5, 5, 10, 15, 20, 25, 26, 26.5, 29, 30, 32.5, 35

SAMPLE: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

DESCRIPTION AND CLASSIFICATION

0-3.5 FEET: SAND, GRAVEL, CLAY, WOOD (FILL) (TO BE REMOVED)

3.5-26 FEET: clean SAND, brown, medium dense to dense, nonplastic, moist, medium grained, trace to some gravel (SP)(FILL)

piece of rubber in sample

26-26.5 FEET: concrete

26.5-29 FEET: sandy CLAY, brown, very stiff, low plasticity, moist, some silt, trace gravel (CL-ML)(FILL)

29-32.5 FEET: silty CLAY, brown, very stiff, low plasticity, moist, some sand (CL)

32.5-35 FEET: very silty SAND, brown, very dense, low plasticity, moist, trace gravel (SM)

NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

1. DRILLED WITH TRICONE BIT AND BENTONITE MUD

2. HOLE grouted full depth

HOLE NO. SW-3

SITE ...ice Water Building

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Midland Units 1 AND 2	7220	2 of 2	SW-3

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS PERCENT CORE RECOVERY	PENETRATION BLOWS 1st 6"	2nd 6"	3rd 6"	ELEVATION	DEPTH IN FEET		SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	18"	10"	68	30	35	33	599.5	35		13	35 - 42 FEET very silty SAND, gray, very dense, nonplastic, Moist (SM)	
SS 2"	18"	18"	90	25	43	47				[illegible]		
SS 2"	18"	18"	78	30	37	41		40		15		
							592.5					
SS 2"	18"	18"	115	30	50	65				14	42 - 49 FEET very sandy CLAY, gray, hard, low plasticity, Moist, trace gravel (CL-4L)	
SS 2"	18"	18"	104	34	44	60		45		17		
							585.5					
								50			Bottom of hole at 49 feet	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: Service Water Building

HOLE NO. SW-3

42

BORING LOG

PROJECT: MIDLAND UNITS 1 AND 2
JOB NO.: 7220
SHEET NO.: 1 of 2
HOLE NO.: SW-4
SITE: Service Water Building
COORDINATES: S4993, E787
ANGLE FROM HORIZ.: 90°
BEARING: —
BEGUN: 3/13/79
COMPLETED: 3/ /79
DRILLER: Raymond Int'l
DRILL MAKE AND MODEL: CME-55
HOLE SIZE: 4"
OVERBURDEN (FT.): —
ROCK (FT.): —
TOTAL DEPTH:
CORE RECOVERY (FT./%): —
CORE BOXES: —
SAMPLES:
EL. TOP OF CASING: —
GROUND EL.: 635.0
DEPTH/EL. GROUND WATER:
DEPTH/EL. TOP OF ROCK: —
SAMPLE HAMMER WEIGHT/FALL: 140#/30"
CASING LEFT IN HOLE: DIA./LENGTH: —
LOGGED BY: MARSHALL / WANZECK

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH OF CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS 12" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	SAMPLE
SS 2"	18"	10"	19	4	8	11	1
SS 2"	18"	12"	25	10	14	11	2
SS 2"	18"	11"	19	5	8	11	3
SS 2"	18"	18"	41	11	18	23	4
SS 2"	18"	18"	38	11	15	23	5
SS 2"	18"	12"	16	10	7	9	6
SS 2"	18"	15"	15	6	7	8	7
SS 2"	18"	9"	11	5	7	4	8
SS 2"	18"	6"	3	1	1	2	9
SS 2"	18"	4"	2	1	1	1	10
SS 2"	18"	16"	12	0	2	10	11
SS 2	18	18	42	14	18	24	12

ELEVATION	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
635.0	0	0-3 FEET: SAND, GRAVEL, CLAY, (FILL)	
632.0	3	3-18.5 FEET: clean SAND, brown, medium dense to dense, nonplastic, moist to wet, fine and medium grained (SP)(FILL)	
616.5	18.5	18.5 - 24 FEET: silty CLAY, brown, very stiff, low plasticity, moist, some sand (CL)(FILL)	
611.0	24	24 - 31 FEET: silty CLAY, brown, very soft, low plasticity, moist, some sand, trace gravel (CL)(FILL)	× 2 JARS
		31.0 - 35.0 V STIFF BROWN SANDY CLAY Some SILT TR GRVL Fill	

Depth marks: 0, 3, 5, 10, 15, 18.5, 20, 24, 25, 30, 35

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: Service Water Building
HOLE NO.: SW-4

BECHTEL

#2

BORING LOG

PROJECT: MIDLAND UNITS 1 & 2
JOB NO.:
SHEET NO. – OF
HOLE NO.: SW4

SITE: SWB
COORDINATES: S-4993 – E787
ANGLE FROM HORIZ.:
BEARING:

BEGUN:
COMPLETED:
DRILLER:
DRILL MAKE AND MODEL:
HOLE SIZE:
OVERBURDEN (FT.):
ROCK (FT.):
TOTAL DEPTH:

CORE RECOVERY (FT./%):
CORE BOXES:
SAMPLES:
EL. TOP OF CASING:
GROUND EL.:
DEPTH/EL. GROUND WATER:
DEPTH/EL. TOP OF ROCK:

SAMPLE HAMMER WEIGHT/FALL:
CASING LEFT IN HOLE: DIA./LENGTH:
LOGGED BY:

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	PENETRATION BLOWS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				1ST 6"	2ND 6"	3RD 6"						
SS 2"	18	18	118	36	53	61	✓			13	36.0 - 39.0 V HARD SANDY BROWN CLAY Some SILT	
SS 2"	18	18	160	60	65	95	–			14	ML-CL	
											TOTAL DEPTH 39.0' BOTTOM ELEV 606.0	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE:

HOLE NO. SW4

BORING LOG

PROJECT: MIDLAND UNITS 1 & 2
JOB NO.:
SHEET NO.: 1 of
HOLE NO.: SW5A
SITE: SERVICE WATER BLDG
COORDINATES: S 5011 E 799
ANGLE FROM HORIZ.:
BEARING:
BEGUN: 3-14-79
COMPLETED: 3-14-79
DRILLER: RAYMOND INTL
DRILL MAKE AND MODEL: CME 55
HOLE SIZE: 4"
OVERBURDEN (FT.):
ROCK (FT.):
TOTAL DEPTH:
CORE RECOVERY (FT./%):
CORE BOXES:
SAMPLES: 5
EL. TOP OF CASING:
GROUND EL.: 634.5
DEPTH/EL. GROUND WATER:
DEPTH/EL. TOP OF ROCK:
SAMPLE HAMMER WEIGHT/FALL: 140#/30"
CASING LEFT IN HOLE: DIA./LENGTH:
LOGGED BY: WANZECK

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.5'				0-9.0 NO SAMPLES	THIS BORING WAS MADE TO CONFIRM MATERIAL FROM 12.0'-180' IN BORING SW5
								5				
SS 2	18'	1"	5	2	2	3		10		1	9.0 - 12.0 SAND MEDIUM MEDIUM TO COARSE SOME GRAVEL (FILL)	
SS 2"	18'	1"	11	7	6	5				2		
SS 2"	18"	8"	5	1	2	3				3	12-17.5' SAND LOOSE FINE TO COARSE WET WITH SOME GRAVEL (FILL)	
SS 2"	18'	0"	3	2	1	2		15		4		
SS 2"	18"	8"	8	1	1	7				5	17.5-18.0 SAND MEDIUM FINE TO MEDIUM SOME GRAVEL (FILL)	
								20				

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE:
HOLE NO.:

BECHTEL

4 ~~#59~~
7169

BORING LOG

PROJECT: MIDLAND UNITS 1 & 2
JOB NO.: 7220
SHEET NO.: 1 of 2
HOLE NO.: SW-5

SITE: SERVICE WATER BLDG
COORDINATES: S 5008 E 801
ANGLE FROM HORIZ.: 90°
BEARING:

BEGUN: 3-13-79
COMPLETED: 3-13-79
DRILLER: J. HAMMOND RAYMOND INT
DRILL MAKE AND MODEL: CME 55
HOLE SIZE: 4"
OVERBURDEN (FT.):
ROCK (FT.):
TOTAL DEPTH: 46.5'

CORE RECOVERY (FT./%):
CORE BOXES:
SAMPLES: 16
EL. TOP OF CASING:
GROUND EL.: 634.5'
DEPTH/EL. GROUND WATER: 8.5' / 626.0'
DEPTH/EL. TOP OF ROCK: N/A

SAMPLE HAMMER WEIGHT/FALL: 140# / 30"
CASING LEFT IN HOLE: DIA./LENGTH: NONE
LOGGED BY: J. O. WANZECK

ELEVATION: 634.5

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	SAMPLE
SS 2"	18	12"	18	6	9	9	1
SS 2"	18	18"	28	6	12	16	2
SS 2"	18"	8"	6	1	3	3	3
SS 2"	18	0"	3	2	2	1	4
SS 2"	18	0"	6	2	3	3	5
SS 2"	18"	8"	11	4	6	5	6
SS 2"	18"	18"	16	6	9	7	7
SS 2"	18"	18"	35	11	17	18	8
SS 2"	18	12"	28	18	16	12	9
SS 2"	18"	12"	19	2	6	13	10
SS 2"	18"	18"	42	14	18	24	11
SS 2"	18"	18"	77	9	20	57	12

DEPTH: 5, 10, 15, 20, 25, 30, 35

DESCRIPTION AND CLASSIFICATION

0-2.5' SAND GRAVEL TR CLAY (FILL)

2.5'-9.5' MED DENSE FINE BROWN SAND TRACE GRAVEL (SP)

9.5'-11.0 MEDIUM BROWN SAND WET TR. GRVL (FILL)

11-12.0 MED BROWN SILTY CLAY Some Sa. Fill

12.0-20.0 MED / FINE BROWN SAND WET TR GRVL

14.0 - 16.5 LOST SAMPLES HOLE WILL BE MOVED 2.0' TO ATTEMPT RECOVERY (FILL)

20.0-22.5 STIFF BROWN SILTY CLAY SOME SAND (FILL)

22.5 - 27.0 V STIFF BROWN SILTY CLAY SOME SAND (FILL)

27.0 - 29.0 MED BROWN SILTY CLAY SOME SAND (FILL)

29.0 - 33.0 HARD BROWN SANDY CLAY SOME SOME SW TR GRAVEL (FILL)

33.0 - 35.5 V. DENSE FINE BROWN SAND (FILL)

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

NO WATER GAIN OR LOSS THIS HOLE

15.0' OF 4" CASING USED

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: SERVICE WATER BLDG
HOLE NO.: SW-5

BORING LOG

PROJECT: MIDLAND UNIT 1 & 2	JOB NO.	SHEET NO. 2-2	HOLE NO. SW5
SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
BEGUN 3-13-79	COMPLETED 3-13-79	DRILLER	DRILL MAKE AND MODEL
HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING
GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK	
SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY: J.O WANZECK	

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH OF CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	PENETRATION BLOWS 1st 6"	2nd 6"	3rd 6"	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	18"	18"	112	20	48	64			13	35.5 - 41.0 V DENSE MED-COARSE SAND SOME GRAVEL WET (SW)	
SS 2"	18"	18"	81	30	33	48			[illegible]		
SS 2"	18"	18"	110	30	50	60		40	[illegible]	41.0-43.5' V DENSE FINE GRAY SAND SOME SILT SP	
										43.5-46.5 VERY HARD GRAY V SILTY CLAY SOME SAND ML-CH	
SS 2"	18"	18"	151	29	71	80		45	[illegible]		
										TOTAL DEPTH 46.5' BOT. ELEVATION 588.0	HOLE GROUTED TO SURFACE FROM BOTTOM UP.
								50			

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE

HOLE NO. SW5

BORING LOG

PROJECT: Midland Units 1 and 2
JOB NO.: 7220
SHEET NO.: 1 of 2
HOLE NO.: SW-6
SITE: Service Water Building
COORDINATES: S5056, E720
ANGLE FROM HORIZ.: 90°
BEARING: —
BEGUN: 9/15/78
COMPLETED: 9/16/78
DRILLER: RAYMOND Intn'l
DRILL MAKE AND MODEL: Acker Ace
HOLE SIZE: 2 5/16"
OVERBURDEN (FT.): —
ROCK (FT.): —
TOTAL DEPTH: 50.0'
CORE RECOVERY (FT./%): —
CORE BOXES: —
SAMPLES: 12
EL. TOP OF CASING: —
GROUND EL.: 634.5
DEPTH/EL. GROUND WATER: see notes
DEPTH/EL. TOP OF ROCK: —
SAMPLE HAMMER WEIGHT/FALL: 140# / 30"
CASING LEFT IN HOLE: DIA./LENGTH: —
LOGGED BY: MARSHALL

SAMPLE TYPE AND DIAMETER	SAMPLER ADV./LENGTH CORE RUN	SAMPLE RECOVERY/CORE RECOVERY	SAMPLE BLOWS / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	SAMPLE
							634.5	0	
							620.0	14.5	
							616.0	18.5	
SS 2"	18"	12"	25	11	12	13			1
SS 2"	18"	12"	31	10	14	17			2
SS 2"	18"	6"	33	13	16	17			3
SS 2"	18"	12"	62	16	28	34			4
SS 2"	18"	12"	—	11	12	6	606.5	28	5
SS 2"	18"	14"	24	8	10	14			6
SS 2"	18"		30	9	13	17			7
							601.7	32.8	
							601.4	33.1	
SS 2"	18"	10"	—	5	2	1/5, 1/7	599.5	35	

DESCRIPTION AND CLASSIFICATION

DRILLED FROM 634.5' grating

14.5-18.5 FEET: CONCRETE

18.5-28 FEET: clean SAND, brown, medium dense to dense, nonplastic, wet, medium grained (SP)(FILL)

28 - FEET: sandy CLAY, brown, stiff to very stiff, low plasticity, moist (CL) (FILL)

2" thick medium grained clean sand seam at 32 feet (SP)

33.1-36 FEET: clean SAND, brown, very loose, nonplastic, wet, trace silt, fine grained (SP-SM

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

1. DRILLED WITH REVERT AND TO BE grouted and sealed by construction.

2. No significant water loss observed.

WATER LEVELS	
DATE	Elevation
9/16/78	632.5

SS = SPLIT SPOON ST = SHELBY TUBE.

SITE: Service Water Building

HOLE NO.: SW-6

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Midland Units 1 AND 2	7220	2 OF 2	SW-6

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: A WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							599.5	35			
SS 2"	18"	8"	30	4	10	20	589.5	36	9	36-48 feet: very silty SAND, gray, dense to very dense, non-plastic, moist, occasional clay (SW)	
SS 2"	18"	12"	69	23	27	42		40	10		
SS 2"	18"	12"	115	32	57	58		45	11		
							586.5	48		48-50 feet: very sandy CLAY, gray, hard, low plasticity, moist (CL)	
SS 2"	18"	18"	99	50	47	52	584.5	50	12	Bottom of hole at 50 feet	

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER

SITE: Service Water Building

HOLE NO. SW-6

BORING LOG

PROJECT: Midland Units 1 and 2
JOB NO.: 7220
SHEET NO.: 1A of 1
HOLE NO.: SW-7

SITE: Service Water Building
COORDINATES: S5019; E738
ANGLE FROM HORIZ.: 90°
BEARING: —

BEGUN: 3/14/79
COMPLETED: 3/15/79
DRILLER: Raymond Intn'l
DRILL MAKE AND MODEL: CME
HOLE SIZE: 4"
OVERBURDEN (FT.): —
ROCK (FT.): —
TOTAL DEPTH: —

CORE RECOVERY (FT./%): —
CORE BOXES: —
SAMPLES: 13
EL. TOP OF CASING: —
GROUND EL.: 635.0
DEPTH/EL. GROUND WATER: —
DEPTH/EL. TOP OF ROCK:

SAMPLE HAMMER WEIGHT/FALL: 140#/30"
CASING LEFT IN HOLE: DIA./LENGTH: —
LOGGED BY: WANZECK/KINSER/MARSHALL

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							635.0				0-30 feet on log made by J.O.W. 0-5 NO SAMPLE'S MISC FILL CLAY STONE SAND	WATER ENCOUNTERED AT 8.25'
SS 2"	18"		3	2	1	2		5		1	5-6.5' CLAY SOFT GRAY SILTY TRACE SAND (FILL)	
SS 2"	18"		21	10	11	10				2	6.5-10.0' SAND MED DENSE MED TO FINE, BROWN TRACE GRAVEL (FILL)	
SS 2"	18"		24	5	9	15		10		3	10.0 - 13.5' SAND MED DENSE COARSE, BROWN WET (FILL)	
SS 2"	18"		12	6	4	8				4	13.5 - 20.0' SAND MEDIUM FINE, BROWN SAND	
SS 2"	18"		9	6	4	5		15		5		
SS 2"	18"		19	11	10	9				6	(FILL)	
SS 2"	18"		11	13	6	5		20		7	20.0 - 22.5' CLAY MED STIFF GRAY SILTY SOME SAND (FILL)	
SS 2"	18"		37	23	20	17				8	22.5 - 30.5' CLAY V STIFF BROWN SILTY SOME GRAVEL	
SS 2"	18"	✓	31	11	11	20		25		9		
SS 2"	18"		19	12.	12	7				10	(FILL)	
2"	15"	15"	60	9	23	37	604.0	30 30.5		11	30.5 — 32.5 FEET; very sandy CLAY, brown, hard, low plasticity, moist. trace gravel (CL)	
							602.0	33				
SS 2"	18"	18"	150	45	60	90				12	32.5 - 35 feet: very silty SAND, brown very dense, nonplastic, moist (SM)	
							599.5	35				

BORING LOG

PROJECT: Midland Units 1 and 2

JOB NO.: 7220

SHEET NO.: 2 of 2

HOLE NO.: SW-7

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: A. WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	18"	18"	150	50	70	80	599.5 598.0	35 36.5	▨	13	35-36.5 FEET: sandy CLAY, gray, hard, low plasticity, moist, trace gravel (CL)	
											Bottom of hole at 36.5 feet	
								40				
								45				

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENISON; P = PITCHER; O = OTHER

SITE: Service Water Building

HOLE NO.: SW-7

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND UNITS 1 AND 2	7220	1 of 3	AX-5

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Auxiliary Building	S4011; E122	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
3/10/79	3/20/79	RAYMOND INTN'L	Acker Acc	2 15/16	—	—	

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—		—	644.23	NOT ENCOUNTERED	—

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140#/30"	—	MARSHALL / HENNE

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							644.23	0			DRILLED FROM PLATFORM AT EL. 644.0	1. DRILLED WITH REVERT. 2. 50% MUD LOSS AT 52-57 FEET 3. 100% MUD LOSS AT 60 TO 62 FEET.
								5				
								10				
								15				
								20				
		√					619.0	25	Δ		25-37 FEET. CONCRETE	
								30	Δ			
							609.0	35				

SITE

HOLE NO.

BORING LOG	PROJECT MIDLAND UNITS 1 AND 2	JOB NO. 7220	SHEET NO. 2 of 3	HOLE NO. AX-5

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: A WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							609.0	25			CONCRETE	
SS 2"	18"	10"	33	8	13	20	606.66	37.33		1	37.33 - 40.25 FEET: clean SAND, brown, dense, nonplastic, wet, fine to Medium grained (SP) (FILL)	
SS 2"	18"	12"	9	3	5	4	604.08 603.33	40 40.25 41		2	40.25 - 41 FEET: sandy CLAY, brown, medium stiff, low plasticity, wet, some gravel (CL) (FILL)	
							601.33	42			41-42 FEET: clean SAND, brown, medium dense, nonplastic, wet, fine grained (SP)(FILL)	
SS 2"	18"	6"	3	3	3/12	-	600.83	43.5		3	42 - 43.5 FEET: sandy CLAY, brown, very soft, low plasticity, wet, trace gravel (CL)(FILL)	
SS 2"	18"	6"	4	3	2	2		45		4		
							597.83	46.5			43.5 - 46.5 FEET: clean SAND, brown, very loose, nonplastic, wet, some gravel (SP)(FILL)	
SS 2"	15	6"	—	0	3	5	595.83			5	46.5 - 46.5 FEET. sandy CLAY, brown, very soft, low plasticity, wet (CL)(FILL)	
SS 2"	18"	12"	32	10	14	18		50		6	8.5 - 62 FEET: clean SAND, brown, dense, nonplastic, wet, fine and medium grained (SP)(FILL)	
SS 2"	18"	10"	42	12	19	23				7		
SS 2"	18"	10"	44	13	18	26		55		8	fine grained	
SS 2"	18"	14"	90	18	28	62				9	medium grained	
SS 2"	18"	18"	75	25	39	36		60		10	Medium grained	
SS 2"	18"	12"	8	4	2	6		62		11	62-64 FEET: sandy CLAY, brown, Medium stiff, low plasticity, Moist, little gravel (CL) (FILL)	
SS 2"	18"	18"	38	8	15	23		65		12	64-	
								70				
								75				

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE: AUXILIARY Building

HOLE NO. AX-5

BORING LOG

PROJECT: MIDLAND POWER PLANT
JOB NO.: 7220
SHEET NO.: 1 of 1
HOLE NO.: RW-5
SITE: WEST OF RADWASTE BLDG
COORDINATES: S 4721' E 4'
ANGLE FROM HORIZ.: 90°
BEARING: —
BEGUN: 3·16·79
COMPLETED: 3·19·79
DRILLER: RAYMOND INTN'L ~~[illegible]~~
DRILL MAKE AND MODEL: CME 45
HOLE SIZE: 3 3/4"
OVERBURDEN (FT.): 30.0'
ROCK (FT.): NONE
TOTAL DEPTH: 300'
CORE RECOVERY (FT./%): N.A.
CORE BOXES: N.A.
SAMPLES: 10
EL. TOP OF CASING: N.A.
GROUND EL.: 634.0'±
DEPTH/EL. GROUND WATER:
DEPTH/EL. TOP OF ROCK: N.A
SAMPLE HAMMER WEIGHT/FALL: 140 LB / 30 IN.
CASING LEFT IN HOLE: DIA./LENGTH: SEE GROUNDWATER OBSERVATION WELL RECORD
LOGGED BY: W. KINZER

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.0	0		0-5' NO SAMPLES.	DRILLING WITH 6" NOM. O.D. FLIGHT AUGERS
								5		5(?)-9.0' SILTY CLAY: BROWN, VERY SOFT, MED. PLASTICITY, WET, SOME FINE-GRAINED SAND, TRACE OF MED.- TO COARSE-GRAINED SAND (CL)	
SS	18'	3'	2	1	1	1			1		
SS	18"	8"	2	1/12"		1			2		
SS	12"	6"	3	1	2	REF. 50/1"			3	6.5-9.0' TRACE TO LITTLE FINE SAND	DRILLING WITH 3 3/4" ROLLER BIT USING FRESH WATER & RECIRCULATING
							625.0			9.0-10.0' CONCRETE:	
SS	18"	14"	13	6	6	7	624.0	10	4	10-12.5' SILTY CLAY: BROWN, STIFF, LOW PLASTICITY, MOIST, LITTLE TO SOME FINE SAND, TRACE OF MED. TO COARSE SAND (CL)	
							621.5				
SS	18"	6"	7	2	3	4			5	12.5-17.0' SANDY CLAY: BROWN, MED. STIFF, MED. TO LOW PLASTICITY, WET, TRACE OF FINE GRAVEL (CL) 12.5-14' SOME MED. TO COARSE-GRAINED SAND SEAMS.	
SS	18"	8"	14	4	8	6		15	6		
							617.0				
SS	18"	12"	25	7	13	12			7	17.0-30.0' SILTY CLAY: BROWN TO MED. GRAY, VERY STIFF, MED. PLASTICITY, MOIST, LITTLE FINE TO MED. SAND, TRACE OF FINE GRAVEL. 20-23.5' TAN & STIFF WITH TRACE OF SAND AND GRAVEL. 23.5-30.0 TAN & VERY STIFF.	
SS	18"	18"	15	4	6	9		20	8		
SS	18"	0"	25	16	12	13			9		
								25			
SS	18"	4"	25	16	12	13			10		
								30		BOTTOM OF HOLE: DEPTH: 30.0' ELEVATION: 634.0' BORING DEVELOPED INTO A GROUND WATER OBSERVATION WELL	
								35			

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENISON; P = PITCHER; O = OTHER

SITE: WEST OF RADWASTE BLDG.
HOLE NO.: RW-5

BORING LOG

PROJECT: Midland Units 1 AND 2
JOB NO.: 7220
SHEET NO.: 1 of 3
HOLE NO.: AX-4

SITE: Auxiliary Building
COORDINATES: S 4884; E 418
ANGLE FROM HORIZ.: 90°
BEARING: —

BEGUN: 3/15/79
COMPLETED: 3/17/79
DRILLER: Raymond Intn'l
DRILL MAKE AND MODEL: Acker Ace
HOLE SIZE: 2 15/16
OVERBURDEN (FT.): —
ROCK (FT.): —
TOTAL DEPTH:

CORE RECOVERY (FT./%): —
CORE BOXES: —
SAMPLES: 12
EL. TOP OF CASING: —
GROUND EL.: 645.0
DEPTH/EL. GROUND WATER: NOT RECORDED
DEPTH/EL. TOP OF ROCK: —

SAMPLE HAMMER WEIGHT/FALL: 140# /30'
CASING LEFT IN HOLE: DIA. /LENGTH: —
LOGGED BY: MARSHALL /HENNE

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	2ND 6"	3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
								645.0	0				1. DRILLED WITH REVERT AND BENTONITE. 2. WATER LOSS AT BOTTOM OF CONCRETE.
									5				
									10				
									15				
									20				
									25				
		4						619.0	26			26-37'8": CONCRETE	
									30				
								610.0	35				

SS = SPLIT SPOON ST = SHELBY TUBE, D = DENISON P = PITCHER, O = OTHER

SITE: Auxiliary Building

HOLE NO.: AX-4

BORING LOG

PROJECT	JOB NO	SHEET NO	HOLE NO.
MIDLAND UNITS 1 AND 2	7220	2 of 3	AX-4

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: A. WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							610.0	35			concrete	
SS 2"	15"	6"	20	5	12	8	607.3	37.7		1	37.7-40 FEET: clean SAND, brown, medium dense, nonplastic, wet medium grained (SP)(FILL)	
							605.0	40			40-41 FEET: sandy CLAY, brown, stiff, low plasticity, wet, trace gravel (CL)(FILL)	
SS 2"	18"	10"	17	3	8	9	604.0	41		2	41-44.5 FEET: clean SAND, brown, medium dense, nonplastic, wet, medium grained (SP)(FILL)	
SS 2"	15'	6"	12	5	6	6				3		
							601.5	44.5			44.5-45.5 FEET: sandy CLAY, brown, very soft, low plasticity, wet, trace gravel (CL)(FILL)	
							601.0	45				
SS 2"	24'	7"	—	1/12	2	3				4		
SS 2"	18	12"	23	6	11	12	596.5	48.5		5	48.5-59.8 FEET: clean SAND, brown, medium dense, nonplastic, wet, some gravel (SP) (FILL)	
								50				
SS 2"	18'	12"	19	4	7	12				6		
SS 2"	18'	10"	13	5	6	7				7		
								55				
SS 2"	18'	12"	50	14	22	28				8		
SS 2"	18'	12"	—	17	35	13 1/4	585.2	59.8		9	some clay	
								60			59.8 - 69.5 : CONCRETE	
								65				
SS 2"	18"	18"	56	13	24	32	575.5	69.5		10	69.5-81.5 FEET: silty CLAY, grey, hard, low plasticity, moist (CL)	
								70				
							570.0	75				

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON, P = PITCHER, O = OTHER

SITE	HOLE NO
Auxiliary Building	AX-4

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
Midland Units 1 AND 2	7220	1 of 2	SW-5

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
Service Water Building	55011 ; E778	90°	—

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH
3/17/79	3/18/79	RAYMOND Intn'l	Acker Ace	2 5/16	—	—	

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
—	—	9	—	634.5		—

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140#/30"	—	MARSHALL

SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N" PERCENT CORE RECOVERY	PENETRATION BLOWS 1st 6"	PENETRATION BLOWS 2nd 6"	PENETRATION BLOWS 3rd 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							634.5	0			Drilled from grating at 634.5	1. DRILLED WITH REVERT. 2. WATER LOSS AT BOTTOM OF concrete. water in casing dropped to 619' when cement [illegible] [illegible] placed into it.
								5				
								10				
							620.0	14.5 15			14.5-17.8 feet: concrete	
rods fell to 19 under their own weight							616.7				18.5-22 FEET: sandy CLAY, brown, very soft, low plasticity, wet (CL) and clean SAND, brown, very loose, nonplastic, wet (SP) (FILL)	
SS 2"	24"	10"	—	2	1	1/12		20		1		
sampler went to 22' under weight of rods, hammer												
SS 2"	18"	16"	15	5	7	8	612.5	22		2	22-31 FEET: very sandy CLAY, brown, stiff, low plasticity, moist, little gravel, clean sand at [illegible] feet (CL)(FILL)	
SS 2"	18"	10"	12	4	6	6				3		
SS 2"	18"	12"	12	4	5	7		25		4		
SS 2"	18"	14"	22	7	9	13				5		
								30				
SS 2"	18"	14"	72	15	35	37	603.5	31		6	31-35 FEET: very sandy SILT, brown, hard, low plasticity, moist, trace gravel. (ML)	
							[illegible]	35				

WATER LEVELS	
DATE	ELEVATION
3/18/79	619.0

SS = SPLIT SPOON ST = SHELBY TUBE; D = DENISON, P = PITCHER, O = OTHER

SITE	HOLE NO.
Service Water Building	SW-5

BECHTEL

BORING LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
MIDLAND UNITS 1 AND 2	7220	3 OF 3	AX-4

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	PENETRATION BLOWS 1ST 6"	PENETRATION BLOWS 2ND 6"	PENETRATION BLOWS 3RD 6"	ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: A. WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS 2"	15"	18"	49	11	21	28	570.0	75		11	Silty clay [illegible] low plasticity, moist (CL)	
								80				
SS 2"	18"	18"	55	18	24	31	563.5	81.5		12		
											Bottom of hole at 81.5 feet	
								85				
								90				
								95				

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON ; P = PITCHER; O = OTHER

SITE: Auxiliary Building

HOLE NO. AX-4

UNITS 1 AND 2

JOB NO. 7220

SHEET NO. 2 of 2

HOLE NO. SW-8

GRAPHIC LOG

SAMPLE

DESCRIPTION AND CLASSIFICATION

NOTES ON: A WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

7 35-39 FEET: very silty CLAY to clayey SILT with sand seams [illegible] hard, low plasticity, moist, some gravel (CL-ML)

8 39-45.5 FEET: very silty SAND, brown, very dense, nonplastic, wet, some clean sand (SM, SP, SM-ML)

9 clean sand at 45.5-46 feet

79.5

35

39

40

45

45.5

595.5

589.0

56

73

101

29

26

130

18'

16"

1"

SITE Service Water Building

2

JOB NO. 72-0

SHEET NO. 2 of 2

HOLE NO. SN-8

ON AND CLASSIFICATION

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

FEET: very silty CLAY
ayey SILT with sand
ad, stratified, hard, low
asticity, moist, trace
gravel (CL-ML)

39-46.5 FEET: very silty SAND, brown,
very dense, nonplastic, wet, some
clean sand (SM, SP, SM-ML)

clean sand at 45.5-46 feet

45

46.5

9

38.0

HOLE NO. SN-8

vice Water Building

JOB 7220
MIDLAND UNITS 1 & 2

ORDER-OF-MAGNITUDE COST ESTIMATE FOR CORRECTIVE ACTIONS

	S/C	FIELD	ENG & HO	TOTAL
1. Bearing piles for the Service Water Pump Structure, including a pile bearing test.	$ 100,000	$ 300,000	$ 100,000	$ 500,000
2. Underpinning of Electrical Penetration Rooms and the Main Feedwater Isolation Valve Pits, including pit temporary supports.	$ 3,250,000	$ 300,000	$ 250,000	$ 3,800,000
3. Area Dewatering for Underpinning.	$ 500,000	$ 150,000	$ 50,000	$ 700,000
*Contingency plan for temp. support of Aux. Bldg.:				
-initial cost of plan		$ 190,000	$ 10,000	$ 200,000
-total cost if required	((	$ 370,000	$ 30,000	$ 400,000))
4. Chemical Grouting for the Railroad Bay of the Aux. Bldg. and the Diesel Gen. Bldg. as required, including a grout testing and specification program.	$ 1,500,000	$ 200,000	$ 300,000	$ 2,000,000
TOTAL FOR THESE ITEMS:	$ 5,350,000	$ 1,140,000	$ 710,000	$ 7,200,000
			-or-	
((	$ 5,350,000	$ 1,320,000	$ 730,000	$ 7,400,000))

Costs not indicated on this sheet:

1. Diesel Generator Bldg. Surcharge
2. BWSTs and Condensate Tanks
3. Diesel Oil Tanks
4. Underground Utilities
5. Cause investigation and support to NRC question responses.

AAO - 5/11/79

7969 [illegible] 2

Pile Tests for Service Water Building

Telecon with Mo. Elgaaly and Shing Lo: April 11, 80 (Fri)

Changes to Spec: - item 1 & 3.

(1) Change requested by Davisson will be kept the same. ie use of same make and model.

(2) This will be verified with Davisson during the middle of the week

(3) Lo. to check with CPCo & Bechtel's QA on the applicability of Geotech supervising the work by others without a QA program.
(Called Walt on April 14th. Mon. He is going to have a conference call on this sub.

④ Wanzek's statement that the equipment - make & model is common and can be obtained for driving the regular piles also -

⑤ Cost around $35000.00

⑥ Check with G. Keely & Informed T. Cothcart on April 14th.

⑦ Talked with Walt Bird & Rixford - QA issues Procedures for the Test

⑧ Should request S. Lo to inform me on date of pile test, when Davisson's team is going to be there, etc.

⑨ Request S. Lo to send you a copy of the spec. at the same time it hits the field & Canonsi. - To make sure all our & Davisson's Comments are incorporated

⑩ To ask Zaa to send MTD. spec. - a copy of it to you.

Communication with S. Lo 4.10.83.

1. Cost for driving a pile $15000

2. Cost for mob. & demob. of Caroni. $6000

3. Cost of doing the test $4000. - Davisson

Total Cost : 15.000 + 4.000 = 19,000 min
+ Restrike time, etc.

Soils Issue Relationship between E (Young Modulus) and K- subgrade Modulus.

Soil Mechanics: Selected Topics - American Elsevier publishing 1968.

I.K. Lee: Subgrade Reaction Theory.

Vesic 1961 - 5th International Conf. on SMFE

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address: P.O. Box 1000, Ann Arbor, Michigan 48106

Kevin
I need some help.
Could you find out when this C82 cost increase will be responded to.
Yellow, right
Chuck McConnell
7145

April 3, 1980

BLC- 9081

Consumers Power Company
1945 W. Parnall Road
Jackson, Michigan 49201

Attention: Mr. R.C. Bauman
Project Engineer

Talked with Chuck McConnell on 5.5.80. 9:00 AM. Gave approval over the phone

Subject: Midland Plant Units 1 and 2
Consumers Power Company
Bechtel Job 7220
Cost Increase for Technical
Services Agreement C-82
File: 0270, C-82YR

Your approval to increase the cost of Technical Services Agreement (TSA) 7220-C-82 by $151,000 is requested. The revised total price for this TSA will then be $306,000. The additional work performed by Goldberg-Zoino-Dunnicliff and Associates (GZD) was required to prepare responses to NRC questions regarding areas other than the diesel generator building and to implement additional recommendations by Consumers Power Company's soil consultants. To substantiate this increase, we have provided the following cost breakdown for the present billings:

206
151
145

145,000 →

Present Billing Items	Cost $
1. Office manpower including consulting engineering services to assist in planning, installation, reading procedures, maintenance of instruments, data interpretation, instrument selection, training of engineering personnel, and program modification	11,000
2. GZD field manpower from April 1979 through January 1980 to direct installation of sondex and deep borros anchors in the diesel generator building, to direct installation of deep borros anchors and piezometers in the auxiliary building, to direct installation of temperature correction devices on the diesel generator building, and to modify and read existing borros anchors to provide more accurate settlement readings	65,000

(1) 145000 — ~~[illegible]~~ Current TSA — Has [illegible]

125,000 has been [illegible] →
151,000
3500 - (1-4)
116000 → has been completed

35000
20,000
55000 not yet completed.

3.	Installation of 20 direct current displacement transducers (DCDT) to monitor the auxiliary building and feedwater isolation valve pit during dewatering and underpinning	10,000
4.	Full profile settlement gage readings taken for the condensate pipe and service water in the yard using closer increments; additional cost for diesel generator pipe due to closer reading intervals	20,000
5.	Supplementary report after completion of surcharging and reports on sondex system, borros anchors, strain gage, and full profile gage monitoring resulting from specification change	10,000

	<u>Anticipated Future Billing Items through December 1980</u>	Cost $
1.	GZD engineering services assistance in interpreting data	13,000
2.	GZD field manpower to direct lowering of sondex and deep borros anchors to permanent locations	10,000
3.	Contingency for rework required on direct displacement transducers for the feedwater isolation valve pit before underpinning begins	5,000
4.	Future revision to reports	7,000 7,000
5.	The monitoring of deep borros anchors from Janaury 1980 to December 1980. This cost was included in the cost increase identified in BLC-8877 dated February 25, 1980	70,000

We have reviewed the GZD billings and have found them to be reasonable for the work performed or anticipated to be performed. Your approval on this addition to the subject technical services agreement is requested on or before April 7, 1980.

Very truly yours,

CCA

for: L.H. Curtis
Project Engineer

LHC/LA/ccb
3/24/4

cc: D.B. Miller
T.J. Sullivan

Response Requested: Yes

90% budget - CCB - submit request
- submit - ch →
Trk
clean up paper work

Consumers
Power
Company

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • (517) 788-0550

June 3, 1980

Mr L H Curtis, Project Engineer
Bechtel Associates Professional Corp
PO Box 1000
Ann Arbor, MI 48106

MIDLAND PROJECT
SITE DEWATERING SYSTEM
FILE: B2.4.3 UFI: 42*05*22*04 S[illegible]IAL: 9092

We have reviewed your letter BLC-[illegible] and the attached Piping and Instrumentation Diagram 7220-M-781, Revision [illegible] for the Site Dewatering System. We have no comments.

T R Thiruvengadam

for: R C Bauman
Design Production Manager

RCB/TRT/jm

BCC: DTPerry
DBMiller/TCCooke

[illegible] **not proofed**

2/7/ [illegible]

QUESTION 28

Cracks

[illegible] crack [illegible] extent of the crack [illegible] crack

Your response to question 14 provides insufficient information regarding the cause(s) of the cracks in structures, significance of the extent of the crack, and crack consequences. We note, for example, that your investigations to date provide no clearly established relationship between reported settlement measurements and observed cracks, and that cracks have been noted in certain structures for which no significant differential settlement is reported. We require that you conduct a detailed and comprehensive study designed to answer these questions in a reliable and timely manner.

The question [illegible] clearly established [illegible] between reported settlement [illegible] and observed cracks

RESPONSE:

[illegible]

The crack maps presented in the response to question 14[1] were done for certain seismic Category I structures and portions thereof which were suspected to be located on questionable backfill. The results of the soil investigation done subsequent to initial crack mapping indicated that among those structures, the auxiliary building control tower and the railroad bay have adequate foundation.

The purpose of the crack mapping program presented in the response to question 14 was to investigate the effect of the questionable backfill on the structures which were located on it. The results of the study of those cracks, which will be provided in the latter part of this response, indicate that some of the tension cracks may have resulted from insufficient support provided by the backfill. However, there are cracks which could have been caused by reasons other than differential settlement in the structures or foundation. In general, cracks due to shrinkage and temperature changes will occur even in carefully designed and constructed structures.

A) Mechanism of Crack Formation(2,3)

might imply creep.

1) Cracking Due to Volumetric Change

Cracks may occur due to shrinkage and temperature change.

Shrinkage ? (Cause tension)

During the curing process, concrete loses some of its moisture which may cause cracking. The number of cracks formed in this manner is limited only by the magnitude of shrinkage and the existence of restraints. hygroscopic →

According to American Concrete Institute (ACI) Committee 209,(4) for normal weight concrete (using both moist and steam curing and Types I and II cement), the standard equation for unrestrained shrinkage is as follows.

The shrinkage strain of moist-cured concrete at any time after age 7 days:

$$(\epsilon_{sh})_t = \frac{t}{35+t}(\epsilon_{sh})_u \qquad (28\text{-}1)$$

where

t = time in days

$(\epsilon_{sh})_u$ = ultimate shrinkage strain in./in. — definitive [illegible] days

The above equation is valid for:

Slump ≤ 4 inches

Relative humidity = 40% — moist cured

Minimum thickness of member ≤ 6 inches ~~[illegible]~~

The ACI Committee 209 method[4] ~~indicates~~ predicts ultimate shrinkage strain (sh)$_u$ was found to be in the range 0.000415 to 0.00107, with a mean value of 0.00080 for moist-cured concrete. For different values of slump, relative humidity, age, and minimum thickness of member, correction factors are applied to (sh)$_u$.

Table 28-1 provides a theoretical value of average crack width in plain concrete for different thicknesses. In reinforced concrete structures, in addition to the factors mentioned above, crack widths are influenced by the size and spacing of reinforcing bars.

how they are influenced

Crack [illegible] will be controlled by [illegible] due to [illegible] provision of reinforcement.

TABLE 28-1

min ? Thickness of Member (inches)	? Theoretical Average Shrinkage Crack Width At 5' Spacing for Plain Concrete After 1 Year (inches)
6	0.036
12	0.025
18	0.014
24	0.010
30	0.005

The values of crack widths in Table 28-1 are based on standard humidity and ~~shrink~~ slump conditions of Equation 28-1 and appropriate correction factors given in Reference 4.

It should be noted that for reinforced concrete members, the size and spacing of reinforcing bars will affect the crack width and spacing. ? more or less

External Loading

2) Cracking Due to Stresses

a) Direct stresses result from dead loads, applied loads, and, especially, reversible loads.

b) Indirect stresses are induced by strains (e.g., differential settlements).

Thermal - ?

Cracks in concrete are formed once the tensile strength is exceeded. Because of the bond forces that exist between concrete and the reinforcing steel, the tensile forces are transferred to the reinforcing steel.

. . .

Not clear - reword

There is considerable disagreement among the theories of cracking (2) concerning the significance of the variables involved, especially concerning the distribution of bond stress along the reinforcing steel.

what are the variables -

The number of cracks that can form depends on the bond force. When no further cracks can form, and as the structure is subjected to further direct or indirect stresses, the existing crack will continue to widen.

~~due to~~ as strain in rebar

B) Identification of Causes of Cracks in Specific Structures

In this section, an explanation for the formation of cracks found in some of the plant structures (shown in crack maps of Figures 14.2 through 14.11(1)) will be presented.

The most probable reasons for crack formation ~~have been derived~~ based on the size, nature, location, and extent of the cracks and also on the sequence of construction. ✓ It ~~should also be noted~~ that concrete is a heterogeneous material. If concrete were homogeneous and isotropic, one would expect the cracks to form at the section subjected to the maximum ~~bending~~ tension. However, due to the existence of planes of weakness at random sections in the member, cracks may form at a section away from the section of maximum ~~bending~~.

→ obvious

* Not too far away

1) Cracks in the Service Water Pump Structure

A typical construction sequence for the portion of the structure on fill is shown in Figure 14.3, Revision 3.

Shrinkage cracks (marked "S" in Figure 14-3) in this structure have been identified based on the nature, location, and configuration of the cracks and also by comparing the size of the crack with the value given in Table 28-1. From the construction sequence, it appears that these shrinkage cracks were formed along the joints of two adjacent pours of concrete, possibly due to the restraint provided by the already hardened older concrete on the shrinkage of the newly poured concrete during the process of setting.

The letter "L" is used to identify cracks where structural deformation may have been a dominant factor in the formation of the crack. This can be reasonably explained by making a comparative study of the nature and location of cracks and the construction sequence.

The differential settlement between the north end of the structure and interior bearing walls resulted in a redistribution of deformation in the structure. The loads from the portion of structure on fill under the north end were partially carried by the cantilever action over the interior bearing walls of the structure.

All the cracks that
widened are
shrinkage

As the different pours of concrete were placed, existing shrinkage cracks widened and possibly some new cracks formed due to structural deformation with the increase of dead load.

[illegible]

When the wall in Pour 4 was placed, because of its flexibility, ~~the slab~~ was able to move with the fill. The backfill material also ~~could have~~ provided ~~partial~~ support because the dead load at this stage was very low. Therefore, it can be reasonably assumed that no structural cracks were formed at this stage, which justifies the absence of structural cracks in most of the walls below el 634'-6".

~~No shrinkage~~ ?

In the case of the two central walls, the portion from el +634'-6" to el +654'-0" was placed in a continuous pour (Pour 7). It appears, from the crack pattern of these walls, that structural cracks were formed due to a combination of shrinkage and structural deformation caused by ~~bending~~ cantilever ~~ac~~ bending over the interior cross wall. ~~north edge of this slab at el 634'-6"~~, ~~with~~ tension at the top of the wall by the greater crack width ~~based on the observation that the cracks are~~ at the top of the wall wider at the top. The crack pattern also indicates that most of the cracks are confined within the height of this pour. From these observations, it can be theorized that cracks were formed at the early stages of setting of the concrete and that the already hardened stronger concrete wall of the previous pour was carried by a combination of soil bearing under the wall and cantilever action over interior bearing wall. The probable reason for the structural cracks in the center west wall being larger than those in the center east wall could be the discontinuity in the center west wall below el ±634'-6".

The east and west end walls were constructed by two separate pours (Pours 7 and 8) from el ±634'-6" to el ±654'-0". Subsequent to the placement of Pour 7 ~~was~~ shrinkage and structural cracks in this zone were formed. Structural deformation due to cantilever action was similar to that which occurred at the central walls. However, fewer cracks occurred in this region because the dead load of the concrete of Pour 7 was smaller in the cases of the end walls. When Pour 8 was placed, the cantilever bending deformation took place in the freshly poured concrete zone where the concrete was still weak. This combined with shrinkage resulted in cracks.

It should be noted that as the southern portion of the east and west end walls were constructed, the continuity in the walls made the west and east end walls more rigid than the two central walls. Therefore, when the roof slab was poured, the majority of the dead load from above was shared by the end walls. This could have caused more cracking or widening of already formed cracks in Zone 8, and also in Zone 4a (see construction sequence in Figure 14-3, dated 2/80).

It is theorized that shear stresses contributed to the formation of inclined cracks near the cross wall (running east-west, below the slab at el 634'-6") which acted as a support.

The northern half of the roof slab, the two roof beams running east-west, and the concrete around the precast panels were all placed in one continuous pour. The cantilever bending action of the walls (explained earlier) induced tensile strain in the roof slab (due to the added weight) possibly in the early stages of curing of concrete. The two cracks running north-south near the edges of the central walls below appear to have been caused by transverse tension at the top of the slab; whereas the single (north-south) crack in the eastern bay could be due to shrinkage induced tension. The inclined cracks at the corner were due to corner restraint. The short east-west cracks, at the junctions of the slab and the walls (north-south) below, were primarily due to propagation of cracks already formed in the walls, caused by the cantilever action.

2) Cracks in the Diesel Generator Building

A typical construction sequence for the diesel generator building is given in Figure 14.2 (dated February 1980).

As already stated in the response to Question 14,(1) structural cracks in the diesel generator building walls were caused primarily by the restraint on building settlement provided by the vertical duct banks at the northern portion of the building (Figure 7-1, February, 1980). The concrete encased condensate water lines running under bay 2 (reference: key plan of Figure 28-1, 2/80) also provided restraint.

In Figure 28-2, settlement data (from Figure 28-1) of the building footings have been plotted with respect to reference planes a, e, g, and k to schematically explain the above mentioned effect of duct banks and the condensate water lines.

It appears, from the settlement trend (See Figure 28-2, plane B) that prior to the release of the duct bank, the building in general was tilting down towards the south end, while the northeast portion was lifted by the duct banks. Less settlement of the building about bays 2 and 3 is also indicated in the figure. This can be attributed to the additional support (restraint on the building settlement) provided by the concrete encased condensate water lines running underneath.

The above mentioned behaviour of the structure indicates that (except for the center wall) the east, east-center and west-center walls were subjected to some limited warping. This would explain the slight difference in the crack pattern between the two surfaces of those walls. As there was no such warping in the center wall, the crack pattern on both the surfaces of the center wall is similar and the cracks are more uniformly distributed around the duct bank penetrations.

From the construction sequence it appears that most of the cracks were formed in Pours 6 and 7 while the concrete was still weak due to partial curing. By the time walls at the next higher elevation were placed, the concrete of Pours 6 and 7 had gained enough strength to stop further propagation of cracks.

The change in direction of some of the cracks (predominantly in the east wall) can be attributed to change in the settlement subsequent to releasing duct banks from the structure (see Figure 28-2, plane C). As the duct banks were cut loose to allow more uniform settlement of the building, the northern part of the building settled rather rapidly. This caused the change in relative deformations which could cause the subsequent cracks to change direction.

Fewer cracks were formed in the west wall because there was no duct bank penetrating through the foundation of that wall. This observation further indicates that cracking in the building was primarily due to the restraint caused by the duct banks. The hairline cracks seen in the west wall were possibly initiated by shrinkage. Those cracks might have propagated slightly higher on the wall due to settlement while the concrete was still in the early states of curing.

3) Cracks in Auxiliary Building (Electrical Penetration Areas, Control Tower and Railroad Bay)

a) Electrical Penetrations Areas

From the crack-maps in Figures 14-4 through 14-7, it can be seen that almost all the cracks are scattered in location, short, and small in size. Moreover, by comparing the crack pattern of the two faces of the same wall, it can also be seen that most of those cracks are surface cracks. Based on these observations, crack formation in these cases can be attributed to volumetric changes in the concrete due to shrinkage and temperature changes. These cracks have been identified as "S" in the figures.

Structural deformation may have contributed the crack (marked "L" in Figure 14-5) in the wall elevation at column line 7.8, west face looking east (location A). Referring to the key plan of Figure 14-5 short-term localized settlement near the corner (H, 7.8) of the electrical penetration area (location B) could have resulted in differential displacement of supporting walls which, in turn, could result in the formation of the observed crack.

The lower portion of the crack marked "S/L" (location C, Figure 14-5) in the wall elevation at Column "K", south face looking north, could have been initiated by shrinkage. Afterwards, when the wall above el 642'-7" was poured, further propagation of the same crack could have occurred due to a short-term localized settlement. It should be noted that the presence of cross-wall at column line 8.6 made the wall at Column "K" stiffer, whereby this crack was formed at a section east of line 8.6 Similar cracking did not occur in the Unit 1 side of the electrical penetration area as the fill underneath the Unit 1 area was better, as indicated by Table 12-1 of Reference 1, Revision 3.

b) Control Tower Area

Based on their nature and location, most of the cracks in this structure appear to be caused by volumetric changes due to shrinkage and temperature effects. The vertical cracks in the middle of the interior walls (at column lines 5.9, 6.2, and 7.2 locations D) shown in Figure 14.9 were formed due to shrinkage and temperature effects at the control joints. The control joints were purposely made (planes of weakness) so that cracking and contraction could occur along these preselected straight lines.

The structural cracks in the control tower floor slab at el 659' at the northeast corner (between the stair well and the containment and between column lines G and H, location E, Figure 14-10) were probably formed due to any cantilever bending action of the Unit 2 electrical penetration area resulting from a short-term settlement of that portion of the structure. This reasoning is based on the existence of occasional layers of very loose sand in the fill underneath the Unit 2 electrical penetration area (Table 12-1, Reference 1, Revision 3) which could have cuased a short-term settlement of that area. This could have led to the structure having to carry the load by cantilever action until there was a redistribution of load. It appears from the Item 1 (stated below) contilever action might have taken place while the control tower slab, in question, was still in the early stages of curing. It should also be noted that:

1. The slab in question was poured in October of 1978, whereas the roof slab at el 695'6" of the Unit 2 electrical penetration areas was completed in August of 1978.

2. The thickness of the slab is 1'-6", whereas the thickness of the adjoining slabs are greater. For example, the slab south of line H and just east of the control tower wall at column line 7.8 is 3'-8" thick, making this portion of the electrical penetration slab stronger than the area containing the cracks.

Therefore, the cantilever bending action in the electrical penetration area could have caused cracking in the relatively weaker and unhardened slab, as the tension was transferred into the concrete through the reinforcing steel.

c) Railroad Bay

The nature, locations, and sizes of the small number of cracks found in the railroad bay area (Figures 14-8 and 14-10, locations f) indicates that they are mostly due to shrinkage, which could be normally found in any concrete structure. As reported in Table 12-1 of Reference 1, Revision 3, the railroad bay has adequate foundation.

4) Cracks in the Feedwater Isolation Valve Chambers

Previously inaccessible parts (shown in the initial crack maps of Figure 14-11 dated 9/79) of these structures were investigated for cracks in January 1980 and the results were incorporated in the Figure 14-11, dated February 1980. Results of both the initial and final crack mapping indicate that no significant cracking occurred in this structure. The single 10-inch long crack found in the inside wall of the Unit 1 valve chamber (location G) appears to be a shrinkage crack.

5) Cracks in the Borated Water Storage Tank - Foundations and Valve Pits

The 10 mil cracks (marked "S" in Figure 14-11 locations H) appear to be shrinkage cracks. The valve pit walls above el 626'-4" were poured about 3 months later than the footing. So the already hardened concrete in the footing provided restraint on the shrinkage of the newer partially cured concrete above the footing resulting in the formation of those cracks.

The construction sequence indicates that the 20 mil crack (location I) was formed at the construction joint. The portion of the valve pit wall (Zones 4 through 8) on the side of the borated heater storage tank ring wall, was constructed after the rest of the structure. Therefore, at the time of the placement of the outside portion of the valve pit walls, this section was relatively less rigid as the concrete was still partially cured. At this stage, any short-term differential settlement between the older and partially cured portions of the structures could have caused the crack. According to the results of crack survey in January 1980, as reported in Table 28-2, the crack has reduced to 15 mils, which indicates that some equalization of settlement has occurred.

Preliminary 1/31 14

QUESTION 30

You imply in your response to Question 7 that the electrical duct banks underneath the diesel generator building may not have been designed and/or constructed to seismic Category I requirements. Clarify whether this is indeed the case. If true, identify and justify all areas of non-compliance, and indicate on what basis you conclude that the availability of on-site power to safety and safety-related equipment is assured during and following a design basis earthquake. In this regard, we find that the occasional passing of a "rabbit" through the duct banks, as discussed in your response, provides no assurance as to the ability of the duct bank to withstand earthquakes. Provide an analysis of the duct banks using criteria applicable to seismic Category I structures. Your analysis and discussions should be based upon "as built" and "as is" conditions of the duct banks.

RESPONSE

The electrical duct banks which run from the diesel generator building under the turbine building and enter the auxiliary building were designed and constructed in accordance with ~~seismic Category I requirements.~~ Subsection. 3.7.3.12.6 [illegible]

The evaluation of duct banks for seismically induced loads followed the procedures referenced in FSAR Subsection 3.7.3.12 and available literature, including BC-TOP-4-A, Rev 3. Two types of stresses in buried structures are induced by earthquake motion.

A) Stress Due to Free Field Seismic Wave Propagation

The portions of a long, buried structure far from the ends are assumed to move with the ground under the propagated seismic compression and shear waves. The magnitude of the strain is proportional to the site ground motion velocity and acceleration and is inversely proportional to soil compression and shear wave velocities.

The value of wave propagation velocity to be used when calculating maximum soil strain surrounding a buried structure is the effective velocity of the ground motion disturbance past the structure. For rock or very strong soils, the effective propagation velocity is equal to the in situ wave propagation velocity as measured by field or laboratory tests. If the structure is embedded in a softer layer or at a shallow depth in uniform soils, the effective propagation velocity should be taken as the propagation velocity of the underlying competent soil or rock.(1) For example, the effective shear wave propagation velocity should not be taken as less than the shear wave velocity at a depth of 400 to 500 feet or, in any case, never less than approximately 2,000 fps.

The original analysis for the Midland plant used a shear wave velocity of 1,359 fps for the ducts. The slower shear wave velocity results in higher stresses from the analysis, thus making the original analysis more conservative. Because normal techniques for duct bank construction may include using a trench for part of the form work, as-built dimensions are not available. Therefore, the reanalysis was performed using the minimum duct size. In addition, a parametric study was performed by repeating the analysis with the duct bank dimensions increased 10%, 20%, and 50%. The results of the analyses are shown in Table 30-1. The results show very little change due to the duct size and, therefore, it was not considered critical to precisely control the overall size of the duct banks.

B) Stress due to Soil-Building Differential Movements

The FSAR commitment in Section 3.7.3.12 was to design buried items to remain functional when subjected to seismic loads combined with other applicable loads. It was determined that the ducts would be reinforced to resist the free field-induced strains, but because there is no functional requirement to maintain a pressure boundary at the duct to building interface, there was no need to reinforce the duct for the soil/building differential movement effects. To substantiate this decision, the absolute building movements at the auxiliary building interface have been tabulated in Table 30-2 together with the possible reduction of area in the 4-inch conduit due to this movement. The bending and axial strains associated with these movements are shown in Table 30-3. The interface of the duct bank is free to move at the entrance to the diesel generator building and, therefore, would not induce stress into the duct.

In conclusion, the free field and building interface strains are not sensitive to changes in duct size (Tables 30-1 and 30-3), and the reduction in conduit area due to soil-building movement is quite small (Table 30-2). Based on the above evaluation, we conclude that on-site power will be available to safety and safety-related equipment during and following the design basis earthquakes.

---

(1) Hall, W.J., and Newmark, N.M., "Seismic Design for Pipelines and Facilities," Journal of the Technical Council on Lifeline Earthquake Engineering of ASCE, No. TCI, November 1978

TABLE 30-1

FREE FIELD
DUCT BANK STRAINS
FOR SHEAR WAVE
AND COMPRESSION WAVE

Duct Size	Percent of Yield Strain in Reinforcing Steel		
	Bending	Axial	Combined
30 x 34	0.07	8.20	8.27
+10%	0.08	8.20	8.28
+20%	0.09	8.20	8.29
+50%	0.12	8.20	8.32

Notes:

E_y = yield strain of reinforcing steel = 0.00207 in./in.

f'_c = concrete design compressive strength = 3,000 psi

F_y = reinforcing steel yield stress = 60,000 psi

C_s = shear wave velocity = 2,000 fps

TABLE 30-2

SOIL/BUILDING DIFFERENTIAL MOVEMENT

(Auxiliary Building at El 593'-0")

	OBE		SSE	
Earthquake Displacements	Absolute Displacement	Percent Reduction in Area	Absolute Displacement	Percent Reduction in Area
E-W	0.090"	2.9	0.180"	5.8
N-S	0.092"	0*	0.184"	0*
Vertical	0.035"	1.1	0.070"	2.2

*Axial movement, no reduction in area for this direction

TABLE 30-3

AUXILIARY BUILDING/DUCT BANK INTERFACE STRAINS

	Percent of Yield Strain in Reinforcing Steel			
		Direction of Earthquake		
Duct Size	Vertical (Bending)	E-W (Bending)	N-S (Axial)	Combined
30 x 34	6.4	23.3	209.0	210.4
+10%	6.7	24.0	209.0	210.4
+20%	6.9	24.3	209.0	210.5
+50%	7.5	25.8	209.0	210.7

14

Preliminary
2/4/80 — 2/7

Question 14

For all Seismic Category I structures (including, but not limited to, the diesel generator building) which are located on fill, provide the results of an evaluation showing which structure you predict may experience settlements in excess of that originally intended, and provide an evaluation of the ability of these structures to withstand the increased differential settlement. For the diesel generator building and/or any Seismic Category I structure which exhibits cracking, evaluate the effects of the existing and/or anticipated cracks on the performance of the intended function of these buildings. The calculated stresses for Seismic Category I structures at critical locations should be tabulated and compared to that of allowable stresses as stated in the appropriate ACI Codes.

Response

The Seismic Category I structures located completely or partially on fill are identified in Figure 14-1. Rev.?

1) Predicted Settlement

The settlement of the diesel generator building exceeded the predicted settlement in the FSAR. Other Seismic Category I structures do not exceed the predicted maximum settlement. For structures founded on questionable fill, the planned remedial actions identified in Table 12-1 (attached to the response to Question 12) will restore the foundation media to a satisfactory condition or provide support that is not based on the fill material. Therefore, it is not anticipated that the settlement of Seismic Category I structures other than the diesel generator building will exceed the ultimate settlement values shown in ~~FSAR Figure 2.5-48~~. Rev.? discussed Q31

Rev.? Is the table going to remain unchanged in terms of predictable values with revised calculation

DG Bldg Only

Total Vs Residual settlement ultimate

For the borated water storage tanks, where no corrective action is required, the estimated settlement will be reviewed upon completion of the load test program discussed in the response to Question 6 and 31 and also identified in Table 12-1.

postponed commitment

2) Effect of Differential Settlement

The effects of differential settlement within a structure can be divided into two parts:

(Rigid body) includes Rotation & Translation.

a) Tilting

b) Curvature (BM) ? and distortion (shear)

Revision 5
2/80

Tilting is of concern in tall, narrow structures such as towers and stacks. The plant structures subjected to differential settlement do not belong to this class of structures. Tilting does not cause any additional stress in the structure, whereas a curvature or distortion will cause additional stresses. Because the stress due to curvature is strain-induced it is self-limiting in nature. Therefore, the ultimate strength of the structural member is not affected by differential settlement. ✓

→ why.

?

?

The distortion is also dependent upon the stiffness of the structure. For a rigid structure which cannot be deformed appreciably, the distortion will be reduced by redistribution of soil bearing pressures.

These observations are verified by the behavior of the diesel generator building exterior walls. In general, the building was constructed from east to west in four bays. The three solid walls at the north, east, and west sides of the building mainly show tilting. Because of the presence of large openings, the south wall did not have sufficient stiffness until the intermediate floor was erected and cured. Prior to the construction of the intermediate floor, the foundation of the south wall was settling due to the weight of fresh concrete and assumed a slight arch shape. After the south wall gained the necessary stiffness, additional tilting of the entire building was observed as a result of settlement of backfill material. Therefore, in spite of the appearance of the south wall, the settlement stresses in the diesel generator building are not greater than a building founded on highly compacted backfill material. It is also evident that no extensive cracking has been observed, except those cracks caused by the temporary restraint from the electrical duct banks in the diesel generator building, indicating no large stress built up in the structural members.

?

explain or discuss.

only diesel.

closed

As discussed in the interim 10 CFR 50.55(e) report dated August 10, 1979, the diesel generator building ~~is being~~ has been analyzed for variable foundation properties by a finite element model. ~~The possible building distortion is simulated through the use of different support stiffnesses.~~ The support stiffnesses ~~were~~ varied in magnitude ratios of 1 to 2 and were arranged in various combinations. The modulus of subgrade reaction (support stiffness) is directly proportional to the Young's modulus for a given foundation size. From the rebound data for the diesel generator building, the actual Young's modulus ratio ranges have been determined to vary from 1 to 1.5. Thus, the basis of the analysis is deemed adequate. For information, the stresses resulting from the analysis have been combined and evaluated in accordance with ACI code requirements. A summary of the evaluation is presented in Table 14-1.

? function of loads also

Not clear - is it needed.

k³ ? for individual springs

?!

This is only building whose analysis for variable foundation properties (3)

Are you incorporating in the model settlement or starting from initial condition of no settlement?

Dawson Publications

Migliore, AD Mar 12 1979

Are you sure! K ⇒ E.

?

or FSAR 3.8.1.3?

How about other structures - I.

→ Not discussed or analyzed → ?

The settlement will not exceed FSAR 2.5-48.

3) Evaluation of Cracking

and BWST valve pits

The diesel generator building, the fill-supported portion of the service water building, parts of the auxiliary building (railroad bay, electrical penetration rooms, and control tower area), feedwater isolation valve chamber, borated water storage tanks, and valve pits have been examined for cracks in the main structural elements. The identified cracks in these structures have been mapped. They are presented in Figures 14-2 through 14-11. The majority of these cracks are shrinkage and temperature cracks, as evident from their widths and orientation.

exceed
13 mils
16 mils
ACI

The maximum crack width ~~encountered~~ measured in each structure on or before June 1979 is tabulated below:

cf. Q. 28

Structure	Maximum Crack Size (in)
a) Diesel generator building	0.028
b) Service water pump structure	0.020
c) Auxiliary building	
Railroad bay	0.010
Electrical penetration areas	0.020
Control tower — ? - ~~They other [illegible]~~ fill	0.030 (2 locations)
d) Feedwater isolation valve chambers	0.010
e) Borated water storage tank foundation and valve pits	0.020

The structural cracks in the diesel generator building are located in the lower part of the structure and are located in the areas around the vertical electrical duct banks. They were caused by the estimated 1,000 kips of load transmitted from the building to the duct bank. Since then, the concentrated load has been eliminated by isolating the duct bank from the building. For details, refer to the response to Question 7.

In the applicable portions of the service water pump structure, the structural cracks are probably caused by the partial cantilever action of the northern part of the structure. It is theorized that the cracks on the roof slab are due to the bending tension and the cracks on the walls are due to principal tension caused by shear.

better wording.

by calculation — hypothesis - ?
(not proven)

A crack in concrete indicates that the tensile strength capacity of concrete has been exceeded. Because no reliance is placed on concrete tensile strength in designing for bending and axial tensile stress, the strength of the structure (to resist these forces) is not affected by the crack. The compressive forces can be transmitted through the crack by bearing and shear force by the uncracked concrete or concrete in compression and reinforcing bars. However, the stresses in these walls are small, and only a fraction of the member capacity in shear is utilized to resist loads.

Generic discussion

Comp Tens force

During seismic
Tangential shear

DGB? SWP

Wherever cracks are caused by loads not included in the original design, their widths may be reduced when the loads are transferred during the remedial action. For the diesel generator building, the major source causing cracking was the settlement restraint created by the duct banks. Since the isolation of these duct banks from the structure, the crack widths have been substantially reduced. The crack sizes in the service water pump structure have stabilized. This may be due to an equilibrium state of the cantilever condition and also due to the additional strength gained from aging of the concrete. With the planned remedial action of providing pile support at the cantilever portion of the service water pump structure, certain cracks will reduce in size. The auxiliary building electrical penetration areas, which are founded on questionable fill material, will be underpinned with caissons. This will eliminate the possibility of any future settlement and development of additional cracks.

partial support of soil also ?

also true for SWP

Feedwater Iso valve - ?

4) Comparision of Allowable versus Calculated Forces and Moments at Critical Sections

cl

Are these applicable -

In FSAR Tables 3.8-19, 3.8-22, and 3.8-27, the calculated forces and moments for critical load combinations for the auxiliary building foundations, service water pumphouse, and diesel generator building have been compared with the allowable forces and moments. Also, in FSAR Table 3.8-20, the amount of reinforcements required has been compared with the amount of reinforcements provided for representative walls in the auxiliary building.

?!

?

Are these needed loads

These load combinations do not consider the effect of differential settlement. The settlement stresses and the loading combinations for the diesel generator building are discussed in Part 2 of this response.

where is Part 2.

Section 2

TABLE 14-1

DIESEL GENERATOR BUILDING
SUMMARY OF GOVERNING LOADS, RESULTING STRESS, AND ALLOWABLE CAPACITY FOR PRINCIPAL CONCRETE MEMBERS

		Maximum Calculated Loads						
Principal Member	Description of Member	Axial$^{(1)}$		Flexural$^{(2)}$	Shear$^{(3)}$		Stress in Reinforcement, ksi (Allowable = ±54 ksi)	Allow. Yield Stress$^{(4)}$ / Calculated Stress
		(+Pu)	(-Pu)	(Mu)	(Vu)	(Vs)		
Exterior west wall	2'-6"x50'x75' Vertical reinforcement	8.5	-37.5	20.2	23.1	0	17.6	3.07
	Horizontal reinforcement	5.2	-14.7	6.3	23.1	0	6.9	7.83
Exterior west wall footing	2'-6"x10'x75' reinforcement	-	-	42.5	11.1	0	26.0	2.08
Exterior south wall	2'-6"x50'x155' Vertical reinforcement	14.3	-85.9	4.8	99.1	75.6	46.2	1.17
	Horizontal reinforcement	92.8	-50.0	6.6	99.1	74.1	31.3	1.70
Exterior south wall footing	2'-6'x10'x155' reinforcement	-	-	52.8	11.9	0	32.4	1.67
Exterior north wall	2'-6"x50'x155' Vertical reinforcement	19.0	-65.5	15.7	52.9	26.1	38.4	1.41
	Horizontal reinforcement	37.1	-18.4	8.5	52.9	19.8	24.2	2.23
Exterior north wall footing	2'-6"x10'x155' reinforcement	-	-	38.4	9.5	0	23.5	2.30
Exterior east wall	2'-6"x50'x75' Vertical reinforcement	6.8	-37.6	20.2	27.3	0	16.5	3.27
	Horizontal reinforcement	5.3	-19.1	6.2	27.3	0	7.6	7.71
Exterior east wall footing	2'-6"x10'x75' reinforcement	-	-	43.3	10.8	0	26.5	2.04

TABLE 14-1

DIESEL GENERATOR BUILDING
SUMMARY OF GOVERNING LOADS, RESULTING STRESS, AND ALLOWABLE CAPACITY
FOR PRINCIPAL CONCRETE MEMBERS

Principal Member	Description of Member	Maximum Calculated Loads Axial(1) (+Pu)	(-Pu)	Flexural(2) (Mu)	Shear(3) (Vu)	(Vs)	Stress in Reinforcement, ksi ✓ (Allowable = +54 ksi)	Allow. Yield Stress(4) / Calculated Stress 0.9fy ✓
Interior west center wall	1'-6"x50'x75' Vertical reinforcement	8.5	-66.2	5.7	36.1	21.5 ?	32.8	1.64
	Horizontal reinforcement	12.9	-12.8	2.3	36.1	20.2	30.6	1.76
Interior west center wall footing	2'-6"x50'x75'	-	-	68.9	17.1	0	42.3	1.28
Interior center wall	1'-6"x50'x75' Vertical reinforcement	8.5	-66.5	6.3	34.2	19.6	32.0	1.69
	Horizontal reinforcement	14.0	-12.8	2.3	34.2	16.8	28.6	1.89
Interior center wall footing	2'-6"x10'x75' reinforcement	-	-	65.9	16.1	0	40.4	1.34
Internal east center wall	1'-6"x50'x75' vertical reinforcement	8.5	-66.3	7.4	33.3	18.5	32.6	1.65
	Horizontal reinforcement	14.0	-12.8	2.4	33.3	15.8	26.7	2.02
Interior east center wall footing	2'-6"x10'x75' reinforcement	-	-	69.7	17.5	0	42.8	1.26
Floor slab at el 664'-0"	2'-0" thick E-W reinforcement	22.4	-5.1	23.3	19.0	0	44.4	1.22
	N-S reinforcement	19.3	-8.7	15.8	19.0	0	46.5	1.16
Roof slab at el 680'-0"	1'-9" thick Slab E-W reinforcement	37.0	-14.1	16.8	16.0	0	33.0	1.64
	N-S reinforcement	7.7	-17.2	15.9	16.0	6.5	36.4	1.48

shear carried by rebar - ?

Table 14-1 (continued)

---

(1) k/ft, P_u is calculated axial tension (+) or compression (-)

(2) k-ft/ft, M_u is calculated bending moment

(3) k/ft, V_u is calculated shear and V_s is shear carried by rebar) — ?

(4) Due to 1.4D* + 1.7L + 1.7E and obtained from one of the following conditions:

A. Combination of maximum stresses within the principal member

B. Maximum stresses of individual element within the principal member

where

D* - dead load with settlement effect
L - live load
E - operating basis earthquake

1.7 Vs 1.9

Preliminary
2/1/80

QUESTION 26

Your proposed method for re-evaluation of seismic Category I structures founded partially or totally on fill is not acceptable as outlined in the response to, Question 15. To provide the information required for our review, the structural analysis must be based upon criteria in Standard Review Plan Section 3.8.4 and 3.8.5, or upon ACI 349 as supplemented by Regulatory Guide 1.142.

RESPONSE

For seismic Category I structures which are founded partially or totally on fill and subjected to differential settlement, the effect of differential settlement will be incorporated into the Midland project structural design criteria for service load and severe environmental conditions as follows:

A) Service Load Condition

No reference
made to 3.8.4 or 3.8.5
ACI 349 with 1.142

$$U = 1.05D + 1.28L + 1.05T$$

and

$$U = 1.4D + 1.4T$$

Where

D = Dead load

L = Live load

T = Cumulative effects of temperature, creep, shrinkage, and differential settlement

The above load combinations take into consideration the effect of differential settlement on the long-term serviceability of the structure and are in compliance with ACI 318-71 code requirements.

B) <u>Severe Environmental Condition</u>

$$U = 1.0D + 1.0L + 1.0W + 1.0T$$

and

$$U = 1.0D + 1.0L + 1.0E + 1.0T$$

Where

W = DESIGN Wind load

E = Operating basis earthquake

[illegible] A)

The above load combinations exceed ACI 318-71 code requirements and recognize the occurrence of design wind load and operating basis earthquake for more than once in the life of the plant.

For those seismic Category I structures which are either supported by adequate backfill or include corrective measures to transfer the loading directly to the glacial till, the effect of differential settlement need not be evaluated. ✓

Are you not expecting any dif settlements?

For all Category I structures, the effect of differential settlement will not be provided for extreme environmental loads such as tornado or safe shutdown earthquake and abnormal loads generated by a high-energy pipe break accident, since these are postulated as one-time occurrences. [illegible]

Taking into account the original FSAR criteria and the additional criteria mentioned above, together with the modifications, the structures will be able to safely resist all normal types of loads and postulated events.

To establish a basis for comparison, the effect of differential settlement on the diesel generator building ~~only~~ will be analyzed in accordance with ACI 349 as supplemented by Regulatory Guide 1.142.